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EXPLANATORY NOTE

Illustrated articles are marked with an asterisk (*), book notices with a dagger (†), and new shop equipment as described in the departments "Shop Equipment News" and "Condensed Clipping Index of Equipment" with a double dagger (‡). Cross references to a particular initial word may apply also to its derivatives. The cross references condense the matter and assist the reader, but are not to be regarded as complete or conclusive. So, if there were a reference from "Milling" to "Jigs and fixtures," and if the searcher failed to find the required article under the latter topic, he should look through the "Milling" entries, or others that the subject might suggest, as he would have done had there been no cross reference. The plural of any given item may not necessarily follow the singular immediately, as the items are listed in alphabetical order. All articles written by any given author are listed directly under his name. Articles that are not credited to any author, or are credited to "Special Correspondence," may be found under the heading "No author."

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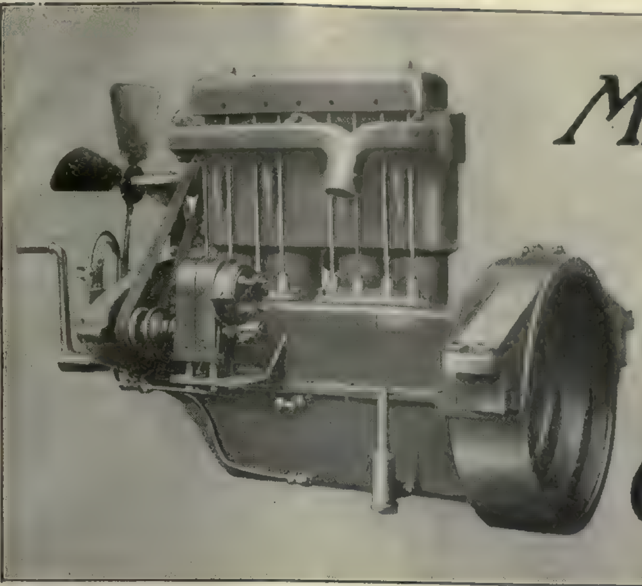


MANUFACTURING OPERATIONS in Making a GASOLINE MOTOR

In this article are shown the jigs and fixtures for machining the parts of a gasoline motor. The operations for machining the cylinder are taken in sequence and speeds, feeds and operating time are given. An interesting jig for drilling the intake manifold, which is provided with a toggle equalizing mechanism for centering and holding the part, is worth noting.

THE Gray Motor Co., Detroit, Mich., has recently developed a power plant that has been specially designed for service in trucks and tractors. The engine has four cylinders of $3\frac{1}{2}$-in. bore and 5-in. stroke. The valves, which are of the overhead type, are operated by a crankshaft. Some of the principal operations entering into the construction of this engine will be described in the following paragraphs. The operation of milling the parting line of the cylinder, which is illustrated in Fig. 1, is carried on as follows: The c a s t i n g is placed on four arms, as at *A*, and rests against a stop at the forward end; the straps on the cylinder are then tightened, thus holding it securely during the machining operation. The cutter *B* is 18 in. in diameter and operates at 38 r.p.m. The fixture that is utilized when drilling the holes on the parting line of the cylinder is shown in Fig. 2. The casting is placed on the steel ways and pushed back against a stop by a screw that runs through the plate *A*. The plate is located in the fixture by the two studs *B*. The casting is adjusted on the sides by a flanged stud, which forces the cylinder against an adjustable screw, as illustrated. Sixteen $\frac{11}{32}$-in. and six $\frac{15}{32}$-in. holes are then machined, the production being 15 cylinders an hour.

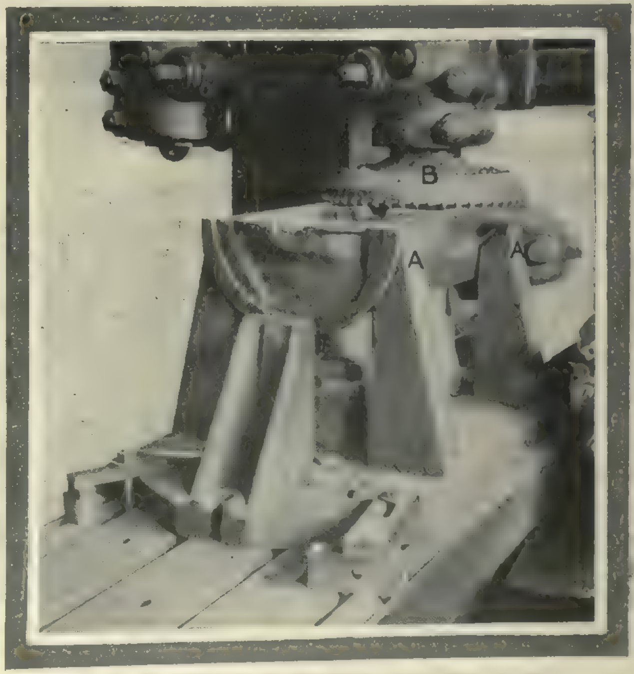
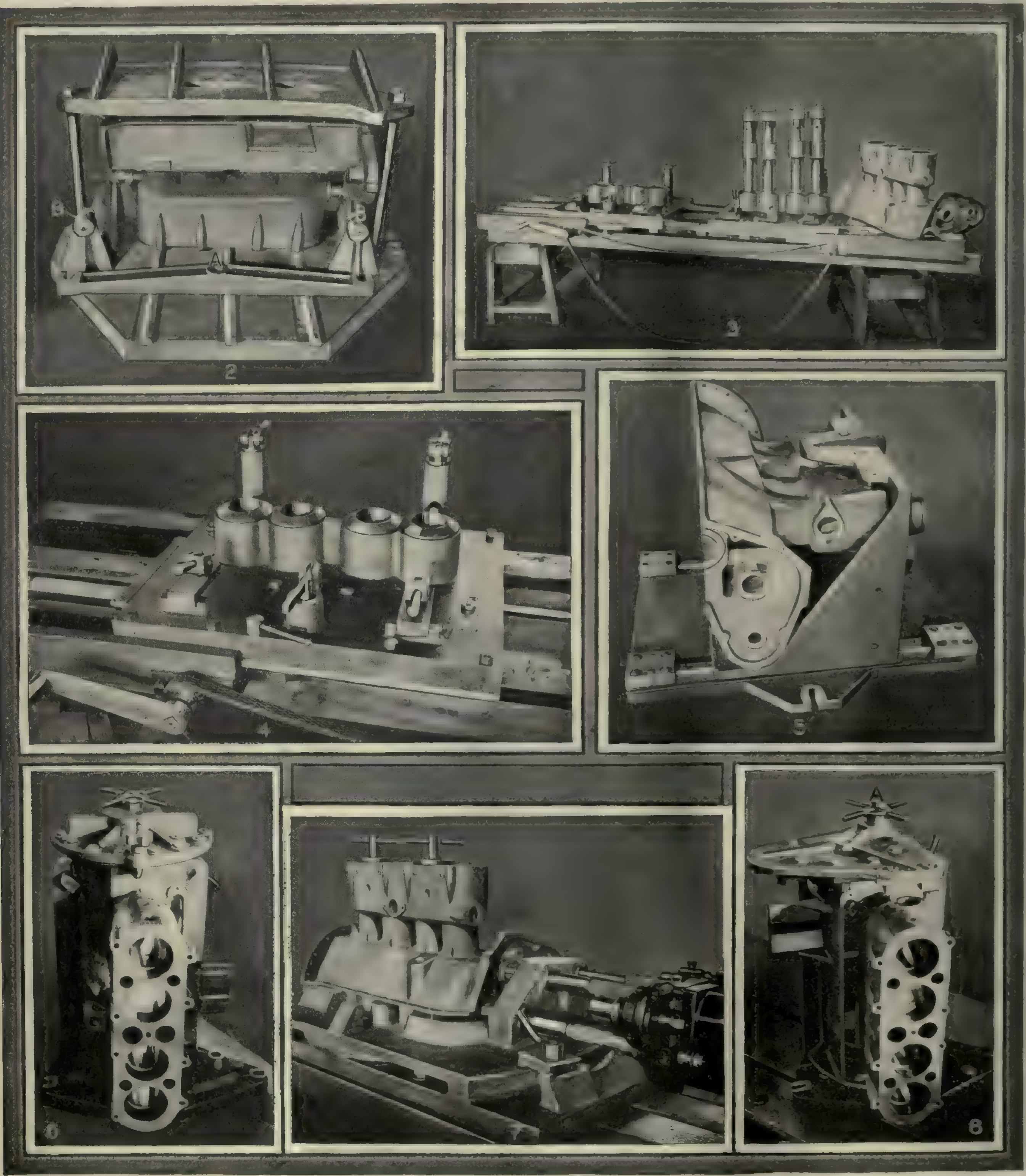


FIG. 1. MILLING CYLINDER PARTING LINE

The fixture for boring the cylinder block is shown in Fig. 3. The casting is located by dowels, which fit into the holes that were drilled in the previous operation. The cylinder is held down by clamps. Four holes, $3\frac{1}{2}$ in. in diameter and 10 in. long, are bored at one time, and the production is nine cylinders an hour. The boring bars are guided through long bearings in the fixture. While one cylinder is being bored, the operator is loading another casting in position on the fixture. After the first cylinder has been bored, the sliding part of the fixture is carried over by means of the chain shown, and at the same time the second fixture, which has been loading, is brought into position. The correct location is determined by means of an index pin that fits into a bushing in the fixture base. In Fig. 4 is shown a close-up view of one of the sliding members of the fixture. The design of the clamps and the locating pin may also be seen from this illustration. In Fig. 5 is shown the jig for drilling the water-inlet and relief-petcock holes. The casting is located by plugs, which fit into two of the bores that were machined in the preceding operation. Clamps are then tightened to hold the casting in position. In this machining operation, six $\frac{5}{16}$-in. holes are drilled; the production is 20 cylinders an hour. The jig employed when drilling the holes in the cylinder to suit the flywheel housing is shown in Fig. 6. The casting is placed on the vertical side of an angular base and held against it by hook bolts. The

jig proper is located by plugs that fit into the crankshaft bore and fan-support hole. Eight $\frac{19}{64}$-in. holes are then drilled, the average time necessary being $2\frac{1}{2}$ minutes. The hook bolts allow a quick set-up to be made.

tightened on the casting to hold it in position. The main bearing is $2\frac{3}{8}$ in. in diameter, the camshaft bearing $1\frac{3}{4}$ in. and the pumpshaft $1\frac{1}{8}$ in. The three bars are driven together by means of the multiple head, and



FIGS. 2 TO 8. VARIOUS DRILLING AND BORING OPERATIONS

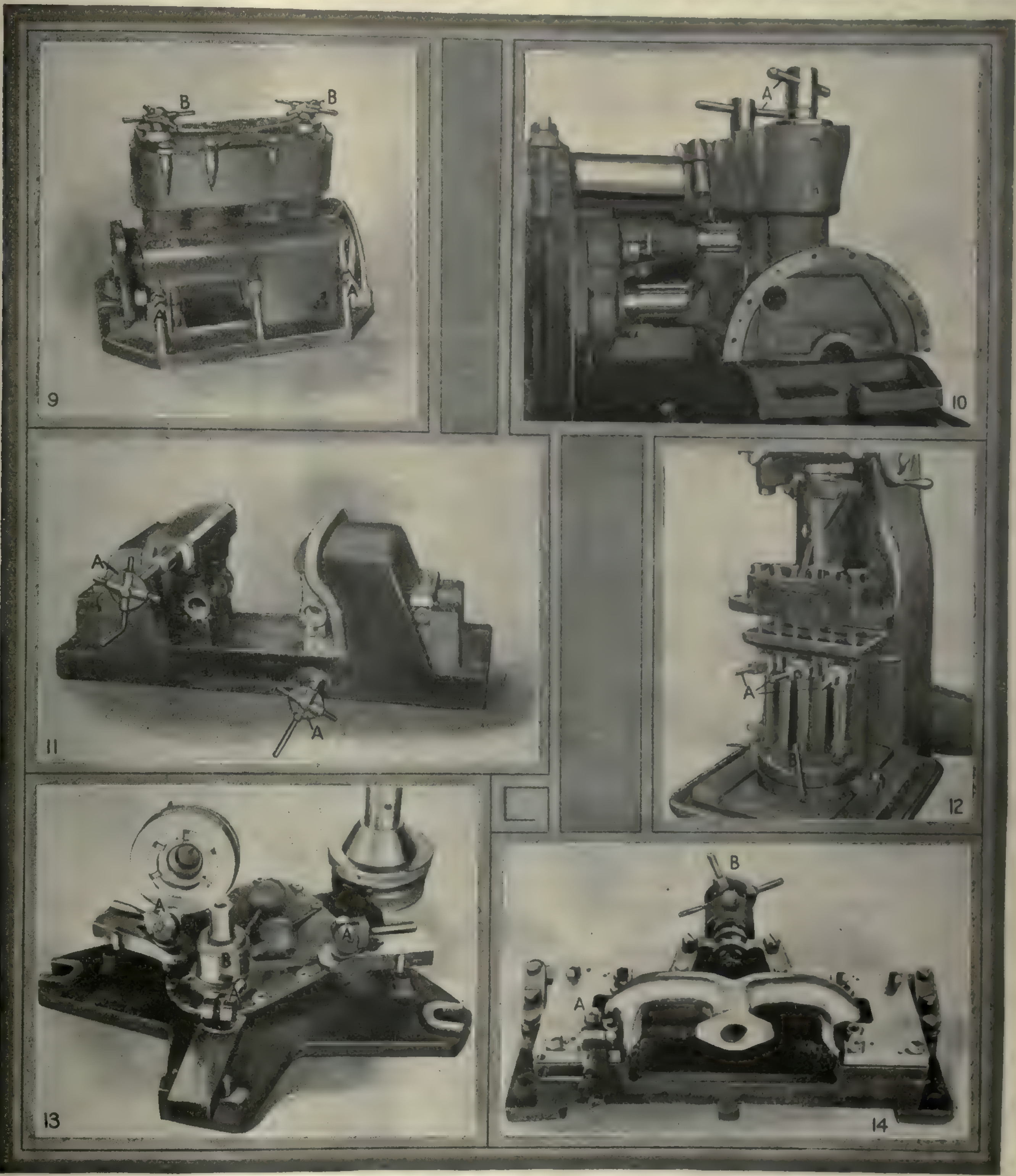
Fig. 2—Drilling holes on parting line. Fig 3—Boring fixture for cylinders. Fig. 4—Close-up view of boring fixture. Fig. 5—Drilling water-inlet holes. Fig. 6—Drilling housing-cover holes. Fig. 7—Boring bearings in cylinder. Fig. 8—Drilling gear-case cover holes

The fixture for boring the main, camshaft and pump bearing holes is shown in Fig. 7. The cylinder is located by dowels, which fit into the holes that were machined in the parting surface. Clamps are then

the cam and main bearing bars are supported in bearings at both sides of the cylinder casting, thus insuring a good alignment of the holes. The production in this operation is 5 cylinders an hour.

In Fig. 8 is shown the jig used when drilling the holes at the gear end of the crankcase. As before, the casting is placed and held on an angular base. The jig is located by plugs, which fit into the machined crankshaft and camshaft holes. The jig is held in position by an expanding plug *A*, which fits in the crankshaft bore. Nine $\frac{5}{16}$-in. holes are then drilled, the time required being $2\frac{1}{2}$ minutes.

The jig employed when drilling the holes to suit the cylinder head and valve tappet guide plates are shown in Fig. 9. The casting is placed in the jig and forced back against the adjustable stop screws *A*. It is also located from the side by a stop surface. The jig for the cylinder-head holes is located by the expanding plugs *B*. Nine $\frac{13}{32}$-in. and four $\frac{5}{16}$-in. holes are then drilled, the machining time being 4 minutes.



FIGS. 9 TO 14. A NUMBER OF DRILLING AND MILLING OPERATIONS

Fig. 9—Drilling holes for cylinder head. Fig. 10—Milling magneto and tappet guide-plate pads. Fig. 11—Milling large end of connecting-rod. Fig. 12—Drilling bolt holes in connecting-rods. Fig. 13—Milling boss on gear-case cover. Fig. 14—Drilling intake manifold

In Fig. 10 is shown the fixture for milling the magneto and valve tappet guide-plate pads. The casting is located by dowels that fit into the machined holes in the flange. The cylinder is held in position by the hook bolts *A*, which go through the cylinder bores, the hooks fitting over the sides of the holes in the fixture base. The cutters are 2½ and 2¾ in., and are fitted with stellite blades. The milling cutters operate at 245 r.p.m. with a feed of 0.03 in. per revolution.

An interesting feature is the driving head used for the milling cutters. This head is fastened to the column of the machine and is supported by the overhanging arm. The two cutters are driven by gearing with the driving spindle of the miller. The cutters are placed in the proper relative positions with each other so that both pads will be machined in the correct planes.

The fixture shown in Fig. 11 is made use of when milling the sides of the large end of the connecting-rod. The forgings are located by means of fixed and movable V-blocks. The latter are operated by the handles *A*. The handles operate screws on which wedge blocks are placed. As the screws are operated, the wedges come in contact with the upper ends of the movable V-blocks and force them against the connecting-rods, thus locating and holding them. The other end of the forging is held with a strap, as shown. Four 8-in. cutters correctly spaced are used for the machining operation. The cutters operate at 40 r.p.m. with a feed of 0.07 in. per revolution.

In Fig. 12 is shown the jig for drilling the bolt holes in the connecting-rod. The forgings—the jig holding six—are located on plugs, which fit into the wristpin and crankshaft holes.

The jig is provided with the cam-operated clamps *A*, which force down washers onto the rods, thus holding them in position. Six $\frac{7}{16}$-in. holes, or three rods, are drilled at one time. The jig is then swung around, being located for the two positions by an index pin operated by the lever *B*. By this method and tool set-up three rods may be drilled in 1½ minutes.

Milling Gear-Case Cover

The fixture used when milling the gear-case cover engine support is shown in Fig. 13. The casting is held on the fixture by the three clamps shown, pressure being applied to them with the cams *A*. The boss *B* is then hollow-milled to 3 in. in diameter, the roughing and finishing tools being shown at the rear of the fixture. The average time required to machine one of these parts is 3½ minutes.

In Fig. 14 is shown the jig for drilling the intake manifolds. The casting is inserted into the jig by raising the cover *A*. The handle *B* is then turned, which operates the toggle mechanism and centers the casting in the jig. Sufficient pressure may be exerted by the handle to hold the casting securely during the drilling operation. Four $\frac{1}{3}\frac{3}{2}$-in. holes are then drilled, the time necessary being 2 minutes.

In Fig. 15 is shown a view of the testing department, where various types of engines manufactured at this factory are being given a test for gas consumption, and to determine if the desired horsepower is being produced. The water brakes and other apparatus for the testing may be noticed in the illustration. The two testing stands in the foreground are of interest. The numerous T-slots in the bed and the flexible connections make these stands applicable to various sizes of engines.

A view of one of the truck and tractor engines, the manufacturing operations in which have just been described, is shown in the headpiece.

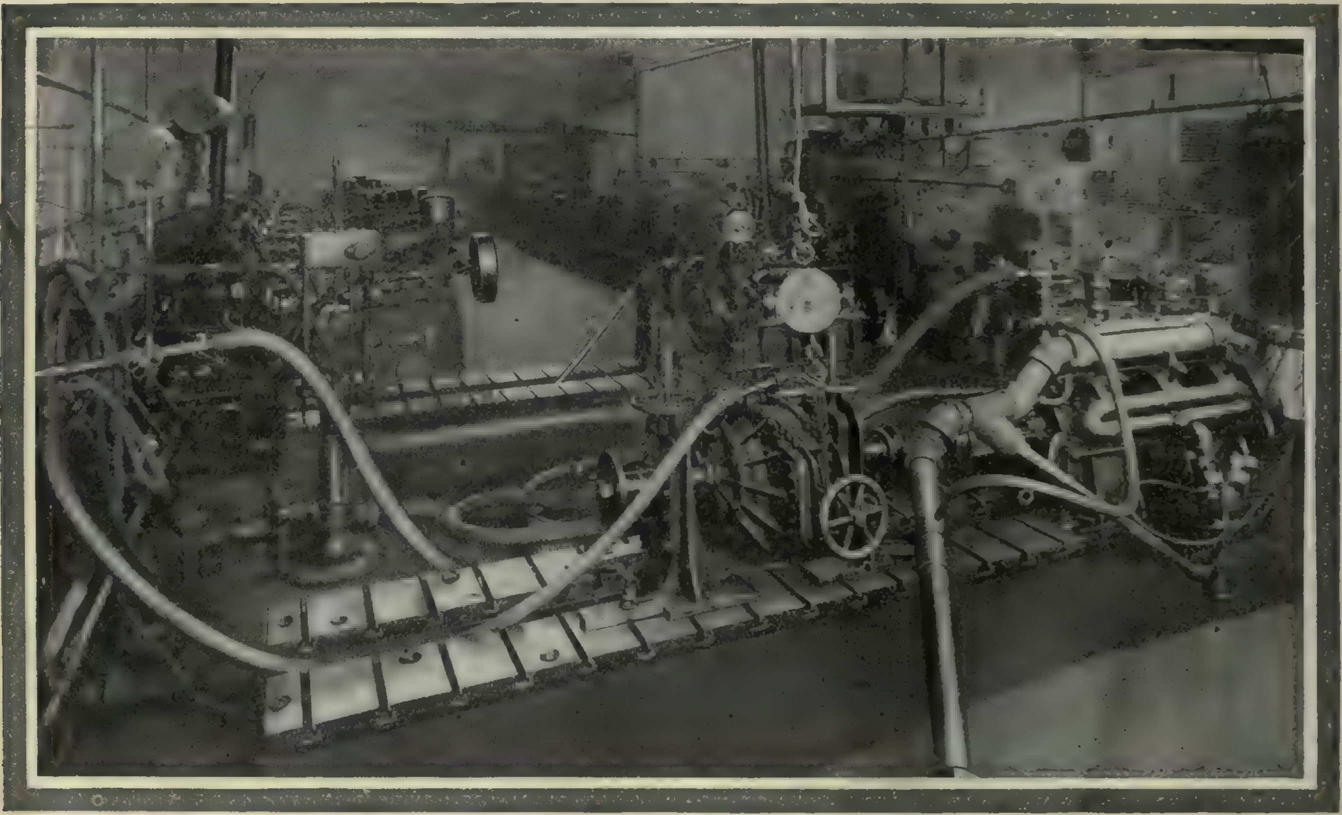


FIG. 15. VIEW IN TESTING DEPARTMENT

Correcting Dies That Failed To Draw

By A. C. Lindholm

Making drawing dies for irregular-shaped parts is often a proposition that requires deep thought, and many jobs are thrown in the scrap due to overlooking the principal details involved in shaping the metal at the start in order to have it draw correctly in the succeeding operations that are often involved.

THE making of the irregular-shaped box and cover, shown in Fig. 1, presented to the writer a peculiar problem. The dies had been made as designed, and in trying them out they were condemned as useless. Another important item was discovered, namely, the job was contracted for at an estimated price, and the cost of making had already exceeded the estimate; therefore, the work was a total loss, and a failure to make good, a serious proposition.

The cover, as shown, has a folded edge and a rectangular depression in the center. In this case the first operation was blanking, the die having been made after the correct shape had been determined by forming. The blank was then placed on pressure plate, Fig. 2, located by spring pins.

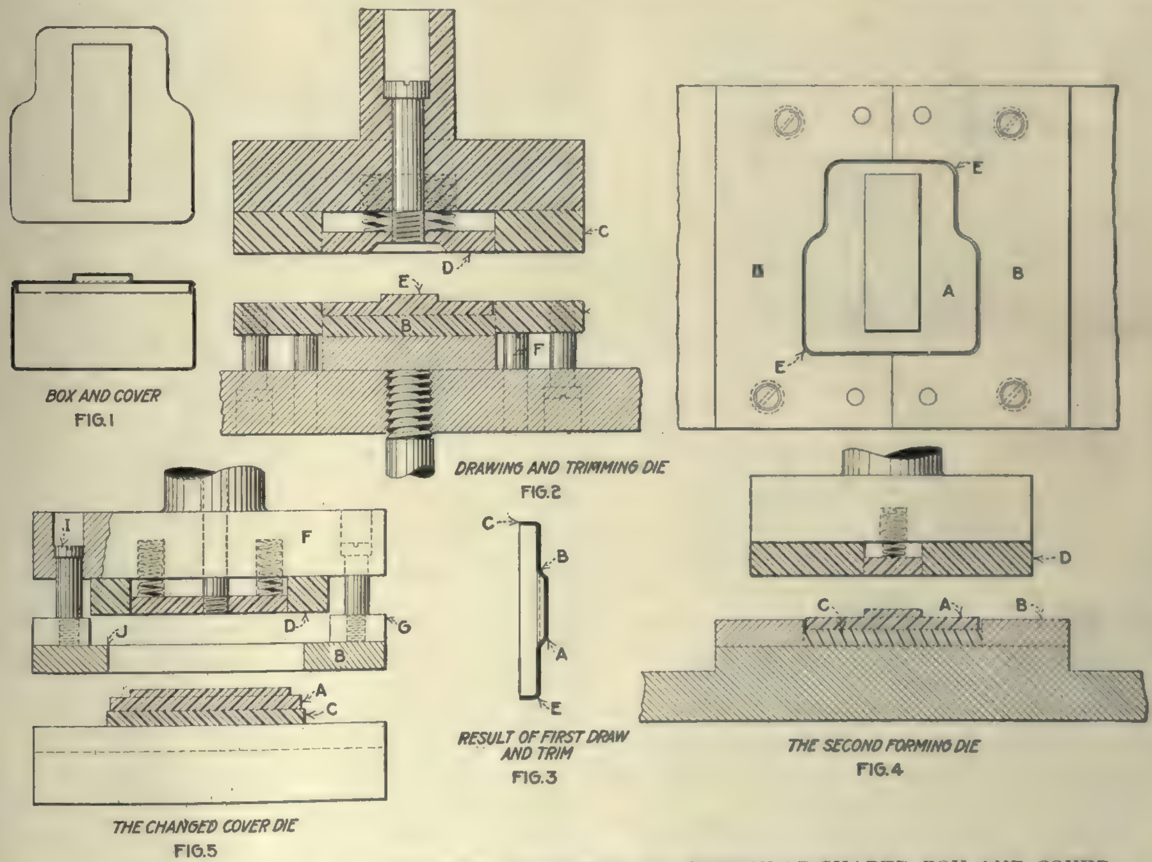
This die besides drawing the cover, also trimmed it, the trimming plate *B* cutting off the surplus metal at the round edge on the drawing die *C*. A recess in the knock-out *D* was allowed for the depression of the cover, it being formed by drawing punch *E*. The pressure plate was actuated by pins *F* resting on a buffer ring under the bolster.

The product from this die is shown in Fig. 3. It will be noticed that the wall of the recess *A* was left at an angle of about 45 deg. This was done in order to allow a proper forming in the next operation. As this proved detrimental to the appearance of the cover in forming the wall square in the die, Fig. 4, the recess was formed correctly in the first operation (drawing) the correction being made by making a new knock-out with square walls.

Explaining the appearance stated, in forming *A*, Fig. 3, to coincide with the horizontal line, or top, the metal is straightened or bent back to its original place, and this left a slight hollow at *B*. This same effect is readily noticed in bending a strip of metal at an angle, and then trying to straighten it out.

In trying out the next die, Fig. 4, the greatest difficulty encountered was the placing of the blank in the die, and after forming the shouldered edge, removing the product.

The space between the plate *A* and plates *BB* was required to be nearly the same width as the thickness of metal used, or 0.022 in., in order to obtain a square shoulder so that the edge of the box and shoulder should form a close joint.



FIGS. 1 TO 5. DETAILS OF DIES USED IN MAKING AN IRREGULAR-SHAPED BOX AND COVER
Fig. 1—Box and cover. Fig. 2—Cover drawing and trimming die. Fig. 3—Result of first draw and trim. Fig. 4—The second forming die. Fig. 5—The changed cover die.

In operation the work was placed on the holder *A*, the edge resting on plate *C*. The head or shoulder was formed by the flattening die *D*, folding the edge similar to a heading operation. In the first drawing and trimming operation a slight burr was left at *C*, Fig. 3, just enough to prevent the product entering freely into the die, Fig. 4.

It will be noticed the plates *BB* were made in two sections doweled and screwed to the bolster. If these plates had been made so that the joint was at *EE*, the device could have been arranged so that said sections would slide in and out, actuating it by means of cams attached to the punch holder. This, however, would have necessitated a radical change and required two new sections, bolster and slides. The problem was to make the die "work" without adding too much expense, and the solving of this resulted in making the change as per Fig. 5, which represents a section through the punch and die at the joint of plates *BB*, Fig. 4. The same bolster plates *C* and *A* were used as in Fig. 5. A new punch holder *F* was substituted to which the flattening plate *D* was fastened with the knock-out. To this holder the plates *B* were attached, having two straps *G* screwed to them. This combination held by four studs *I*, and actuated by springs at proper locations, was the solution of the problem.

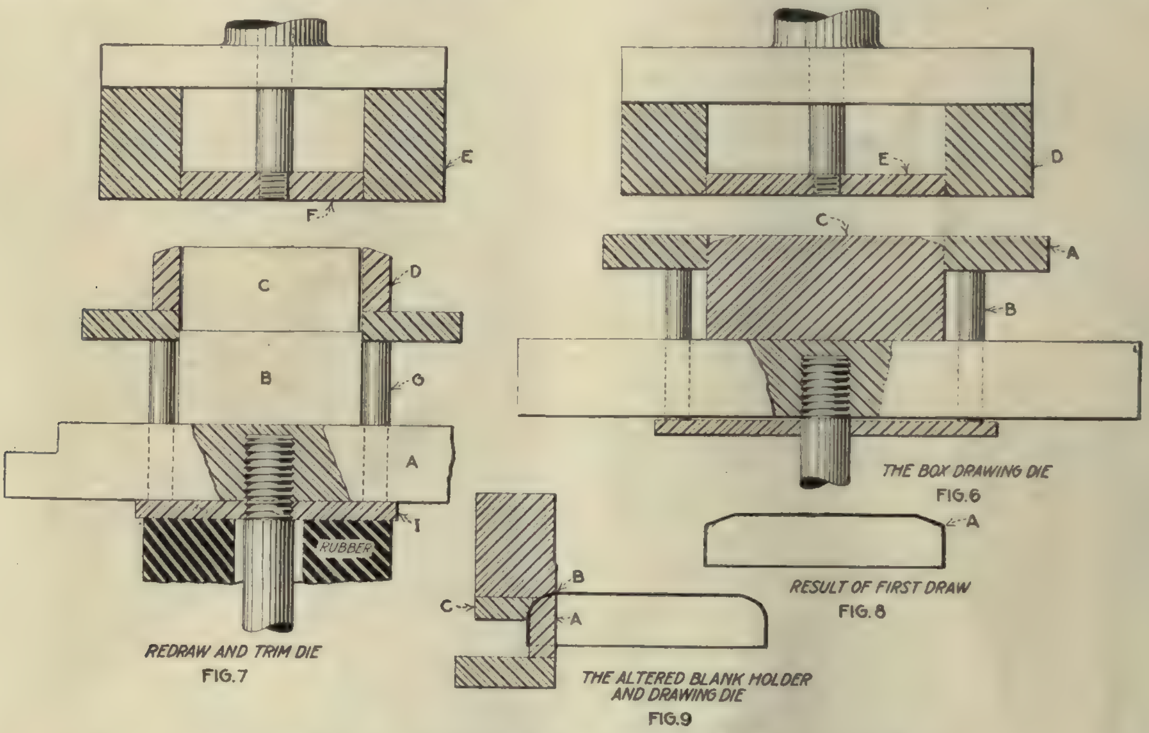
The blank was placed on holder *A*, the edge resting on *C*. As the punch descended, the plates *B* passed freely over the rounded edge *E*, Fig. 3, coming to a stop on the bolster face and resting there until the flattening die pressed the work into shape.

Upon the return stroke the shoulder of the cover just formed rested upon the edge of the plates, *J*, Fig. 5, making the stripping of the work an easy proposition. The finished product was pushed out with a stick so the operator's hands were less liable to be injured in case of the press repeating.

Having solved the cover problem successfully, the next in hand was the box. The same method of operation was used; that is, the first operation was blanking, and the die for this was made last after the proper dimensions had been found by drawing.

The dies were made as shown in Figs. 6 and 7, and the blank or cup from first draw, shaped up as shown in Fig. 8. The die, Fig. 6, worked well, the blank being located on the pressure plate *A*, which was actuated by a rubber buffer and pins *B*. The drawing punch *C* was fastened to the bolster and the die *D* to the punch holder, *E* being the knock-out.

The next operation was the redraw and trim, the die, Fig. 7, being used for this operation. It was here that the faults of both tools were noticed. The cup would only draw part of the way down when it would fracture, the fracture sometimes occurring at *A*, Fig. 8, anywhere on the sides or at both places. The fracture at *A* meant drawing the metal over too sharp a corner; also having too great an angle at this point, which caused the cup to wrinkle at the corners when redrawing.



FIGS. 6 TO 9. DETAILS OF SOME OF THE DRAWING DIES
Fig. 6—Box drawing die. Fig. 7—Redrawing and trimming die. Fig. 8—Result of first draw. Fig. 9—The altered blank holder and drawing die

Before attempting to change the redrawing die, Fig. 7, the punch on Fig. 6 was changed so the cup was drawn to the dotted line shown in Fig. 8. This was done so that the metal, in redrawing, would not have to flow around a sharp turn, thereby eliminating excessive friction.

In the redrawing die, Fig. 7, *A* is the bolster, and attached to it is the cutoff block *B* and the drawing punch *C*. The blank holder *D* was made of two parts, retained by screws (not shown), and actuated by pins *G*, resting on the buffer ring *I*. To the punch holder, the drawing die *E* and the knock-out *F* were substantially fastened. The work was placed on the holder, and drawn into the die sufficiently deep so that the cutoff block *B* trimmed the surplus metal.

After changing the drawing punch *C*, Fig. 6, to obtain the curve shown in dotted outline, Fig. 8, the blank holder for the redraw had to be changed, and the drawing die had to be beveled to facilitate matters and avoid fracture. This correction is shown in Fig. 9; *A* being the blank holder and *B* the drawing die.

Although success was obtained in drawing a box to the required height the wrinkles were still in evidence, so, to prevent these from gathering, another plate *C* was fastened to *B*. The plate was shaped to fit the curve on the blank. It will be readily seen by referring to the illustration that the metal had no sharp turns to make, and the result was a smooth flow.

Drawing dies when completed and working smoothly seem simple in construction and easy to make. Everything can be laid out to a nicety on the drawing board, but as a rule when an irregular piece is to be made, all the little kinks we know and have experienced in previous problems are forgotten for the moment, and we proceed as if a cylindrical shell was the product.

The above dies could have been used to better advantage in a double-acting press, and the blanking die could have been combined with the first draw, but the problem to the writer was to make them work, and not to spend too much money in effecting the necessary change.

How the Priority Board Works

It is highly important that nothing be allowed to interfere with, or in any way delay the production of the many things which enter into our equipment for carrying on the war. And to this end it is highly desirable that we all understand the methods of the Priority Board and to take advantage of it whenever it can be of service in securing either machinery or materials. It cannot work miracles, but it can be of great assistance in many cases and we should all be familiar with every means of expediting manufactures.

As a beginning we can do no better than to quote from the circular of the Priority Committee of the War Industries Board:

Directions as to Priority

During the war in which the United States is now engaged, all individuals, firms, associations, and corporations engaged in the production of iron and steel, and in the manufacture of products thereof are requested to observe the following regulations respecting priority, namely:

1. All orders and work shall be divided into three general classes: Class A, Class B and Class C; with various subdivisions of Classes A and B, indicated by a suffix number, thus: Class A1, A2, A3, A4, etc.; and Class B1, B2, B3, B4, etc.

2. Orders and work in Class A shall take precedence of orders and work in both Class B and Class C; and orders and work in Class B shall take precedence of orders and work in Class C, irrespective of the date the orders were received; and orders and work in Class A1 shall take precedence of orders and work in Class A2, etc.; and Class B1 shall take precedence of Class B2, etc.

3. Class A comprises war work; that is to say, orders and work urgently necessary in carrying on the war, such as arms, ammunition, ships, etc., and the materials required in the manufacture of same.

4. Class B comprises orders and work which, while not primarily designed for the prosecution of the war, yet are of public interest and essential to the national welfare, or otherwise of exceptional importance.

5. Class C comprises all orders and work not embraced in Class A or Class B, and no certificate of the Priorities Committee will be required therefor. Any order for work or material not acccompanied by a certificate covering same, to the effect that the work or material falls within Class A or Class B, should be treated as an order for work in Class C.

6. All materials required in the manufacture of an article or in the prosecution of any work, will be entitled to take the class of such article or work unless otherwise specified in the certificate covering the same.

7. Certificates will be issued by the Priorities Committee upon application therefor, specifying the classification of the order or work, and priority should be given accordingly in producing and furnishing the materials or supplies, or in manufacturing and delivering the article. Certificates of a subsidiary nature will be issued upon request for the furnishing of material and articles required in manufacturing the article or prosecuting the work ordered.

8. All orders placed prior to the date hereof by or on behalf of the War Department or Navy Department of the United States or the United States Shipping Board Emergency Fleet Corporation should be classed as subdivision A1 of Class A, unless otherwise ordered by the officer placing the order or by the Priorities Committee; and all orders for arms, ammunition and other military supplies and equipment placed prior to the date hereof by or on behalf of the nations associated with the United States in the war in which it is now engaged, should be classed as subdivision A2 of Class A unless otherwise ordered by the Priorities Committee.

9. All orders placed after the date hereof should be classed as Class C unless covered by certificates of the Priorities Committee or other written directions of the said committee.

10. Certificates or other documents signed by the chairman, or any member of the Priorities Committee, shall be deemed to have been authorized by said committee and by the War Industries Board of the Council of National Defense.

Robert S. Lovett,
Chairman of the Priorities Committee.

Priority certificates should of course, only be applied for when the need is urgent and the applicant is unable to secure the necessary machinery or materials in any other way. The abuse of the priority certificate, the same as the abuse of any other privilege, works a hardship on some one else; and, in this case the effect can be directly traced to the loss of life of our boys on the other side. Any attempt to secure priority for personal advantage of any kind should be severely dealt with. There is no worse traitor to the cause than he who will jeopardize the lives of our boys in France or elsewhere for personal ends.

There are five forms of priority certificates as outlined in the following extract from circular No. 2 of the Priority Committee, and prescribed forms of blanks are provided for these applications. It is not, however, absolutely necessary to use these, but it is better to do so in order that all the desired information may be given. These application blanks cover:

Applications for Priority Certificates

a. Applications (Form P C 1) for principal certificates covering contracts classified as Class A in paragraph 3 of said Circular No. 1, will be made to the Priorities Committee by the contracting officer or agency of the United States or by the contracting officer or agency of the nations associated with the United States in the war in which it is now engaged, by or through whom such contracts shall be placed.

b. Applications (Form P C 3) for subsidiary certificates covering materials, articles or work required in the manufacture of articles or in the prosecution of work in connection with which a principal Class A certificate shall have issued will be made to the Priorities Committee by the contractor to whom said principal Class A certificate has been addressed.

c. Applications (Form P C 5) for subsidiary certificates covering materials, articles or work required in the manufacture of articles or in the prosecution of work designated in paragraph 8 of said Circular No. 1, as Class A1 or Class A2 will be made directly to the Priorities Committee by the contractor for the expedition of whose contract the priority order is desired.

d. Applications (Form P C 7) for principal certificates covering contracts classified as Class B in paragraph 4 of said Circular No. 1, will be made directly to the Priorities Committee by the individual, firm, association or corporation for the expedition of whose contract the priority order is desired.

e. Applications (Form P C 9) for subsidiary certificates covering materials, articles or work required in the manufacture of articles or in the prosecution of work in connection with which a principal Class B certificate shall have issued will be made to the Priorities Committee by the contractor to whom said principal Class B certificate has been addressed.

In order to use these priority applications it is necessary to have them signed by the contracting officer or his agent. In other words the application must be definitely tied up to a non-contract by some one in authority before it can even be considered by the board. The certificate, when issued, is an order to deliver your machinery or materials in the order which it takes, in any class to which it is assigned.

As may readily be seen, this does not entirely settle the question; for it may easily happen that an order placed today is much more important than one placed a month ago, and some means must be found to sort these orders occasionally with reference to the urgency with which they are needed. This is done in conference at Washington, with representatives of all interested parties, and the position of the various names in the priorities list is then determined, and an order issued accordingly

Much Good Being Accomplished by Cheerful Coöperation

No scheme is ever perfect, and the application of any plan never reaches one hundred per cent. But by cheerful coöperation, by trying to help the Priorities Committee in its varied conferences, much good is being accomplished. These conferences take place daily, different industries and different branches of the same industry taking active part. By bringing men together and presenting the problem so as to make it plain that it is a problem which all must work together, the broader viewpoint is more easily gained.

This committee is also collecting, and has collected, a vast amount of data as to available machines of all kinds, as well as of the probable output of the various factories. In this way it can sidetrack machinery which will not be needed immediately, and hurry the output of that which is urgently needed. In other words, it acts as a reservoir of information, or perhaps more properly, a routing or dispatching system which hurries work and urgently needed machinery, by holding back less needed manufactures, and in this way balancing production in the various shops. Such control is absolutely necessary, and we should coöperate with it in every way. It is unwise to attempt to determine which of your customers is in most urgent need; put it up to the Priorities Committee, who have all the facts before them, and let them decide.

A Surface Grinding Gage

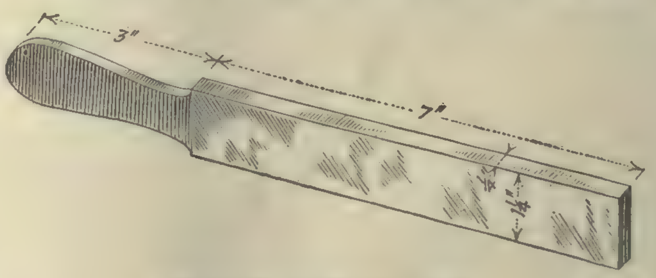
By R. C. Morse

In many factories considerable difficulty has been experienced in grinding long flat surfaces, such as alignment gages, test parallels, sine bars, etc., which have that inevitable tendency to warp and give the toolmaker or grinder cause to worry as to whether or not the job will check up sufficiently close so it can be clamped.

The ordinary method used is to take a chip, turn the piece over and take another chip; repeating this several times until the piece is nearly down to size, taking a very light chip on the finishing cut. This has proved successful to within a certain limit, after which a considerable amount of lapping is required to bring it to a rigid inspector's test.

This method, which came through an experiment on some long alignment gages requiring extreme accuracy, has been invaluable on various jobs of equal precision. The gages were about 10 in. in length, having a formed handle about 3 in. long, making the business end 7 in. The handle was made $\frac{1}{16}$ in. thinner than the thickness which was 0.250, with limit of plus nothing, and minus 0.0002.

Gages were made of machine steel, casehardened $\frac{1}{32}$ deep. They warped very little in hardening and required no straightening. There was about 0.013 or 0.014 in. left to grind. Placing a piece on magnetic



SURFACE GRINDING GAGE

chuck concave side down, take about 0.005 chip, regulating the cross feed to approximately $\frac{1}{32}$ of an in.

If wheel is dressed properly and a 46-grain, grade-I, 6-in. diameter, ½-in. face Norton wheel is used, it will stand up the complete width of the work.

This may look rather slow but is prevents heating of work and there is less vibration of the wheel, which, with heat, causes warping. This is much quicker than going across the work several times, taking a lighter chip, wearing down the surfaceof wheel, necessitating redressing and losing much valuable time in these days of rush and efficiency.

After roughing first side, turn piece over repeating same operation, dressing wheel if necessary, sometimes using opposite side of wheel; it will stand up across side.

Now we have 0.003 or 0.004 left to finish. Place piece on chuck and determine which is concave side, place concave side down and block up both ends and sides. Do not throw switch in, but take 0.0003 to 0.0005 chip using hand power and very slow feed until this side is cleaned up. Completing this operation, take blocking away, turn piece over, throw switch in, and finish to size taking very light chip or leaving 0.0002 or 0.0003 to lap if lapping is required, if not the piece is as straight as lapped surface. Very little lapping is necessary for finish only by this method. Care should be taken to have wheel dressed properly. If the machine is automatically reversed by power while the piece is blocked up the quick reverse of the table is very likely to dislocate the piece from its proper position. This would, of course, be bad.

Overhauling the Gnome Airplane Engine

SPECIAL CORRESPONDENCE

Conditions make it just as important to keep an airplane engine in good order as it is to build it in the first place. For this reason the methods evolved in the French aviation camps should be of value to the mechanics who must look after the Gnome engines being built in this country for our own use.

THE Gnome airplane engines now being built for the United States Aviation Corps make it important that their construction and maintenance be understood by the skilled men who must look after them. In order to show just how these engines are overhauled, some of the more essential operations are illustrated, reproducing the methods from the practice recommended by the French builders and users.

The engine must be taken from the frame and placed on a test stand. To do this, the outer nut that holds the centralizing plates must be removed and the crankshaft forced out of the conical bore of the main bearer plate by using an extractor made for this purpose. The extractor is very similar to what is known as a "wheel-jack" in automobile repair work. The motor is fastened on the repair stand in the same way that it is held in the plane, as shown in Fig. 1. Mounted in this way, the engine can be rotated and is accessible for dismantling or timing.

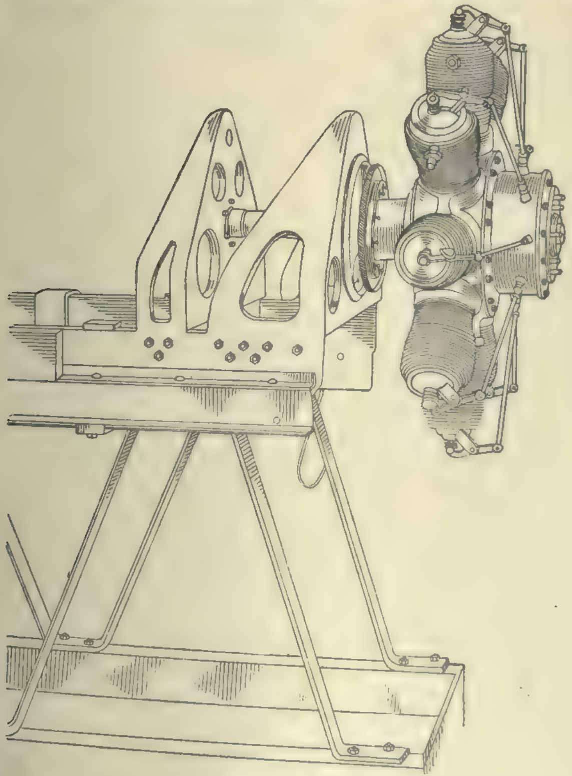


FIG. 1. ENGINE ON STAND

The brass wires are disconnected from the spark plugs and coiled up loosely at the distributor terminal, as in Fig. 12. The spark plugs are taken out and, after the points are thoroughly cleaned, are put into a box to avoid damage. Next, one of the tappet-rod cup ends is detached from its ball end. This can easily be done by selecting a cylinder where the valve is closed and rocking the lever to open the valve with one hand while the cup end is lifted away with the other. The valve case is unscrewed with the proper wrench by turning to the left. It does not matter with which cylinder one starts, but afterward the valves from every alternate cylinder are placed in their proper order on the bench or in a box.

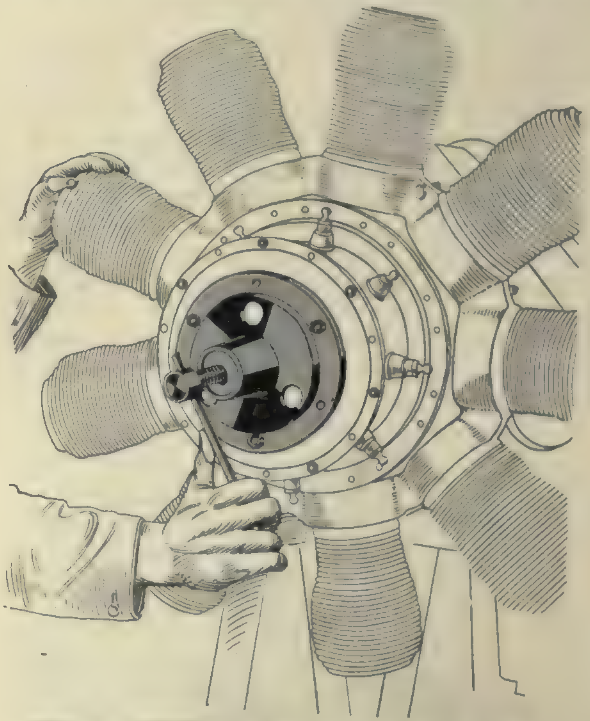


FIG. 2. WITHDRAWING VALVE-GEAR CASE

It is best to have a box with nine compartments, or nine separate boxes, all numbered for this work. In some cases the cup ends of the tappet rods are fitted with special clips that must be removed before the cup ends can be detached.

The special central, or umbrella, nut holding the ball race in the front cover is unscrewed, and then all the nuts in the front cover of the gear case are removed. This cover must then be replaced with a special extractor, shown in Fig. 2, which is held in place by three nuts. The extractor screw should bear on the end of the crankshaft and not on the tubular liner inside the shaft. This will remove the front cover with the ball race, and the crankshaft gear can be pried off with a pair of pinch bars by using one on each side. The camshaft can be removed by giving it a twisting motion, turning it so that the cams clear the tappet rollers. It is not usually necessary to dismantle the cams from their sleeve for cleaning purposes.

The extractor, shown in Fig. 2, is not removed from the front cover, but the front cover and the extractor are replaced upon the valve-gear case, and the front-cover flange is fastened with some of the bolts to the valve-gear case. Then the hexagon nut is removed from the studs that hold the valve-gear case to the crank case.

Care must be taken in using this extractor not to put on sufficient pressure to bend the crankshaft.

The next operation is to remove the short end of the crankshaft, which has a long taper fit and is fastened with a hexagon nut. This nut has a locking screw that must be removed before it can be taken off. Then the special puller, shown in Fig. 3, grips under the edges of the crank web while the outer arms press against the mother rod so that only the small part of the crank is removed. If the crank does not start readily with the pressure alone, a gentle tap on the head of the screw at the same time pressure is being applied will usually bring it off without difficulty. A special clip on the back side of the short-end crankpin pulls the ball race away with the short end.

Next, the brass screws in the connecting-rod wristpins are removed with a broad-pointed screwdriver. Then, with the special screwjack shown in Fig. 4, the corresponding wristpin is removed. The screw of the dog goes into the thread in the wristpin, and by turning the hexagon nut the pin is easily pulled out through both the small connecting-rod and the mother rod. Care must be taken in doing this to avoid damage to any of the parts. It is better to remove pins Nos. 5 and 6 first.

Before taking the wristpin entirely out of the mother rod, the connecting-rod should be held with one hand

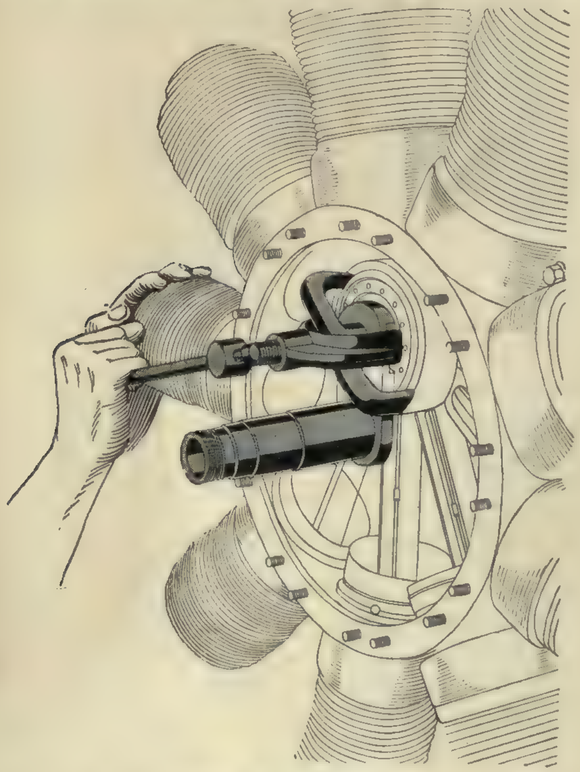


FIG. 3. DRAWING OFF THE SHORT END OF THE CRANKSHAFT

so that the piston does not drop to the bottom of its cylinder, as shown in Fig. 5. The wristpin is removed from the extracting jack, and the brass screw is put back in place, as it is the screw that carries the number and identifies the pin. It is particularly important that No. 1 wristpin go in its proper place, as it has an extra longitudinal oil groove. The piston and connecting-rod can then be removed from the cylinder.

This is done by carefully lowering the piston, turning the connecting-rod, as shown in Fig. 6, and lifting the piston from its cylinder. Great care must be taken in all operations to avoid damage of all kinds. All parts of the piston are extremely delicate, and no bruising or marring of any kind can be permitted.

Before the complete crank case can be removed, the nuts must be taken off the studs that hold the crank case to the thrust cover flange at the back. Spring washers will be found under each nut and should be cared for when removing. Two nuts are generally left at opposite points until all the rest are removed. Then,

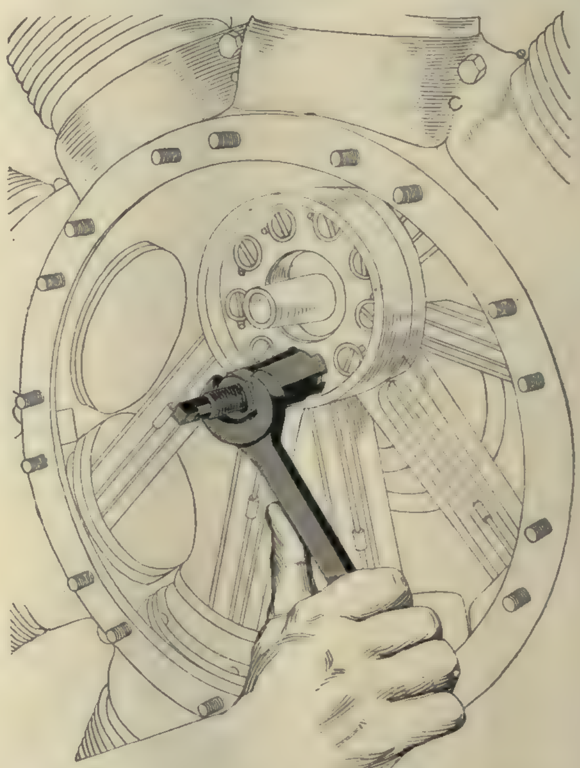


FIG. 4. WITHDRAWING WRISTPINS AND SCREWS

two men hold the cylinders while these nuts are removed, and then hold the cylinders and crank case while the mother rod is being taken out.

The mother rod has to be removed at the same time the crank case is taken from the thrust plate, as its piston cannot be withdrawn from the cylinder until it is clear of the crankshaft. In order to do this, the puller shown in Fig. 7 is used. The jackscrew must be operated very carefully and only as fast as the men move the cylinder and crank case away from the thrust plate, for it must be remembered that the crankshaft remains with the thrust plate, but that the cylinders, crank case and mother rod have to be removed at the same time to avoid any strain on the wristpin. The ball race may come away with the mother rod, or it may remain on the crankshaft. In the latter case it can be removed by a special puller made for this purpose and shown in Fig. 8.

When the mother rod has been removed from the crankshaft, it is also turned at right angles in the cylinder and removed in the same way as the piston previously referred to. When the crank case is removed, it is laid on its side in a special stand having a recess to clear the studs and a shoulder that keeps it from slipping off. Every possible precaution must be taken

against accidental damage to the cylinders. It is not at all necessary to remove the cylinders from the crank case for thorough cleaning, and in fact this should never be done except when it is necessary to replace a damaged cylinder.

In order to dismantle the thrust cover, it is usually put back in place on the crank case, as this lies on its proper stand. This is merely for convenience.

The distribution case, which is shown being removed in Fig. 2, carries a ball bearing and the reducing gears for the oil and fuel pumps. This ball bearing is re-

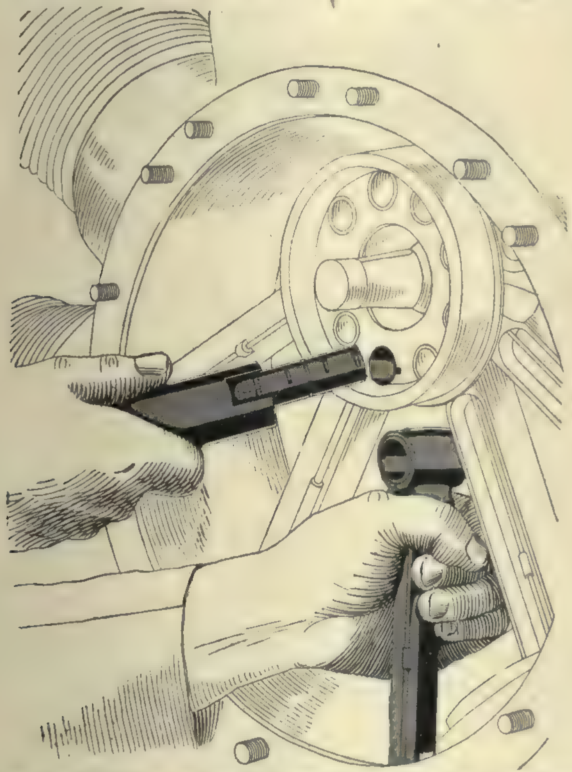


FIG. 5. WRISTPIN WITHDRAWN AND PISTON LOWERED

moved by gently tapping with a round surface punch, tapping entirely on the outer case. By tapping first on one side and then the other, it requires but very little pressure to remove the ball race. The upper or obturator piston ring is easily removed by the fingers, by taking hold of one end only and lifting it just clear of the groove. Then by turning it away from the gap, it will release itself. It should then be removed by catching hold of the two ends and gently springing outward until it can be lifted clear of its groove. The cast-iron piston ring can be removed in the same way. Great care is necessary to avoid distorting these rings, as they are both very light, this being particularly true of the upper or obturator ring.

With the three rings removed, the piston is placed head down on the bench, the cotter pin removed from the head of the taper screw that locks the wristpin, and the screw removed by means of a socket wrench. The piston pin is driven out by a special punch that is placed against the end of the pin *at the split end* where the locking screw enters. It can then be easily driven out the other end. The weight of the piston is usually enough to withstand the light taps necessary for this operation. If not, the left hand may be rested in the position shown in Fig. 9. Here, the thumb and forefinger hold the punch, the little finger holds the connecting-rod away from the skirt of the piston, and the weight of the hand holds the piston on the bench. It is necessary to be very careful in keeping the connecting-rod away from the piston, as the skirt is extremely thin and easily cracked.

After the piston, pin, rings and connecting-rods are completely apart, they are washed in kerosene. The color and markings of the piston and rings are carefully examined. The piston pin should be smooth and not show signs of wear. If there is any indication that the piston has seized, or if it is scored in any way, it should be carefully smoothed down. The piston should also be checked with a micrometer to see whether it is round or oval. If it is over 0.001 in. out of round, it should be replaced. Marks of burnt oil can be removed with very fine abrasive cloth. If there is an accumulation of carbonized oil or black jelly inside the crown, it should be thoroughly cleaned before reassembling. The obturator ring should show a bright edge all around and not bear at the foot except at the extreme end. If this is not the case, a new ring must be put in. The cast-iron ring should be bright all around.

All carbon and burnt oil should be carefully scraped from the inside of the piston and also the piston head.

After all discoloration has been removed by means of fine abrasive cloth, the piston should be placed in a bath

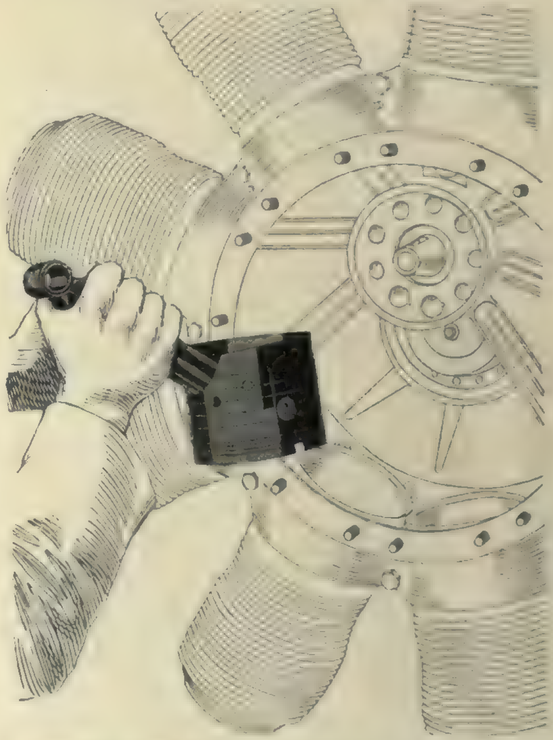


FIG. 6. PISTON AND CONNECTING-ROD BEING REMOVED

of gasoline and cleaned with a brush. The piston-pin holes should be thoroughly syringed out through these pin holes and around the ring groove. In the same way the small oil holes leading from the inside of the piston to the wide piston-ring groove should be cleaned with a wire and syringe.

All the connecting-rods should also be cleaned in kerosene, wiped carefully and any discoloration from burnt oil removed by fine abrasive cloth. If one of the ball races has remained in the mother rod, it can be removed by gentle tapping with a hammer and punch from the

other side. After the rod is thoroughly cleaned, the oil pipe is washed out with a syringe filled with gasoline, as in Fig. 10. This illustration shows a small connecting-rod supporting one end of the main rod with a leather washer to make a joint at the bottom of the piston-pin hole, and also a washer around the nozzle of the syringe. This method is used for cleaning all the oil pipes and similar passages, which it does very thoroughly.

Should new piston rings be necessary, they should be checked very carefully to secure proper clearance. If they are too wide, they can be worked down with a fine file; but it is found preferable to grind them on a piston ring or similar machine. The cast-iron piston rings should have a clearance of 0.002 in. sidewise in the groove. The packing rings for the obturator should also be reduced until the same clearance is obtained.

After the connecting-rods are cleaned, they should be tested by placing a pin through each end and mounting on a V-block, as in Fig. 11. Then a surface gage is used on each end of the pin, which shows the alignment of the two ends of the rod. The cylinder shown is simply used to support the rod. The amount of clearance between the rings and the groove should be tested with a feeler in the regular way. A straightedge should also be laid along the side of the piston to see that the cast-iron ring does not project at any point. Should it be found to project, the inside of the ring can be eased out with a half-round file.

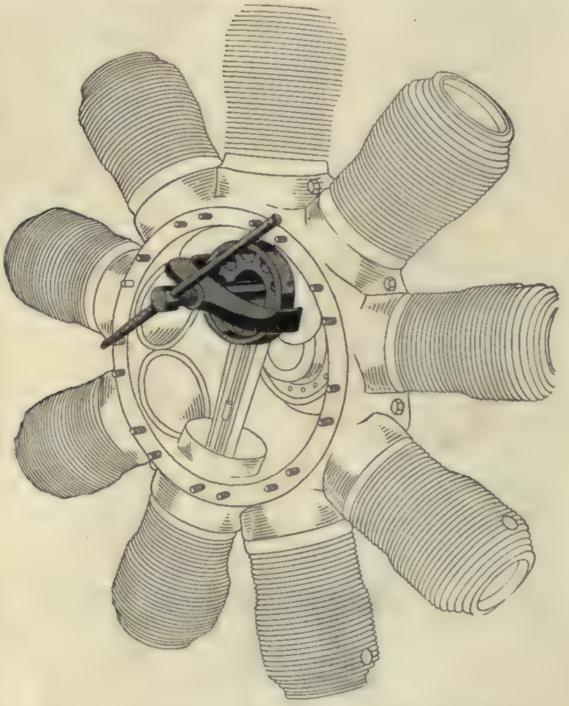


FIG. 7. MOTHER ROD BEING WITHDRAWN

In assembling the piston pins, it should be remembered that the split end belongs in the boss that has the locking screw. This means that the other end of the pin should be pushed through this boss first. At the same time it should be observed that the oil pipe on the connecting-rod is on the opposite side to the locking screw and that the gap in the piston skirt is at the right-hand side when the locking screw is next to the operator. It is also necessary to see that the large end of the taper hole of the piston pin is up and that it comes in line with the capped hole for the locking screw.

If the pin is not entering in exactly its proper position the end can be clamped lightly in a vise, that is protected by copper or lead jaws, and turned slightly until the holes come in line, after which it can be pushed into place and driven home with a special punch and hammer. The locking screw should now be screwed tightly into place and the cotter pin put through the head of the screw so that it comes against the inside of the piston skirt so as to prevent unscrewing. Care should be taken that no small particles of metal dust or burrs remain in the pin slot. They should be picked out, a magnetized scriber being extremely useful in this connection.

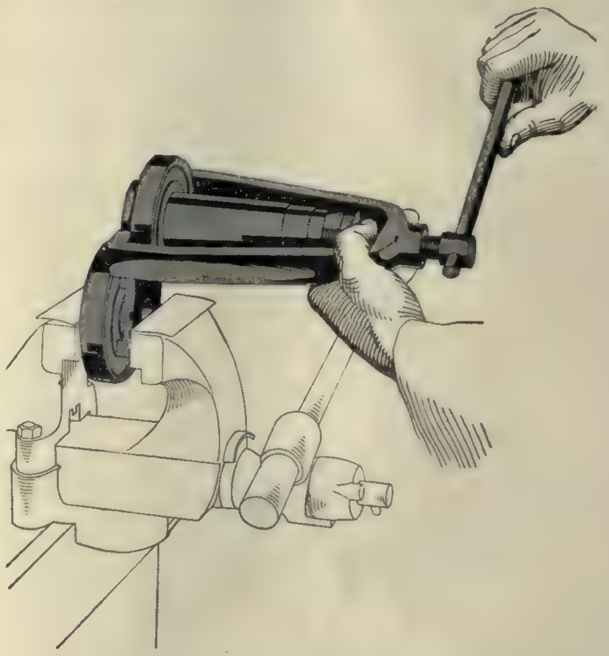


FIG. 8. REMOVING BALL RACE FROM SHORT-END CRANKSHAFT

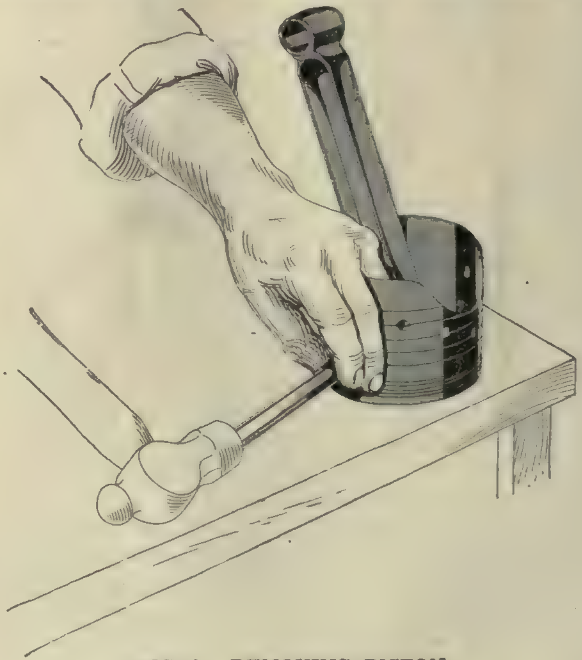


FIG. 9. REMOVING PISTON

The piston rings are put in position by reversing the process of taking them out, care being taken not to spring the ring any more than is absolutely necessary. Then the large ball bearing is put into position on the mainshaft, the shaft assembled in the thrust cover by

FIG. 10. CLEANING AND WASHING MOTHER ROD

gently tapping the ball race into position, and the thrust race can be pressed home by a special draw sleeve made for this purpose. The special wrenches that are needed in almost every instance are usually supplied with the engines.

The walls of the compression space of the cylinders should be thoroughly cleaned before the pistons are again assembled. This can be done with a specially

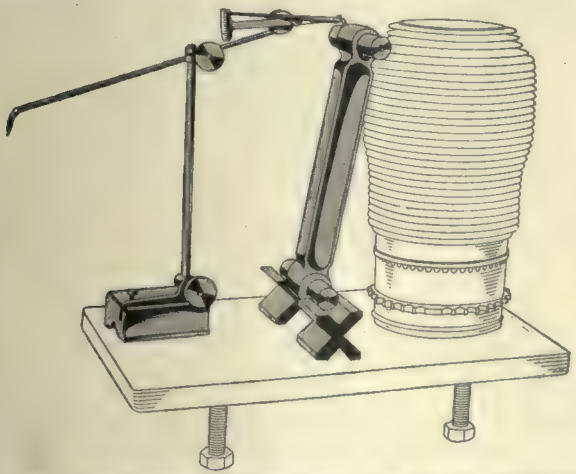


FIG. 11. CHECKING ALIGNMENT OF CONNECTING-ROD BUSHES

shaped scraper, and the outside of the cylinders are also cleaned and polished to remove any marks of heating which may appear. The cylinders are then thoroughly washed with gasoline, particular attention being paid to the holes that form the inlet port for the cylinder gases. Each hole is separately sprayed with the gasoline syringe, so as to be sure that every passage is thoroughly cleaned. Before pistons and connecting-rods are replaced in their cylinders, they are thoroughly wasned in a gasoline bath, and the syringe is used for cleaning out all corners of the piston and pins.

In replacing the pistons the obturator gap should be brought to the same side of the piston as the connecting-rod oil pipe and placed 30 deg. on the opposite side of the piston pin to the clearance cut in the skirt of the piston. The gap in the cast-iron ring should be opposite this, and the gap in the ring that goes beneath the obturator ring should be 90 deg. to it on the side opposite the piston clearance.

The mother rod with its piston is first inserted in cylinder No. 1 by reversing the process described in removing it. It is necessary to watch the obturator gap

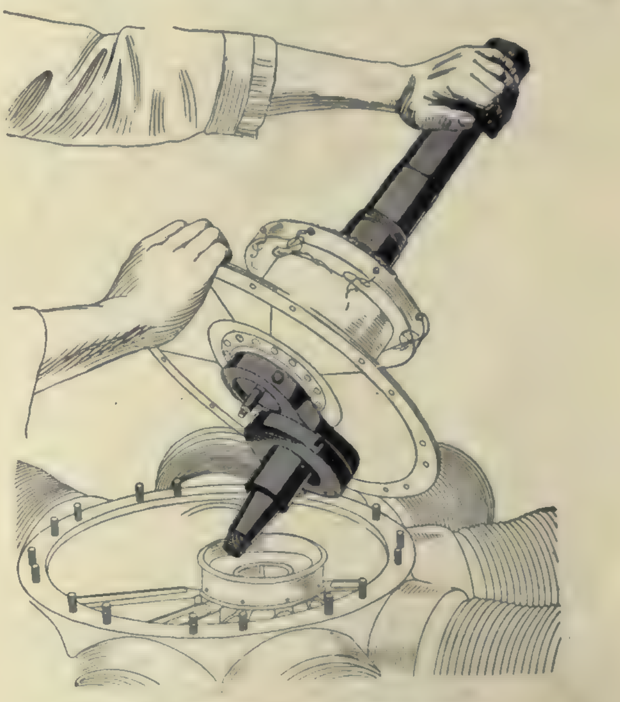


FIG. 12. ASSEMBLING CRANKSHAFT

very closely so as to enter it into the cylinder positively, but easily; and the piston should then be worked up and down slowly and turned at the same time to bring it to the correct position. Before this is done, some crude oil should be put in the cylinder to avoid any semblance of sticking. The clearance cut in the piston must be in its correct position on the trailing side of the cylinder. Starting with No. 2 connecting-rod and piston, the engine is assembled in much the same way that it was taken apart.

Before the small crankpins are put in, they should be thoroughly cleaned with gasoline; and this should be forced through the oil passages to make sure that they are perfectly clear. A special tool is used for holding the connecting-rod in line with the small crankpin, and it is customary to put in pins Nos. 5 and 6 first, as these take the weight of the mother rod and hold it steady. The pins can then be easily entered in their proper positions and tapped home with a light hammer and punch, care being taken that the small lug which prevents the pins from turning is in line with its recess. After each pin is assembled, the rod should be moved about to make sure that the pistons so far assembled are free in all positions. There should be a little side play at each end of the small connecting-rod.

Then the thrust cover, which has been completely assembled, is put into place, as in Fig. 12, threading the crankpin through the mother rod, as shown. The mother-rod ball race should be worked in easily. The thrust cover can then be slipped over the studs, and some of the nuts put into place. These nuts should not be screwed home, however, but only sufficiently to hold the cover to the crank case while the whole thing is being mounted on the engine stand, as shown in Fig. 1. Fig. 13 shows the pistons all in place.

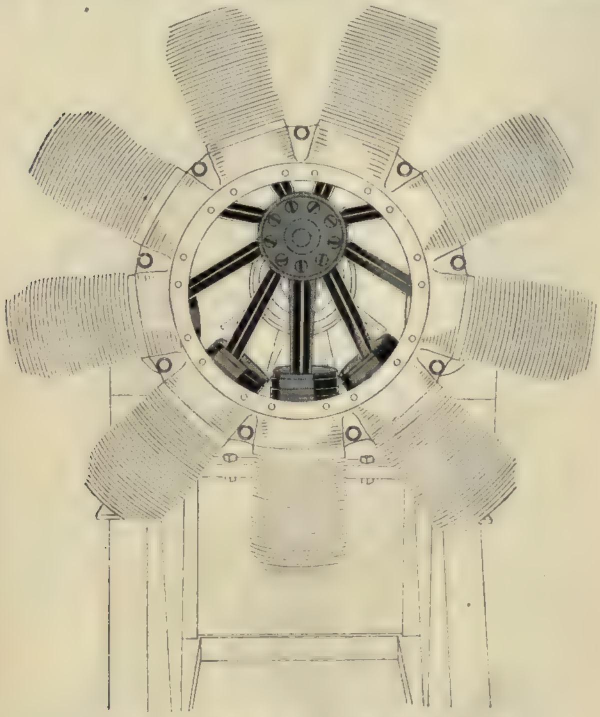


FIG. 13. PISTON AND RODS IN PLACE

Although the ball race in the mother rod is not all the way home, it can easily be pulled into place with a sleeve and nut. From here on, the work of assembling is simply the reverse of that previously described in the earlier operations of taking the motor apart and only requires good judgment on the part of a first-class mechanic. No other should tackle a job of this kind.

After the short end of the connecting-rod is in place, the valve-gear case is put back and forced home by using a sleeve, nut and special wrench, as in Fig. 14. The operating nut is screwed into the sleeve until the thread disappears, and is then slipped loosely over the shaft, avoiding the tappets by rotating slightly. The internal thread on the operating nut will engage with the thread on the crankshaft, and should now be screwed up as far as possible with the wrench shown.

The sleeve is rotated by hand until the flange bears against the ball-race housing. Then, with the wrench on the sleeve, the sleeve and engine are revolved together. This forces the ball race onto the shoulder of the crankshaft. Should it appear to be too tight a fit, it can be helped home with a few blows from a rawhide hammer on the front flange. To withdraw the sleeve, the operating nut is slacked off from its thread on the crankshaft. It should be noticed that No. 3 cylinder and valve are not operated by No. 3 tappet and No. 3 cam. The accompanying table gives the correct relation and shows that No. 3 cylinder and valve are operated by No. 1 tappet and No. 1 cam, also that No. 2 cam operates No. 2 tappet. This unsymmetrical numbering has come from a rearrangement of the cams in a change of design of the engine and the retention of the original numbers.

NUMBERS OF CORRESPONDING PARTS OF GNOME ENGINE

Cylinder, Valve, Tappet-Rod Nos.	1	2	3	4	5	6	7	8	9
Tappet, Valve-Gear Case Nos.	9	5	1	6	2	7	3	8	4
Cam No.	9	5	1	6	2	7	3	8	4

Fig. 15 shows that No. 3 valve has been put into No. 3 cylinder and its tappet rod connected. Before the tappet rod is put on, a test is made with a syringe to see that there is a free passage for oil from the cup end to the fork end of the rod. The engine is turned so that No. 3 cylinder is at 85 deg. from the vertical, as shown. In this position the cam that operates No. 3 tappet should be turned clockwise in the direction of the pointing finger until the rise on the cam, when it is opening the valve, is immediately below the No. 3 tappet roller. The angle at which this cylinder is standing can be checked by using a timing protractor held against the tappet rod, as in Fig. 16. Before the front cover is assembled, the camshaft should be turned in a clockwise direction until the rise of the cam has taken away all end play of the tappet rod. A syringeful of castor oil should be injected into the case after the front cover is put on. The front cover can be slipped into position by noticing that the markings on the outside, or satellite, gears correspond with the markings on the crankshaft gears. Two pegs, one on each side of the front cover, are useful to lead it into position.

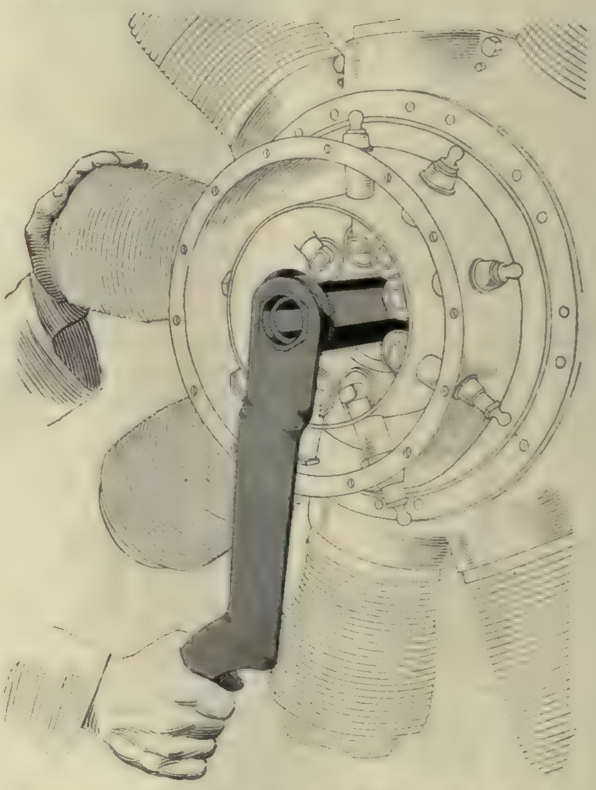


FIG. 14. PULLING VALVE-GEAR CASE HOME

Some of the bolts are now put loosely into the front cover and, before they are tightened up, the ball race is tapped into position on the crankshaft. Then the central nut is screwed up hard, and the front cover bolt is tightened evenly all the way around. This leaves only

the valves, tappets and spark plugs to be assembled, the valve cages being screwed into the cylinder heads by means of a special box spring.

Before assembling the spark plugs, the timing should be checked over, to be sure that the valves are opening

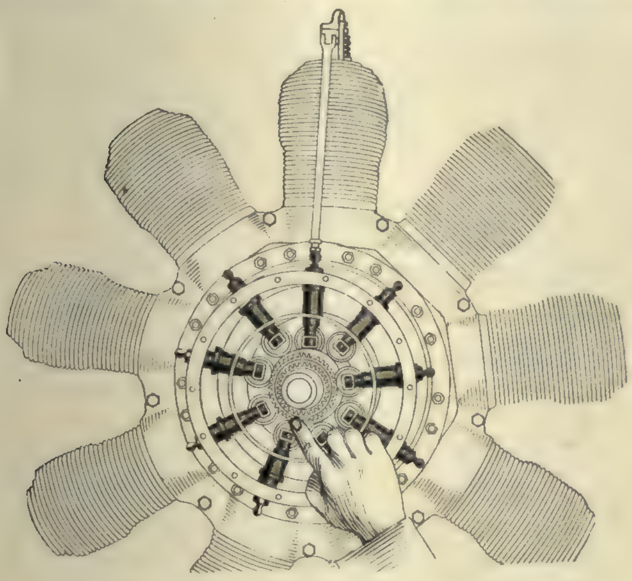


FIG. 15. ASSEMBLING VALVES AND CAMSHAFT

at 85 deg. past the top vertical center and closing at 120 deg. past the same center on the next revolution. All the plugs are assembled with their joint washers, and the wire from the distributors is attached to their

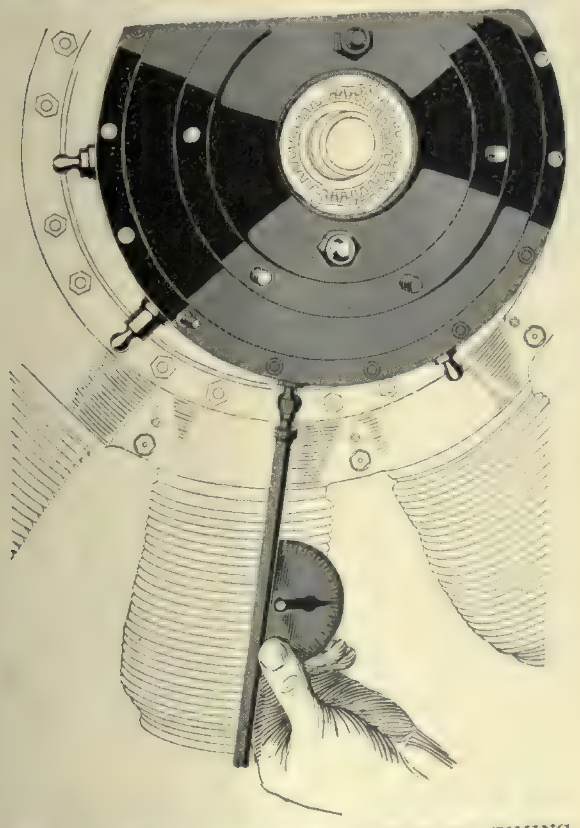


FIG. 16. TESTING CYLINDER ANGLE FOR TIMING

respective plugs. The wires should be securely fastened, but not too tightly, as there should be no tension in them after they are fixed. In handling the engine from the erecting stand to the plane, the main bearing plate should first of all be put upon the bearing. It should be complete with oil pump and air compressor, but not magneto or carbon brush-holder. The centralizing plates should also be assembled. The engine should now be lifted into position, passing the long-end crankshaft through the main bearer plates, and the nuts threaded on and passed through the centralizing plates, when the large nuts should be put in place.

The magneto should next be put in place. The No. 1 cylinder is set 18 deg. in advance of the top vertical center. This can be done by using the protractor shown in Fig. 16. The magneto should be set so that the contact breaker points are just separating. In these positions the magneto gear is brought into mesh with the gear on the engine, and the magneto is fastened up with its three screws. The magneto screws are locked with wire threaded through their heads.

Who Actually Purchases Machine Tools?

By H. W. Woolums

What is wrong with machine-tool advertising? Who does the buying? What man in an organization do you want to reach? Without trying to give a last word on this subject I will jot down a few lines as it appears to me.

First, What is wrong with machine-tool advertising? There are a large number of automatic- and turret-lathe companies that advertise in the *American Machinist* each week. Why don't they give us a close-up view of the machine doing some operation? Why do they let an advertisement run for weeks repeating the same old story? If you are a manufacturer of automatic turret lathes or other specialized machines you want your advertisement to reach a user of machinery and you want to interest him in what your machine will do. Don't make the mistake of thinking your advertisements are not watched.

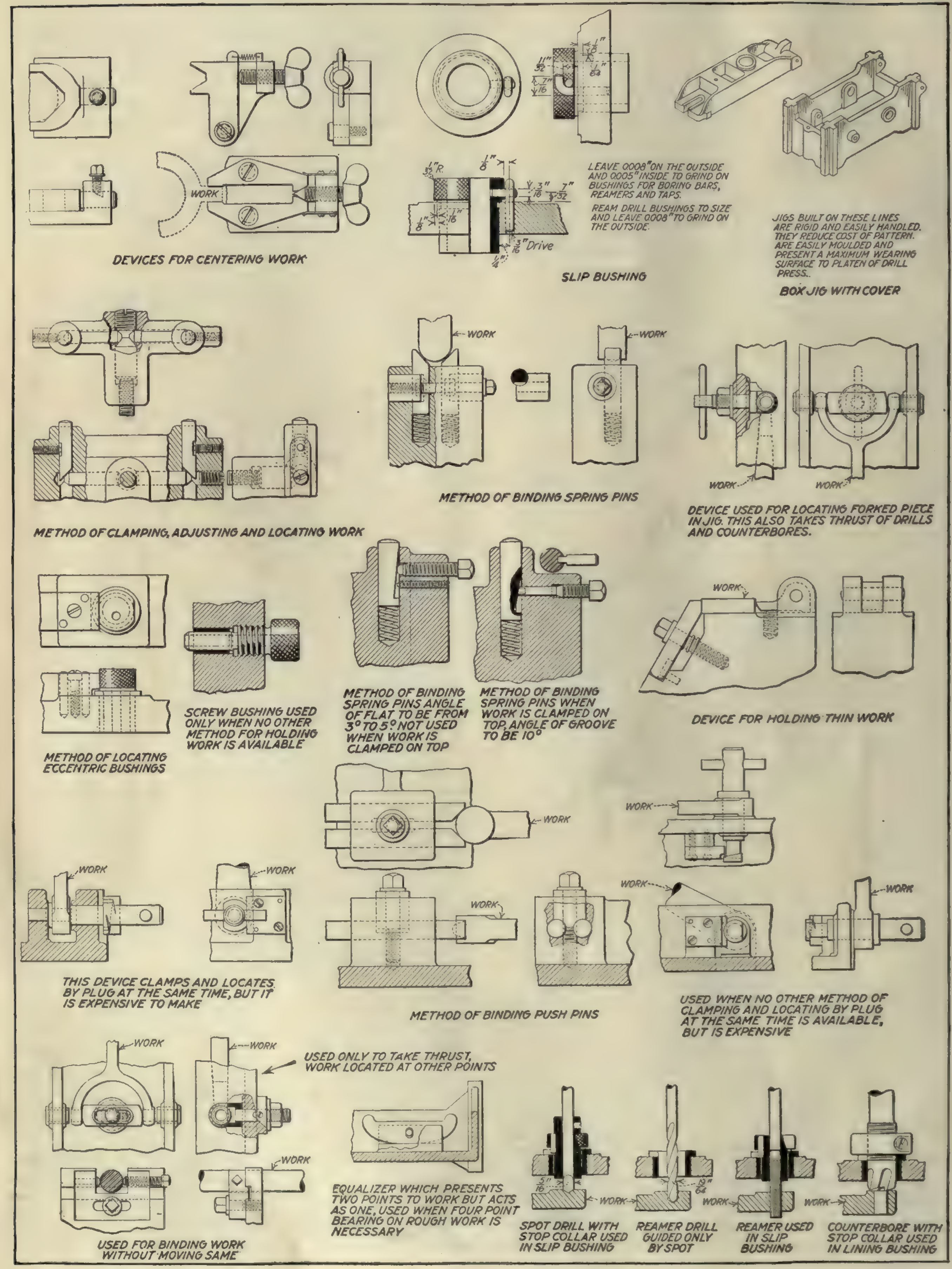
Second, Who does the buying? The purchasing agent?—I should say not! If the company is an extensive user of specialized machines it has an expert in the shop either as foreman or demonstrator or both; and if it has not either, the machine is a failure. Then who does the buying? It is Bill or Jim as the case may be, who has made a study of the turret lathe or automatic game, and this brings us to the third point:

What man in an organization do you want to reach? I would like to see this point presented in large type. You want to reach the man who is in charge of your machines.

If you are a manufacturer of specialized machines, don't think you must have a full-size picture of your machine to catch the eye, but give the man to be reached a view of some point of especial interest, some new tool you have designed. Educate him in repairs. Give him kinks that as a manufacturer you should know. What is the result? Foremen and demonstrators will become better trained men. They will command a larger salary. They will be better satisfied with their jobs, and as a consequence you will sell more automatic or turret lathes, or other specialized machines, as the case happens to be.

Jigs and Fixture Details

BY WILLIAM ROBERTS



DEVICES FOR CENTERING WORK

SLIP BUSHING

BOX JIG WITH COVER

METHOD OF BINDING SPRING PINS

DEVICE USED FOR LOCATING FORKED PIECE IN JIG. THIS ALSO TAKES THRUST OF DRILLS AND COUNTERBORES.

METHOD OF CLAMPING, ADJUSTING AND LOCATING WORK

METHOD OF LOCATING ECCENTRIC BUSHINGS

SCREW BUSHING USED ONLY WHEN NO OTHER METHOD FOR HOLDING WORK IS AVAILABLE

METHOD OF BINDING SPRING PINS ANGLE OF FLAT TO BE FROM 3° TO 5° NOT USED WHEN WORK IS CLAMPED ON TOP

METHOD OF BINDING SPRING PINS WHEN WORK IS CLAMPED ON TOP, ANGLE OF GROOVE TO BE 10°

DEVICE FOR HOLDING THIN WORK

THIS DEVICE CLAMPS AND LOCATES BY PLUG AT THE SAME TIME, BUT IT IS EXPENSIVE TO MAKE

METHOD OF BINDING PUSH PINS

USED WHEN NO OTHER METHOD OF CLAMPING AND LOCATING BY PLUG AT THE SAME TIME IS AVAILABLE, BUT IS EXPENSIVE

USED FOR BINDING WORK WITHOUT MOVING SAME

EQUALIZER WHICH PRESENTS TWO POINTS TO WORK BUT ACTS AS ONE, USED WHEN FOUR POINT BEARING ON ROUGH WORK IS NECESSARY

SPOT DRILL WITH STOP COLLAR USED IN SLIP BUSHING

REAMER DRILL GUIDED ONLY BY SPOT

REAMER USED IN SLIP BUSHING

COUNTERBORE WITH STOP COLLAR USED IN LINING BUSHING

Series for Executives

Keeping the Good Will of the Employee

BY H. D. MURPHY

The inability to distinguish between those details which should be delegated to someone else, and those which are so vital as to need his personal attention, has wrecked the career of more than one manager. In contrast to the man who cannot think otherwise than in large terms, we seem only to have the man who is an absolute slave to details.

AN ORGANIZATION harmonious in character, working entirely in accord is greatly to be desired, and while probably never to be realized by any of us, certainly cannot even be approached upon any other basis than the good will of the employee. This good will is like the bread cast upon the waters and even when his advances are flouted and his interest in the men discounted, as being of selfish origin, the executive must persist. If dissension arises he then has the satisfaction of knowing the fault cannot be laid to him. Furthermore, he knows that he must have gained the good will of some one, and as this leaven works through the whole body, his troubles will be lightened.

We do not appreciate how unconsciously we gain the ill-will of those under our direction. Recently a young toolmaker asked for more money and was immediately promised an advance of 3c. an hour. Unfortunately, a week was allowed to elapse before the change was made on the payroll. The man was naturally disgusted as he could only see that his employer had maneuvered to retain a niggardly sum. Of course, the correction was made; but, unfortunately, the same thing occurred when a second advance was due. It was with difficulty that the young man's services were retained, but while he still has the same job, his attitude toward his employer has changed as is evidenced by the fact that he has since secured additional raises by "squeeze plays." Every time the employee gains by coercion, the employer loses some of that asset, the subject of this paper.

ONE of the employees in a small plant asked for some days off as he wished to celebrate his twenty-fifth wedding anniversary. He had not been with his employers so very long, but his value as a worker was evident from the first day. Without any previous intimation, he received a full week's pay in his envelope. His actions plainly indicated that he was not counting upon this expression of good will. Since that time he has lost no opportunity to speak well of his employers, which has a good effect upon new men, and he is particularly delighted when he can suggest some method for cheapening production. Surely his employers have been literally more than repaid for their thoughtfulness.

Probably one of the strongest examples of how this good will had developed almost unknown to the management was in a place where an attempt was made to force the closed-shop issue. Those who were union men had been instructed to demand more money and in the event of refusal, to quit. One man, who had been there so long as to be considered a fixture, refused to make the demand and was threatened with expulsion from the union. He went to his employers, stated his case, and offered to wash his hands of the union provided he had assurance of employment as long as the concern existed or he was able to work. This proposition was accepted. The man's loyalty was shown by his complete confidence in his employers, for bear in mind that it was a gentlemen's agreement and if he had later been discharged the union would have made him an example of him.

THE good will of the employee is not gained by paternalism. It is not here intended to belittle the attention which is given in these days to the workmen's civic and domestic existence, but those things which can be done to make the working hours congenial are just as efficacious and demand no more effort than the so-called personal touch. Most men are better satisfied with a change which sends them home at the end of a day's task with eyes no longer strained than with a tiled washroom, or are more appreciative of a device which saves many weary footsteps than of solicitude as to their mode of living.

There is instance of an employer who refused to provide ice water for his men in the extreme heat of the summer, stating that all such practice was being discontinued. He neglected to state that in its place many factories were being equipped with systems which provided ice-cooled water, thus avoiding the dangers that lurk in water that has been in actual contact with the ice. Being finally forced to provide ice water, on the threat of the men to quit, this employer did not hesitate to sneak upstairs and refresh himself at one of the coolers whenever he felt thirsty. In this same plant the polishing lathes are arranged along the south side of the room and during certain hours of the day the sunlight streams in and strikes the surfaces of the

pieces being polished. The light thus reflected to the eyes is not only annoying, but is probably injurious. The windows used to be protected by awnings, but they are worn out. Although the men have asked repeatedly for new awnings absolutely no heed has been given to their request. It is regarded as too trivial for attention. Is it not as plain as the nose on your face the kind of an organization this concern is building up, or rather down?

It has been stated above that the good will of the employee is like the bread cast upon the waters. This is true and the return of the bread may take place even after the employee has left and entered the service of another house. Two such instances occur to the writer.

The man in charge of one of the stock rooms became a source of annoyance to the management through a series of personal privileges which he sought. In view of the man's good record, however, these were granted and, proving temporary, when the time for exercising them had elapsed the matter was forgotten. In course of time the employee left, having an opportunity to better himself. It has since developed that a certain order of considerable size, which was the forerunner of others, came from this man's present employers and was the result of a suggestion by him when they were uncertain as to where they could get the articles made.

RECENTLY a firm in an adjacent city bought some scrap brass and sent it to the foundry to be melted up. One of the molders happened to notice some of the pieces and remarked that he did not believe the original owner ever intended them for the scrap heap. He had molded many of them in his previous place of employment and they were considered standard articles. As a result of his friendly interest, the original manufacturer was not only able to stop a leak in his raw materials stock room, but also to bring the culprit to book, and we all know the latter is very difficult to accomplish.

It is possible to delegate to assistants the care of financing, producing, or almost any other phase of work; but this good will can only be engendered by making the man feel that he is the subject of personal consideration on the part of the man who runs the business, be he owner or manager. It is impossible to estimate the value of this asset unless evidence such as cited above accidentally comes to light. Therefore, it is certainly one of the details that should neither be overlooked nor delegated to a subordinate.

The Case of the Superannuated Watchman*

By W. E. Mallalieu

General Manager of the Natinal Board of Fire Underwriters

The subject of watchmen opens a big field for consideration at this time. The prevailing custom among manufacturers, warehousemen and others is that of engaging as night watchman some superannuated employee who is no longer physically able to earn a workman's pay. Such a watchman may make his occasional rounds of clock stations in a purely mechanical way, but the amount of real protection which he furnishes, especially in war time, is very small. Generally he can be avoided with ridiculous ease by any one who is in the place with hostile intent. Or, if not avoided, his overpowering is a matter of little difficulty.

Some of you know of a recent test in a very large grain elevator, where inspectors were sent into a plant at night time, without the knowledge of the aged watchman. These inspectors spent six hours within the plant and made drawings of many of its important features, but their presence was never once detected. As a consequence the owners were given the alternative of engaging a sufficient number of young and vigorous guards or of having their plant taken over by the state authorities.

One Watchman for a 900-Foot Pier

The big Baltimore fire, Oct. 30, 1917, is a striking example of insufficient watchman service. Here was a pier, 900 ft. long, containing such a valuable accumulation of freight as 50,000 bales of wood pulp, 150 carloads of flour, 20 cars of tobacco, 30 cars of bark extract, 40 cars of lubricating oil, 25 cars of spelter, 23 cars of roofing paper, 15 cars of miscellaneous freight in the portion of the pier that was destroyed. Pier 9 contained 29,000 bales of wood pulp, 7000 cases of imported liquor in the bonded end, 300 crates of earthenware, 100 bales of oakum, 100 cars roofing paper, 50 cars of linseed oil cake, 20 cars of tobacco, 23 cars of miscellaneous freight. Think of leaving these stores in the sole charge of a single watchman in a time such as the present!

There are really few subjects in fire prevention so important as the abrogation of this time-honored custom of inefficient watchmen. To make the safeguarding of our production of suppiles depend upon those who can furnish only nominal safety, during the hours when darkness brings the greatest dangers, and to do this in a period of extensive hostile activities would be ludicrous if it were not so grave. It is equivalent to locking the windows and leaving the front door open.

Picked Men, Not Derelicts

Watchmen are charged with extraordinary responsibility. They should be picked men, not derelicts. They should be intelligent, courageous, and physically active. They should be sufficient in number to furnish real protection. They should be armed. They should receive special training for their important duties, and this training should include knowledge of fire alarms, fire prevention and fire protection. They should never be engaged except upon unmistakable evidence of character, and they should be paid the salaries that will command such qualifications.

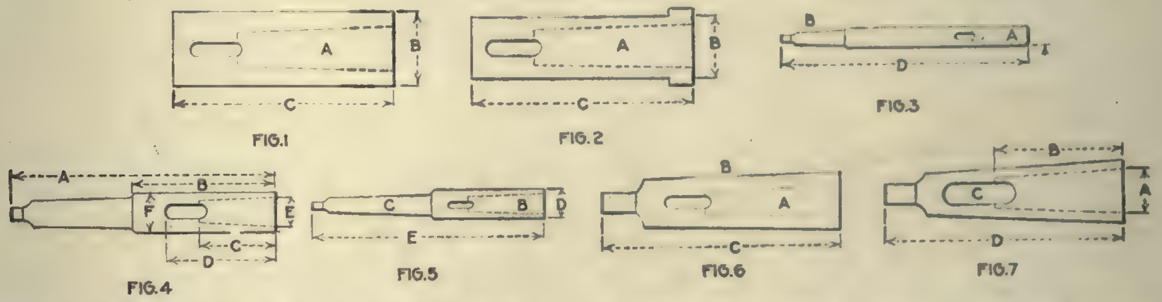
I wish respectfully to suggest that you gentlemen give early and earnest consideration to the correction of what we may well call "the watchman evil." I wish to raise the point as to whether each one of you may not profitably undertake to secure statistics of the watchmen's service in his own state, and to formulate means for a sweeping reform of the whole absurd system. If this can be done, and I believe that you can do it, the efficiency and safety of the nation will be greatly enhanced. It is a crying need of the present hour.

*Extracts from an address at the convention of the Fire Marshals Association of North America, New Orleans, Nov. 15, 1917.

Navy Department Specifications for Sockets for Morse Taper-Shank Tools

THE adoption of standard types and sizes for almost any kind of tool is of advantage to both the user and the manufacturer, as it enables them to concentrate on fewer sizes and avoid the necessity for carrying extremely large stocks in order to be able to supply the particular kind wanted.

The Bureau of Construction and Repair of the Navy Department is preparing standards for various tools and appliances, and we give herewith the specifications for sockets for tools having Morse taper shanks. The tables give complete dimensions, and the tolerances allowed are shown in the notes that follow each table. These tolerances have been given careful consideration, and the bureau is fortunate in having practical men who can determine reasonable tolerances, so that the tools may be sufficiently accurate without having the



Chucking sockets, Figs. 1 and 2, are for use in turrets of chucking lathes, boring lathes, turret lathes, screw machines and the like, shall have straight shanks and Morse taper holes. They shall conform to the dimensions shown in the following table:

Chucking Socket No.	A Morse Taper Hole No.	B Diam. of Shank In.	C Whole Length In.
1	1	1	3 1/2
2	1	1 1/4	3 1/2
3	1	1 1/2	3 1/2
4	2	1	4
5	2	1 1/4	4
6	2	1 1/2	4
7	2	1 3/4	4
8	2	2	4
9	3	1 1/4	4 3/4
10	3	1 1/2	4 3/4
11	3	1 3/4	4 3/4
12	3	2	4 3/4
13	4	1 1/2	6
14	4	1 3/4	6
15	4	2	6

Sockets Nos. 4, 9 and 13 shall be larger than shank at large end of taper as follows: Socket No. 4 shall be 1 1/4 in. dia. for a length of 5/8 in.; socket No. 9 shall be 1 1/2 in. dia. for a length of 5/8 in.; socket No. 13 shall be 1 3/4 in. dia. for a length of 1 5/8 in.

Tolerances—Dimension B. On sockets up to and including 1 1/4 in. diameter of shank, a plus or minus variation of 0.001 in. in diameter of shank will be allowed; on sockets larger than 1 1/4 in. a plus or minus variation of 0.002 in. in diameter of shank will be allowed. Dimension C. A plus or minus variation of 1/16 in. in whole length will be allowed.

Extension sockets. These sockets, Fig. 3, shall be in accordance with the following table; the size of the taper hole of each socket being the same as the size of shank of that socket:

Extension Socket No.	A and B Morse Taper No.	C Outside Diameter of Socket, In.	D Length Overall, In.
1	1	1	6
2	1	1	9
3	1	1	12
4	1	1	18
5	1	1	24
6	2	1 3/16	9
7	2	1 3/16	12
8	2	1 3/16	18
9	2	1 3/16	24
10	2	1 3/16	30
11	3	1 7/16	9
12	3	1 7/16	12
13	3	1 7/16	18
14	3	1 7/16	24
15	3	1 7/16	30
16	4	1 7/8	12
17	4	1 7/8	18
18	4	1 7/8	24
19	4	1 7/8	30

Tolerances—Dimension C. A plus or minus variation of 0.005 in. in outside diameter will be allowed. Dimensions D. On sockets up to 12 in. in length, a plus or minus variation of 1/16 in. in length overall will be allowed; on sockets longer than 12 in. a plus or minus variation of 1/8 in. in length overall will be allowed.

Extension socket for short shanks. These sockets, Fig. 4, shall be made with taper hole suitable for reception of short Morse taper shanks. They shall be plainly marked so they may not be used as sockets with regular Morse taper ho'e. They shall conform to dimensions shown in following table:

Skt. No.	A In.	B In.	C In.	D In.	E In.	F In.	MT Sk. No.	Taper of Hole In. per Ft.	Dimension of Slot In.
1	5 1/2	3	1 13/16	2 1/32	0.475	1	1	0.600	0.263x 13/16
2	6 3/4	3 3/8	2 1/16	3 1/32	0.700	1 3/16	2	0.602	0.388x1 3/16
3	8 1/8	4 5/8	2 1/2	3 7/32	0.938	1 7/16	3	0.602	0.516x1 5/16
4	10 3/8	5 5/8	3 5/16	4 5/32	1.231	1 3/4	4	0.623	0.641x1 1/2
5	13	7	4 3/16	5 21/32	1.748	2 1/2	5	0.630	1.016x2

Dimensions of slots are maximum dimensions; they may be 0.008 in. less in width than dimensions noted.

Tolerances—Dimension A. A plus or minus variation of 1/8 in. in length overall will be allowed. Dimension F. A plus or minus variation of 0.005 in. in outside diameter will be allowed.

Extension reducing sockets. These sockets, Fig. 5, shall have regular Morse taper shanks and Morse taper holes and shall conform to the dimensions shown in the following table:

Socket No.	B Morse Taper Hole	C Morse Taper Shank	D Outside Diameter In.	E Whole Length. In.
1	1	2	1	6 1/8
2	2	3	1 3/16	7 1/2
3	3	4	1 7/16	9 3/8
4	4	5	1 7/8	11 5/8

Tolerances—Dimension D. A plus or minus variation of 0.005 in. in outside diameter will be allowed. Dimension E. A plus or minus variation of 1/8 in. in length overall will be allowed.

Reducing sockets or sleeves, Fig. 6, shall be made in accordance with the dimensions shown in the following table:

Socket No.	A Morse Taper Hole No.	B Morse Taper Outside No.	C Whole Length, In.
1	1	2	3 9/16
2	1	3	3 13/16
3	1	4	4 1/8
4	1	5	6 1/8
5	2	3	4 7/16
6	2	4	4 1/8
7	2	5	6 1/8
8	3	4	5 3/8
9	3	5	6 1/8
10	4	5	6 5/8
11	5	6	8 5/8

Tolerance—Dimension C. A plus tolerance of 1/4 in. and a minus tolerance of 1/8 in. will be allowed in whole length.

Reducing sockets for short shanks. These sockets, Fig. 7, shall be made with taper holes for reception of short Morse taper shanks. They shall be plainly marked so they may not be used as sockets with regular Morse taper hole, and they shall conform to dimensions shown in following table:

Size No.	Morse Taper Outside No.	A. In.	B. In.	Taper of Hole In. per Ft.	Dimen of Slot C. In.	Whole Length, D In.
1	2	0.475	1 13/16	0.600	0.263x 13/16	3 9/16
2	3	0.700	2 1/16	0.602	0.388x1 3/16	4 7/16
3	4	0.938	2 1/2	0.602	0.516x1 5/16	5 3/8
4	5	1.231	3 5/16	0.623	0.641x1 1/2	6 5/8

Tolerances—Dimensions B. A plus or minus variation of 1/16 in. in length of hole will be allowed. Dimension C. Dimensions of slots are maximum. The width of slots may be 0.008 in. less than dimensions given. Dimension D. Whole length of socket may be 1/4 in. longer than dimensions given noted D.

FIGS. 1 TO 7. VARIOUS STYLES OF MORSE TAPER SHANK SOCKETS AND NAVY DEPARTMENT

requirements unnecessarily close. The seven illustrations show the fixed type of socket, and the specifications will form a convenient reference for anyone interested in this line of work.

General specifications for inspection of material, issued by the Navy Department, in effect at date of opening of bids, shall form part of the general specifications:

Types—Chucking sockets; extension sockets; extension sockets for short shanks; extension reducing sockets; reducing sockets, and reducing sockets for short shanks.

Material and Workmanship—The sockets shall be made from the best grade of machinery steel, and shall be free from all defects that may affect the serviceability of the tools. The sockets shall be of the best workmanship, and shall be made in accordance with the best commercial practice.

General Characteristics—The taper hole in each socket shall be true with the outside of socket. The tangs of taper-shank sockets shall be relieved in a manner suitable to prevent the upsetting of end of socket. Each socket shall be stamped or marked plainly with the manufacturer's name or trademark, and also with the size or sizes of the taper or tapers. Each socket shall be fitted with a slot of correct design to receive tang of Morse taper shank of the same size as the hole. The shanks of all taper-shank sockets shall be ground to fit standard Morse taper gages.

Tests—Samples shall be submitted with bids. Sockets will be tested as to their accuracy, in relation to the hole being true with the shank. In no case will sockets be accepted where the error is greater than 0.005 in. in 12 in. Taper shank sockets shall be tested in spindles with Morse taper holes, and test bars inserted in sockets. Sockets with straight shanks shall be placed on true-running Morse taper-shank arbors, specially used for testing sockets. While all measurements will be taken into consideration, consideration mainly will be given to the accuracy of shanks and holes, both in regard to measurements and their running true with each other. In making recommendation, consideration will be given to quality of sockets furnished on previous contracts, and the recommendation will be made with the understanding that the successful bidder shall deliver sockets equal in all respects to samples submitted, and shall replace all sockets which fail to meet the requirements.

Packing and Marking—Each socket shall be thoroughly oiled and then wrapped in paper. Each package shall be plainly marked with the name of the manufacturer, the quantity and type of sockets contained.

Anent Our Fortieth Birthday

By W. D. Forbes

A continued success for 40 years is something which the *American Machinist* certainly has the right to be proud of, yet I feel far more inclined to congratulate the mechanical world than I do this publication; for while the *American Machinist* may have profited greatly in a moneyed way its readers have gained infinitely more in an educational way, but both have my felicitation.

The delightful reminiscences of Brother Colvin have been a source of enjoyment to me as to others. I remember, as a schoolboy, with what glee I detected an error on the part of a teacher, and I have "got one" on Colvin this time. No. 96 Fulton St. was the abode of the *American Machinist*, but that was not on the corner of Nassau St. as stated; it was at Cliff and Fulton. I remember very well the first time I tried to find the office and the look of weary resignation on the face of a man in one of the stores below, when I asked him if it was possible to do so without calling out a hook and ladder company. When I did succeed, just opposite the entrance sat Mr. Lycurgus Moore, short and rotund, next to him, to the north, sat Mr. Hemenway, about as short but fatter, and up in the northwest corner was Mr. Horace Miller, tall and very thin.

Early Appearances

I had come to the *American Machinist*, as a thousand have done since, for information and I got it. I think the paper had been published then about two years, and its heading was ornamented with a lot of curlycues. Mr. Hemenway was a little peeved when I asked him if they represented lathe or planing machine chips. But these have taken their departure with the Gothic designs of planing machine housings and pea-green paint. At that time I think the issue of the *Amrican Machinist* was about as thick as the blade of a case-knife. The first article I submitted for its pages was on the value of an inserted-blade cold chisel, which had been commented on by that inimitable writer, Caudle, and I am very proud that an article of mine has appeared in the fortieth-year issue of the *American Machinist*. In the office, I met for the first time Professor John E. Sweet, a man whom no one ever met without being the better for the meeting. By accident I knew considerable about Professor Sweet and his writings. At the time of our meeting an Englishman, who was making a tour of inspection of American shops, frequently called at the office. He was interested in some established, or about-to-be established, mechanical paper. While talking he said, "It seems very strange to me that so many men working at the bench in America are able to write so entertainingly on their daily work; in England we are not so fortunate, in fact I never knew but one really entertaining writer in this line, but I could never place him as he wrote over the name 'An Englishman in America.'"

I looked up at Professor Sweet who was blushing like a schoolboy, and laughed; for I knew he was the very person the man was looking for. Professor Sweet often referred to this incident in our talks in after life. If anyone will turn to the issues of *Locomotive Engineering* of 1870, '71, and '72 he will find therein the articles referred to, and it will be well worth his while to read them.

In this old office I first met Mr. Hill who had his desk at the north end of the room. When I was introduced to him he had in his hand a colored movable representation of a triple valve, which made clear all the movements of that most valuable invention. I think it was at Mr. Hill's suggestion that the Westinghouse company issued this device. I had met Mr. Hill in Colorado without knowing who he was, and he asked

me if I could find out if a man by the name of Salano was doing anything practical with an air-brake system of the man's own invention. Strangely enough I ran across this man a few days later in a wire-supply store, the proprietor of which, I believe, was named Morse. This store was immediately opposite the *American Machinist* office.

Beside the gentlemen I have mentioned, those named by Mr. Colvin—with few exceptions—were known to me and it is with a tinge of sadness that I glance down the aisles of time and miss those who have "washed up" and gone home for the last time. "Wrapped the mantel of their couch about them and laid them down to pleasant dreams."

Melting of Brass in the Induction Furnace*

By G. H. Clamer

After four years of constant and untiring efforts and the expenditure of a considerable amount of money for development work on the problem of electrically melting nonferrous metals, I have come to the positive conclusion that there is no one type of furnace best suited for meeting each and every condition. For example, a furnace which is a pronounced success for melting red brass and for meeting certain foundry or casting-shop conditions might be an utter failure for melting yellow brass or other alloys of high zinc content. Then again, a furnace which in very large units will exhibit a satisfactory efficiency, may have a very low efficiency in small sizes, etc.

A furnace may be restricted in its field of usefulness because it can be operated to the best advantage only in continuous service, which renders it impossible to operate economically or satisfactorily on an eight- or ten-hour basis. Also, it may not be possible conveniently and economically to change from one mixture to another and so obtain the flexibility of operation which is possible in the fuel furnaces, using crucibles, etc.

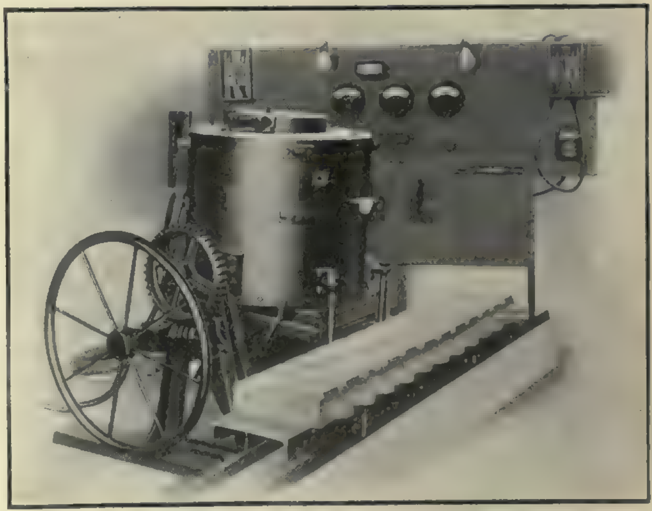
It has been the experience in the steel industry, in which the electric furnace has now become an exceedingly important factor, that many failures have been due to the use of the wrong type of furnace for the service in which it was used. Furnaces which have been condemned for this reason give entirely satisfactory service when used under the proper conditions. Prospective users of electric furnaces for melting nonferrous metals should, therefore, be urged to exercise proper caution in selecting the type of furnace best suited for meeting their requirements; otherwise, the expansion in the use of electric furnaces in this industry will have a serious setback and condemnation, which may be entirely unjustifiable.

There are two injurious factors to guard against in the design of horizontal open-ring induction furnaces—namely pinch effect and low-power factor.

Pinch Effect—When high currents are sent through molten conductors the cross-section of the conductor tends to contract. This contraction will, if the current be sufficiently increased, finally interrupt the circuit at the point of smallest cross-section. This does not occur when steel is being melted in induction furnaces, if the furnace is not forced. Because of the high resistance of steel, the current required to melt it is not sufficient to cause the pinch effect. But, in the case of low-resistance metals, as copper and brass, pinch effect interferes with the proper running of the furnace. This condition occurs only in induction furnaces which have the molten secondary in a horizontal plane of the open channel type.

Low-Power Factor—It is essential in the proper design of a transformer to have the primary and secondary coils as close together as possible. If this is not done, many of the lines of force will not interlink the two coils, hence, a low-power factor will result. In the induction furnace, the molten secondary cannot be placed as close to the primary coil as desired on account of the necessary refractory for heat insulation and also the secondary must have a certain length to give the required resistance. It is possible to reduce these lines which do not interlink by inserting between the primary and secondary another coil which will form lines of force opposite to the leakage lines, hence will neutralize them. But this requires an expenditure of energy, and can hardly be considered a solution of the problem.

In this furnace it is possible to melt 60/40 brass without volatilization of zinc in the channels of the secondary circuit, so long as the cold metal is being fed into the furnace or so long as the bath in its entirety has not reached the temperature at which the zinc is



THE AJAX-WYATT FURNACE

volatilized. It is interesting to know that just as soon as the bath has reached the correct pouring temperature, the needles on the instruments begin kicking. The test now used by the melter in the brass-rolling mills to determine the casting temperature, is to immerse an iron bar in the molten metal. If the melter feels a kick upon the bar, he pronounces the temperature satisfactory. This kick which is felt, is simply due to the so-called boiling of the metal, i.e., volatilization of zinc.

The furnace may be fed with turnings, cabbaged material, ingots, etc. The charge may be added rapidly as there is no danger of solidifying the metal in the secondary channels or in the lower portion of the pool above them, the only precaution necessary being to exercise care to prevent bridging of the charge. The fur-

*Extracts from a paper presented at the Philadelphia Foundrymen's Association at the two hundred and seventy-first meeting, Nov. 7, 1917

nace is entirely noiseless in its operation, very cool on the outside of the jacket, uses no water in cooling, therefore, absolutely safe from any danger of having the heated metal come in contact with water and its consequent results. The shape of the hearth closely approximates that of an ordinary crucible, in fact very closely approaches the ideal for minimum of heat losses, which is a spherical form.

It is possible to tightly seal the furnace to prevent oxidation. The heat is generated in the charge itself and at the bottom of the charge. All the forces effective in the channels have the tendency to carry the heated metal upward, and so bring it in contact with the metal to be melted, viz., motor effect, pinch effect, and Joule effect; consequently, there is constant and energetic automatic circulation. The conditions in all these respects are ideal for high efficiency and minimum of metal losses.

The Ajax-Wyatt furnace has melted several million pounds of yellow metal, a large part of which has been in the form of turnings. The composition has varied from 70/30 to 60/40, with lead as high as 3 per cent., so that the figures hereafter given are not based upon isolated test runs, but cover commercial practice. It would be possible to tabulate details of these runs of which complete records have been kept, but not wishing to burden this paper with details, summaries only are given. The quality of the metal in all cases has been equal to or somewhat better than the alloy made in crucibles in the ordinary pit furnaces.

It has been possible in this furnace to melt cartridge brass in the form of turnings, and produce billets which have been pronounced to work as satisfactorily for the production of new cases as the original billets from which the turnings were derived. Absolutely clean manganese bronze turnings have been melted and poured into ingots which showed physical properties practically equivalent to the original castings from which the turnings originated. Coarse, oily turnings are more easily handled in this form of furnace than in any other, it being possible to feed them from the top, allowing the oil to burn off, and then by means of iron bars, poking them into the charge. Very finely divided material, such as sawings, are very satisfactorily handled with a minimum of loss. Hundreds of analyses of large billets which have been made top, middle and bottom, have demonstrated that segregation is at a minimum.

Inspection Without Reason

By Albert A. Dowd

In the *American Machinist*, page 914, Vol. 47, an article by M. E. Hoag, brings up a question regarding the permissible error in manufacturing thread gages which are to be used as master or reference gages. Some time ago the writer designed a number of thread gages both male and female, which were to be used as reference or master gages. They were not intended for use in any way except as a reference, and the manufacturing tolerance within which they were to be made, was specified as 0.0001 in. The limit was + or — 0.00005 in. on the diameter at the pitch line.

There were 36 male and female thread gages to be made to the various sizes specified, and a complete set of blueprints for each size was sent to six gage manufacturers for an estimate on the cost of manufacture. Only two of the six firms were willing to submit estimates, due to the very close limits of accuracy specified. The other four firms refused to quote because the limits were so close, and they claimed it was unnecessary that they should be restricted to such small tolerances.

Eventually the work was completed and gages were passed by the inspection department as having been made within the required tolerance. Now the question is, whether a tolerance of 0.0001 in., that is, a limit of 0.00005 in., is unreasonable for work of this character? The attitude of the majority of gagemakers seems to indicate that it is; but on the other hand, should not a reference or master-thread gage be made as nearly correct as possible? It has been proven that the gages could be made to the specified limits, and although the cost of making was high, it was by no means prohibitive.

If these gages were to have been used as working gages, the matter would have been very different, but as it was a case of establishing a set of standard, master-thread gages the writer believes that the limits called for were justified.

Core Work at the Nash Foundry

By M. E. Hoag

The small cores used in motor-castings for the Nash Motors Co., Kenosha, Wis., are made by women and girls, as they have been found equal to men both in production and in the facility with which they handle small and delicate work.

A general view of the end of one of the core rooms is shown in Fig. 1. The core sand is mixed and carried by overhead trolley to the storage hoppers shown at *A*. The chutes which conduct the sand from the hoppers to the work benches may be raised out of the way when not in use, and are sufficiently mobile to permit the sand being discharged at any place on the bench.

As fast as the cores are completed they are placed on shelves in the steel cars—one of which is shown partly loaded at *B*—and are allowed to air-dry for a short time before going into the oil-fired ovens shown at the right.

After proper baking, the cars are passed on through the ovens and out to the storage racks on the foundry side as shown in Fig. 2. The oil burners are located in pits, one of which is seen at *A*.

As stated before, the casting of a six-cylinder engine requires some very intricate and complicated cores. The complete set of cores for the cylinders of one of these engines is shown in Fig. 3, and comprises upward of 40 separate parts. The cores for the cylinders themselves, as shown in Fig. 4, are made in halves, each half being made up of numerous separate parts, a few of which are shown in Fig. 5.

While the cylinder cores are complicated they are comparatively heavy, and do not require delicate parts as do the cores for the cylinder heads which are shown in Fig. 6. These cores contain almost as many separate parts as those for the cylinder. A few of these parts partly assembled are shown in Fig. 7.

Fig. 1 General View of Core Room and Ovens

Fig. 2 General View of Ovens and Core Storage Racks

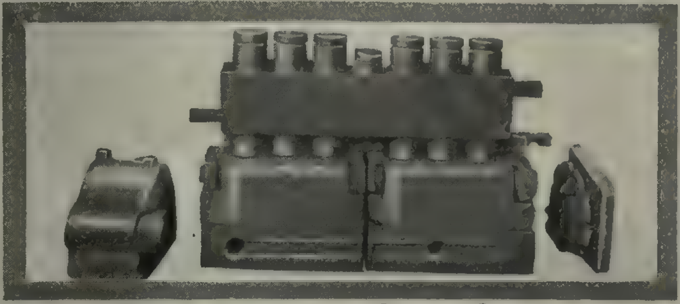


Fig. 3 Complete Cores for a Six-Cylinder Engine

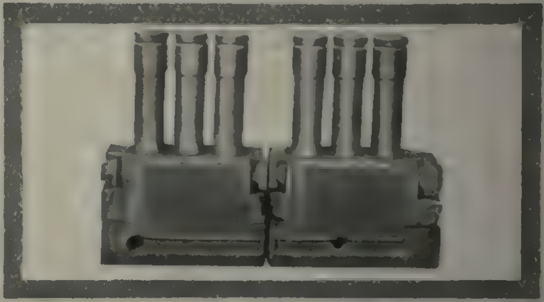


Fig. 4 Cores for the Cylinders

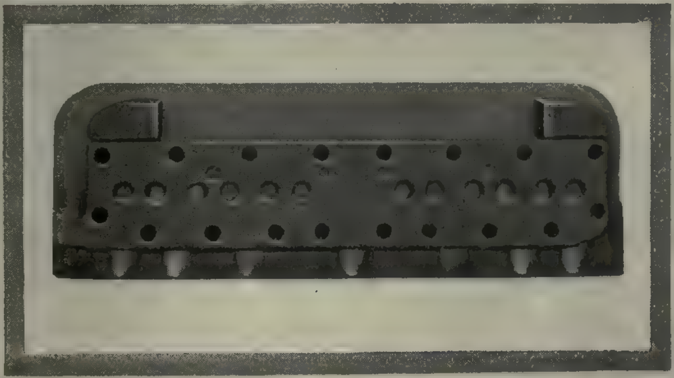


Fig. 6 Cores for Cylinder Head

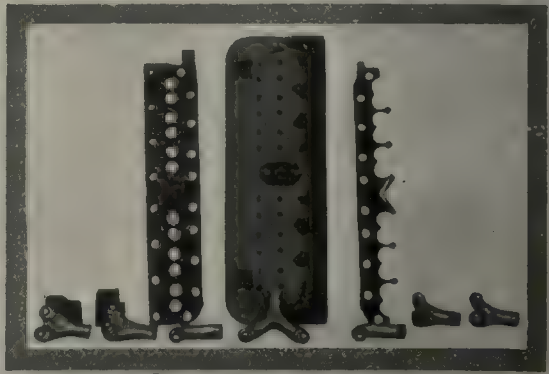


Fig. 7 Some Component Parts of Cylinder Head Cores

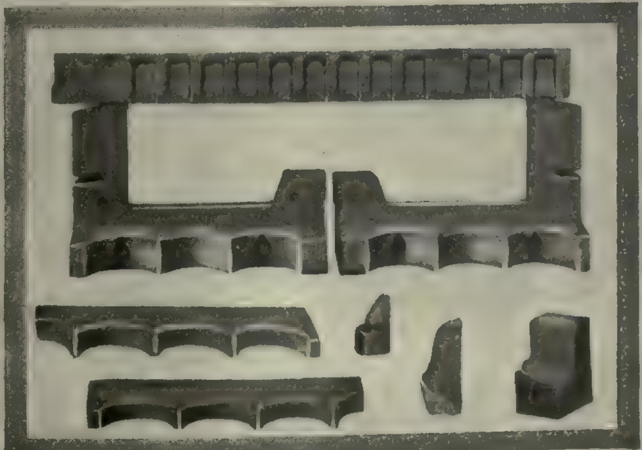


Fig. 5 Some of the Cylinder Core Parts

Fig. 8 Grinding or Reclaiming Plant for Sand

In this foundry the heats are run late in the day, and after the molders have left a crew of men break out the castings, take them to the snagging and sand blast departments and clean up, putting everything in shape for the molders on their return to work the next day.

The molding sand is passed through the reclaiming plant shown in Fig. 8, and after treatment is stored in overhead bins from which it is carried to various parts of the molding floors by trolley.

The Small Shop and Government Work

By Donald A. Baker

It's not a pleasant task to have to criticize the work of others, for all of us to a great or less extent live in glass houses. However, in a matter of public interest which involves the expenditure of hundreds of millions of dollars to which sum we shall all have to contribute our share, I feel that the following statements of facts should be made public and an effort made to correct the conditions to be mentioned.

The condition which I wish to bring to the attention of the people is the lack of appreciation on the part of the Government of the necessity for keeping its credit good with the thousand and one small concerns with which it is today doing business. And especially is this true of its dealings with small machine and tool shops, most of which are being run on a very slight margin of capital and can not well afford small losses or delays in payments agreed upon. As a matter of fact the present method of withholding payments for an indefinite length of time, anywhere from one to several months, puts it up to the small shop actually to finance the Government for whatever length of time the payments are withheld, and this often compels the small shop-owner to borrow money with which to carry on his business; money for which he is obliged to pay an interest that eats up all the profit he might otherwise have made from the Government work.

That this is very poor policy on the part of the Government and one which has a boomerang effect, is well illustrated by the following instances which I know to be a fact: Last April one of the Government supply depots ordered certain materials from a small shop in New York and agreed to pay for it on a 30-day net basis. These goods were got out promptly according to promise, and delivered sometime in the month following, but up to the present, six months later, though the bills have been O.K.'d and the goods put to use, all efforts to collect the money due on them have failed and no adequate excuse for failure to pay has so far been given.

Another Case

A little later another branch of the Government service, in this case the Brooklyn Navy Yard, asked to have some work done and agreed to settle for it within two days after delivery. This work was delivered over two weeks ago and the bill sent with it. A little later a telephone conversation with the party who had ordered the goods confirmed the fact that they had been received all right and that they were entirely satisfactory, but no money was forthcoming. This morning I was invited by the small shop-owner to listen to a second telephone conversation with the same official; all that he was able to tell us was that he had properly O.K.'d the bills and that they had gone to the office and were there being held up for some reason that he was unable to explain.

All this may not seem to be such a serious matter to the outsider, but read here the result which will show the evil effect of this policy: This particular shop has been asked to bid on thousands of dollars worth of Government work, but because they are unable to finance work of this kind and wait for their money over a long and uncertain period of time, they are either refusing to make bids on the work or are intentionally making their bids so high as to be exorbitant in the hope that the bids will be refused.

A Concrete Example

As a concrete example of what this means I quote the following as an actual instance which goes clearly to show how money is being thrown away: The little shop I speak of was asked to bid on six hundred small bronze bushings. Their bid, intentionally high, was 55c. apiece. This bid was at the time turned down, but later they were again asked to bid on these same bushings, only the second time the number wanted was a thousand. Not caring to be bothered with the job a bid of $1 apiece, about four times what they were worth was made, and strange to say was accepted by the navy department which ordered them.

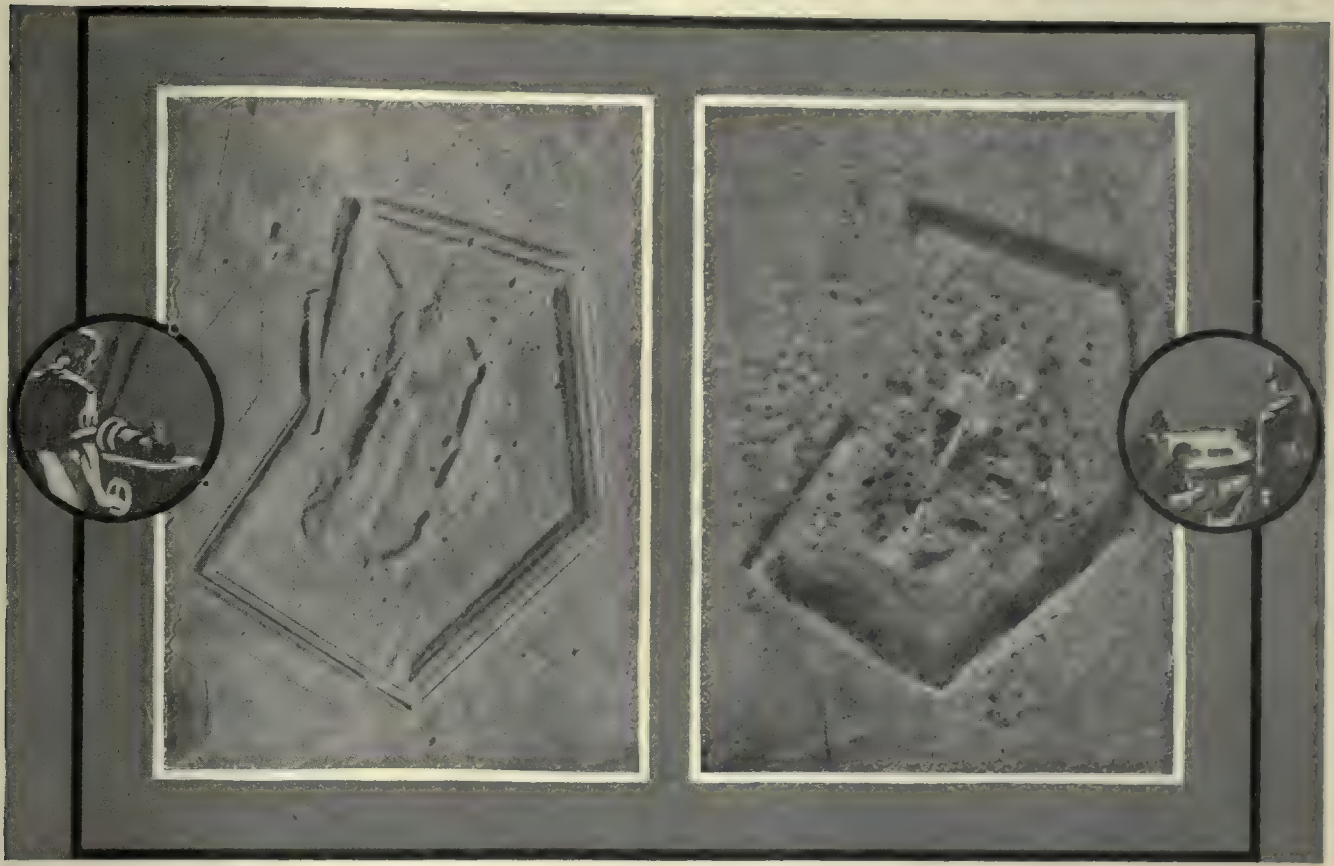
These are only a few instances which have come to my personal attention and of which I have had the facts presented to me in such a way as to warrant acceptance; and my contact with the trade makes clear the fact, that the average small shop today wants little or nothing to do with work connected with the Government where the Government is responsible for payment. Responsible parties who are willing to take their chances of payment from the Government are able to handle and sublet Government contracts at a profit, as they are able to get much lower bids than the Government.

Question of Inspection

Another thing that it might be well to mention is the fear, by the small shop, of Government inspection of their work by incompetent inspectors who demand that work which is shown by the drawings to be of a rough nature, must be held to closer dimensions than those given; this means that jigs and fixtures, after being delivered to the Government, are held by them for indefinite periods, and at the same time payment for them is held up, until eventually they are returned and have to be gone all over and remade better than the use to which they are put, warrants. Then a second inspection and another delay of the money which has been doubly earned.

To sum up, it seems to me that now more than at any other time, the Government should realize the necessity of prompt payments; that it is in an open market, in competition with others who are not only meeting their debts promptly, but who are advancing money for the work which they wish in a hurry and also are giving bonuses for its prompt delivery! It is quite certain that only by so doing will the Government get equal treatment and consideration.

What the Machinist Did to Fort Douaumont



AT THE left is shown the German trenches and fortification of Fort Douaumont, previous to the bombardment by the French. At the right is shown the result, after the artillery had prepared the way for the infantry attack of Oct. 21, 1916. By carefully following the trench lines of the first picture, and then going over the same locations in the second picture, the deadly accuracy of the shell placing will be easily discerned. Well defined lines of shell holes where the trenches formerly existed are seen. When it is remembered that the guns throwing these shells were miles back of the French lines, and that the gunners never saw their targets, the importance of the gun mechanism will be seen. Our hats are off to the French gunners, but also to the machinist back of it all, without whose careful and accurate finishing of the fuses, shells, guns, carriages, sights, and hundreds of other mechanical parts, the best gunners that ever lived would be helpless.

It is a good point for each machinist to keep in mind that each hole drilled and each piece turned, if so done as to pass inspection without waste, speeds the demolition of our enemy's fortifications and reduces the life cost of their taking.

Locating Small Holes Accurately in Die Work

BY HUGO F. PUSEP

One of the difficult problems for the diemaker to solve is that of accurately locating holes of very small diameter, such as are often met with in small die work in model making. It frequently happens that several holes have to be located in a progressive or a piercing die. If the center distances of those holes may vary only 0.001 in. or less, it looks quite a problem sometimes, and more especially when the button method is out of the question on account of the button screw being larger than the diameter of the holes to be bored.

By the method here described, it is possible to locate such holes very accurately and also more quickly than by any other way that I have tried for this class of work, except, of course, with a special vernier-equipped die-boring machine. A good illustration of the principles involved can be had by following the various stages in the making of the progressive die blank for a clock-mechanism part, Fig. 1.

From this sketch it can be seen that a tolerance of only 0.0005 in. either way is allowed for the center distances of all three holes. The circular rack *A* is rough blanked in the same die, sufficient stock being left for a finish-shaving operation in another die.

The layout of the first die is given in Fig. 2. The blank, which is of No. 19 gage (0.0437-in.) cold-rolled steel, does not have to be held to close limits, with the exception of the circular back part. As this is finished in a later operation, spacing the three holes with sufficient accuracy comprises the real problem in this case.

The die opening *A*, Fig. 2, is worked out to a model,

and the $\frac{7}{16}$-in. holes *B*, *C* are bored part way through the die blank, the clearance holes being large enough for the full passage of slugs.

Two pieces of drill rod $\frac{7}{16}$ in. in diameter by $\frac{7}{16}$ in. long are next driven into these holes, and two $\frac{1}{8}$-in. holes are drilled and reamed halfway into the die blank and the drill-rod plugs, as at *F*. The plugs are next removed, and the die blank, with the finished die opening *A*, is hardened. After hardening, this die opening is honed and retouched to fit the model. The drill-rod plugs, together with $\frac{1}{8}$-in. dowel pins in holes *F*, are driven in, and the die blank is ground parallel on both faces. Also, the edges *G* and *H* are ground square, the edge *H* being parallel to the center line of the three holes. Grinding the edges *G* and *H* facilitates locating the button and the drill plate while the die blank is resting on those edges on the surface plate, as will be shown later.

Next the plug in the hole *C* is drilled and tapped for the button screw, and the button is set to the correct location by the usual method, using an indicator in the height gage and taking the necessary measurements from points of the finished die opening. The button thus secured is trued up, and the 0.2197-in. hole is bored out in the lathe. For the two 0.051-in. diameter holes the following method is employed: A piece of $\frac{3}{16}$-in. flat cold-rolled steel is drilled so that a 0.051-in. rod is a good sliding fit in the hole, after which the cold-rolled steel plate is cyanided.

Work on the Insert

Fig. 3 shows the successive steps in locating and drilling the two 0.051-in. holes in the inserted drill-rod plug in the die blank. With a 0.051-in. plug *A*, Fig. 3, in the drilled hole of the cyanided plate *B*, and a plug *C*, consisting of two diameters—namely, 0.2197 in. and 0.051 in.—concentric with each other (a good fit in the previously bored hole of the die), locating the plug *A* correctly for one of the small holes is but a matter of measuring with micrometers and the height gage from plug to plug, testing with the height gage as shown.

After the plug *A* with the plate *B* has been tapped into place, the plug *A* is removed and the die blank, with the drill plate held securely with clamps, is taken to a drilling machine. At *E*, Fig. 3, is shown the die blank resting on parallels on the table of the drilling machine, preparatory to drilling the 0.051-in. hole. It might be said that the hole is first spotted through the drill plate with a 0.051-in. drill, then drilled right through with a drill a few thousandths less in diameter and finally reamed with a 0.051-in. twist drill, which has the corners rounded so as to produce a smooth hole. The drill plate is next removed and the remaining hole treated identically.

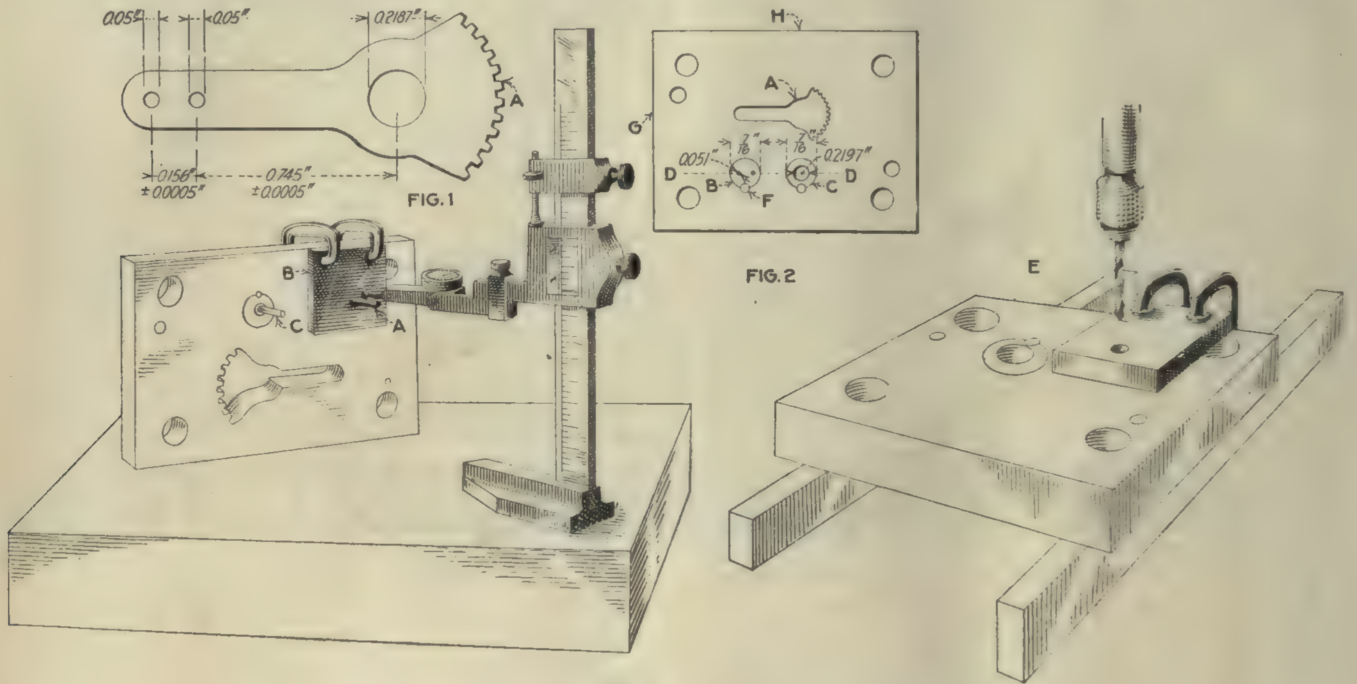


FIG. 3

FIGS. 1 TO 3. LOCATING SMALL HOLES ACCURATELY

Fig. 1—The work. Fig. 2—The die. Fig. 3—Method of locating for boring

All three holes are now taper reamed from the back for clearance; both $\frac{7}{16}$-in. drill-rod plugs are removed from the die blank and hardened, after which they are again pressed back in their respective holes, the $\frac{1}{8}$-in. dowels lining them up to positions they occupied while being drilled and bored. A slight finishing cut is taken over the die face in the surface grinder, thus completing the die blank. The punch holder plate for this die is drilled by the same method; and the blanks, when they come from this punch and die, are well within the limits specified. In cases where one of these drill plates is to be used frequently, it is a good policy to make them out of hardened tool steel; a piece of ground tool-steel stock does nicely for this purpose.

The method just described is a very valuable one in shops where the equipment is not of the best, but where the quality of work turned out is expected to be first class. When the diemaker knows all these "tricks of the trade," he need not get discouraged when confronted with a job of this description.

Reducing Labor Turnover in Our Shops

BY FRED H. COLVIN

With the greatly increasing need for economy in both time and material the question of labor turnover becomes more and more serious. Some of the different phases of the question are here discussed.

THE problem of rapid and economical production has changed greatly, and just as this nation has grown away from its isolation and is now a part of the world family, so the question of shop management has gone far beyond the walls of the shop, to which it was formerly confined.

This is being recognized by many progressive business men, and the old idea that there was a distinct line between the shop and the living conditions of the men who worked there, is being greatly changed. The manning of shops, the difficulty of securing and of keeping men, the cost of constant change both in delay to output and in wear and tear on machinery, all have tended to force consideration of the larger aspects of the case.

It is needless to enumerate the disadvantages of labor turnover as every shop manager knows them full well, at least so far as his shop is concerned. The effect on the housing conditions of a city and on the transportation, both by railway and trolley, is not so often considered. The means of avoiding difficulties as much as possible, are well worth careful study, and generally speaking this is fully as much a study for psychologist as for a shop manager.

A little contemplation of the case, however, shows very clearly how matters outside the shop affect not only the length of time a man will stay but the kind of men who can be had, assuming, of course, that work is sufficiently plentiful for men to have some voice in the matter. A self-respecting man will not bring his family into a town or a neighborhood which does not provide decent housing, good schools, churches and amusements. Or if he does, he will not remain any longer than is necessary.

The Housing Problem

The housing problem is one of the most serious which confronts the promoters of some of the new huge enterprises, such as the shipbuilding and other immense programs. In this case it is the lack of homes.

The quality of the homes has a direct bearing on the amount and quality of the labor which can be secured. This fact ties up the successful shop or the successful community very closely to the necessity of taking an active interest in a question which was formerly considered as entirely outside of the manufacturing field.

In this way, what we formerly termed welfare work and looked upon as a fad for philanthropically inclined men and women, becomes very closely connected with the shop; and while the fatness of the pay envelope still, and probably always will, hold a prominent place in the drawing attractions of a plant, the question of the housing and other social conditions are becoming more important factors every day.

One phase of this problem is to be found in the old factory tenement of the New England mill towns. Some few were well kept but for the most part they were dilapidated affairs, with positive ugliness sticking out all over them. They were, however, much more elaborate as a rule than the company houses built for miners, and they were much more comfortable, as many of the latter were simply board shacks which would not have been tolerable except where coal could be had almost for the asking.

The company house, like the company store is always under the suspicion of the employee, especially where he is compelled to use either; while if the company gives greater value for the money than can be obtained from private owners of houses or stores, there is objection raised on the other side. The company store, or its later development, coöperative buying through the aid of the company's business organization, is however much more likely to remain a fixture than the company house or tenement, and even this is likely to give way to community coöperation, as is shown by action taken in a number of large cities. Readjustment is made necessary by the fact that small concerns cannot afford to invest the necessary capital either in houses or stores, and are consequently placed at a great disadvantage in securing the workers for their shops; there are other factors to consider, such as the inevitable flotation of labor from one plant to another—due to lack of work in some trade or to the natural desire for change of occupation, or friction of temperament and similar causes. All of these make the question of employment a community problem as well as a problem for each individual shop.

This is being recognized by such bodies as the Cleveland Board of Trade and like associations of business men. They realize that this is not a problem either for philanthropy or charity, but is distinctly a business problem as never before. Such a body, under the guidance of properly educated and trained people, can accomplish far more than individual employers, and it removes the whole undertaking from the category of personal or individually selfish interests.

Americanizing the Alien

While the housing problem is of great importance in connection with labor turnover, there is still another which cannot be overlooked without grave danger for both present and future. This is the problem of the Americanization of foreign-born workers within our gates; and it means far more than the mere securing of naturalization papers, which in some quarters, is all too easily accomplished. It means the instilling of American ideas and ideals into minds which have been trained in entirely different ways.

These things imply much more than a mere teaching of the language and the customs of the country; they imply more than learning to repeat the constitution or any set formula, or to salute the flag with appropriate

action and words! And before we can expect a man or woman to be throughly loyal to his or her adopted country, we must see that they have something to be loyal to: That it represents to them what it does, or should represent to us.

We have done much to eliminate the grafting and thieving which formerly beset the immigrant on every hand from the moment he landed until he became accustomed to the ways of the country and of those whom we permitted to prey upon him. The worst of this wrong has gone, but enough still remains to cause a perfectly just resentment in too many cases.

Better Offices and Officials Needed

One of the first things to be done is to raise the cone of the naturalization offices and the tone of the officials with whom the alien must deal. Few of us who have not had occasion to go to these offices, realize what dingy and unimpressive places they are. Tucked away in old buildings on a side street, with dirty stairs and smelly atmosphere, they are not calculated to impress an immigrant with the glory or greatness of this republic with which he has cast his lot.

Then he is too often met by surly officials, themselves foreigners imbued with their own importance in many cases, who treat the new-comer as they would cattle. Names are called with a foreign accent and the applicant jeered at or thrust aside if he does not understand at once. The spirit of kindliness is entirely lacking, and this is a place where it would not only be most welcome but would add appreciably to the immigrant's respect for the new country.

First impressions remain with us for years and many an immigrant has been embittered by his treatment in little things; so much so as to require years to make him really get the true spirit of the country. Particular care should be taken in the selection of the men and women who deal with the foreigner, and careful attention also should be paid to the location, furnishings and general conduct of the offices in which they are handled. Elaborateness is unnecessary and out of place. But simple, clean and wholesome surroundings, together with kindly and sympathetic treatment, will go a long way toward securing the respect and loyalty which is needed always.

A Square Deal Makes for Loyalty

This fair treatment must extend beyond the official, however, and into every dealing with the immigrant. The employer must not take advantage of his ignorance of the ways of the country, but give him a square deal. The loyalty which just and kindly treatment engenders will well repay the effort in nearly every case, even without the additional satisfaction of knowing we have done the right thing. We must not forget that men look upon employers as a class by themselves and judge the whole class by the treatment they receive from their particular employer; thus one unfair employer can cause much disturbance in a city where the majority are giving fair treatment, and thus it becomes to the interest of the rest to see that the black sheep is brought within the fold.

It must not be imagined, however, that all the unfair treatment comes from the employer. In too many cases the men in the shop, either individually or as a group, band together to make it unpleasant for the outsider, entirely forgetting the spirit of brotherhood of which they often talk very fluently. In some cases this is due to a much mistaken notion of Americanism, and in others it is due to the foreigner being hired at less than the regular wage, which in turn gets back to the employer. All lines of race prejudice should be eliminated, and each man treated for what he is or what he is willing to become, without regard to what particular spot in this wide world he happened to be born. Who of us has any choice in this matter?

One of the very important factors in Americanization is the teaching of the language of the country; it also adds to the safety of the workers in the shop and to the output as well, since in many cases both accident and delay frequently come from misunderstandings.

Teaching the Language

This teaching of the language is also a community problem, although many employers, such as Henry Ford, provide special schools for this purpose; but it is necessary to teach the women of the family, as they play a large part in the work of Americanization, and this places it entirely beyond the problem of the individual shop, except, of course, in communities like Plymouth, Mass., where the Cordage Company is the only great manufacturing industry in the town.

Cleveland is trying the experiment of using its public schools as community centers with this in mind, and is centering various activities in these schools for this purpose. These activities include coöperative marketing and other features of direct interest to the women of the household, and all of the conversation and instruction are given in English. When desired, instructors in household economies and in the cooking of various products which are new to the foreigner, visit the homes, and in this way is established a bond of sympathy and confidence with the housewife, at the same time instructing her little by little in the use of the English language. There can be no question as to work of this kind having its lasting effect on the minds of the newcomer, of its increasing his respect for and loyalty to the country; and it all makes for greater security and greater prosperity in days to come.

Just as our ideas regarding housing and schooling as a direct factor in running our shops, have changed materially in the past few years, so must many of our other ideas give way to newer, and we hope better methods of running the shops, for housing and schooling are but part of the factors which enter into the question of labor turnover.

The question of hours and sanitary, lighting and safety conditions in the shop, also plays its part, and at this particular time, when the country needs the greatest production possible, we must consider our shops as part of the great national supply system, whose first duty is to turn out its maximum product regardless of any notions of our own as to just how it shall be done. We must sink any former prejudices as to the number of hours, the payment of overtime and other details, just as the employee must make his union a secondary matter at this time. Nothing must interfere with the production of needed munitions and supplies.

When a shop finds its labor turnover is larger than in other shops in the same locality it is time to begin

to look around for the reason, and the shop which can prevent this large turnover, which affects not only that shop but the whole industry and its output, has a great accomplishment to its credit.

Some of the attractions, aside from the questions of housing and schooling, are shorter hours, bonus or dividends, group-insurance policies for all employees, health insurance, assistance in buying homes or Liberty Bonds or both, and other inducements which, while not gifts, are a reward for earnest work and attention to the business of the company. And there can be no better time than the present to inaugurate any changes which may seem desirable. It is an opportunity for both sides to get together in some equitable sort of a compromise which shall make for greater production and better feeling between the employer and the employed.

Why Force Us To Speak a Foreign Language?

By S. Lambercier

S. Lambercier & Co., Geneva, Switzerland

In the *American ~~Machinist~~*, page 330, Vol. 47, we read the following article: "Why Force Us To Speak a Foreign Language?" by J. P. Brophy, with an illustration of Uncle Sam suited to the text.

Since there has been a question of introducing the metric system into the United States, and applying it to industrial and commercial purposes, we have noticed in the papers a strong campaign against this "importation: innovation"—yet long ago the machinists of America adopted the division of an inch into thousands which are submultiples of the decimal system, base of the metric system!

We have before our eyes the pamphlet issued by Brown & Sharpe Manufacturing Co., and called the micrometers' story. We have found in this pamphlet an illustration of a sheet-metal gage, made in America in 1867, whose divisions are in thousandths. This gage is the forerunner of micrometers which we think have had graduations in thousandths ever since they were made, and nobody has ever demanded that instead of a division into thousandths of an inch, another division should be adopted—for example the twelfth or sixty-fourth of an inch, etc. Practical examples of the advantages of division based on the decimal system are recognized by all mechanics who use micrometer gages whose inch graduation is in thousandths. The division of a dollar into a hundred cents is another example of the application of the decimal system in the United States, and every American traveling in old-fashioned England cannot help finding difficulties (all respect due to an ally) in the division of a pound sterling into 20 shillings, and that a shilling should make 12 pence, and that a newspaper boy should sell a paper for a half-penny.

The generalization of what in specific cases is an accomplished fact, can be attained with small effort; and there is nothing that effort can achieve, which cannot be achieved by the American people.

Among the worst difficulties created for American manufacturers by the introduction of the metric system is that of having to translate all their drawings with the inch and foot measures, into millimeter measures; and as it has been said that few of the leading men in manufacturing concerns understand sufficiently the metric system to supervise this kind of work, many of them would be greatly puzzled.

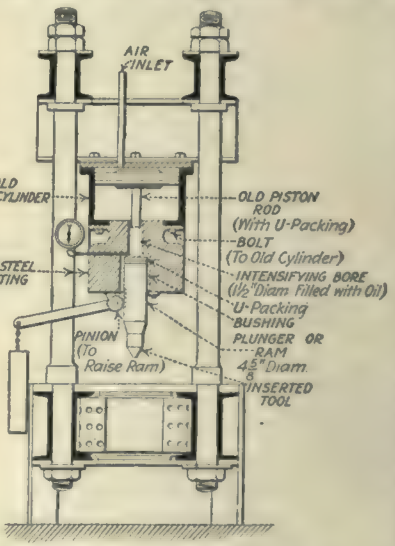
Another objection against an introduction of the metric system is claimed to be the cost of translation of all drawings, and eventually the re-building of jigs, gages, tooling equipments, etc.; but as a very great part of the products manufactured in the United States are sold abroad, it is the foreign customer who finally would bear the costs involved, since naturally the American manufacturers would take note of these expenses in establishing their net costs and consequently their selling prices.

Utilizing an Old Cylinder in Making a Press

By Norman V. Christensen

An old cylinder 18 in. in diameter with a stroke of 6 in. was utilized in the following manner: A new casting, having two bores and the same bolt circle as the old cylinder, was attached to the lower part in place of the old head. The piston rod of the old cylinder was cut to correct length and fitted with special U-packing, steel rings, etc. This rod worked into the upper bore of the attached casting, which was known as the intensifying bore.

Below this intensifying bore was a second bore, in which the bar straightening ram, $4\frac{5}{8}$ in. in diameter, worked. Both bores have one continuous bushing. The smaller or intensifying bore is filled with oil. At 80-lb. pressure per sq.in. in the old cylinder the pressure of the piston rod working on the oil in the intensifying bore is 20,357 lb. This bore being $1\frac{1}{2}$ in. in diameter has an area of 1.767 sq. in., making the pressure per sq.in. 11,521 lb., whereas only 80 lb. existed in the old cylinder. Then the oil at a pressure of 11,521 lb. per sq.in. acts on the plunger in the $4\frac{5}{8}$-in. bore, which has an area of 16.8 sq.in., making the final pressure on the work to be done a total of 193,553 lb., or 96.7 tons.



UTILIZING AN OLD CYLINDER

A limited stroke results, but in this press as much as $\frac{3}{4}$ in. is possible, and in the case of straightening axles and bars, blocking up can be resorted to if necessary.

To ascertain what pressure is being applied a $\frac{3}{8}$-in. diameter hole is drilled horizontally through the casting into the intensifying bore just at a point above the plunger bore, and pipe, gage, etc., attached.

Undercutting Tool and Gage for Shells

By Owen W. Pullan

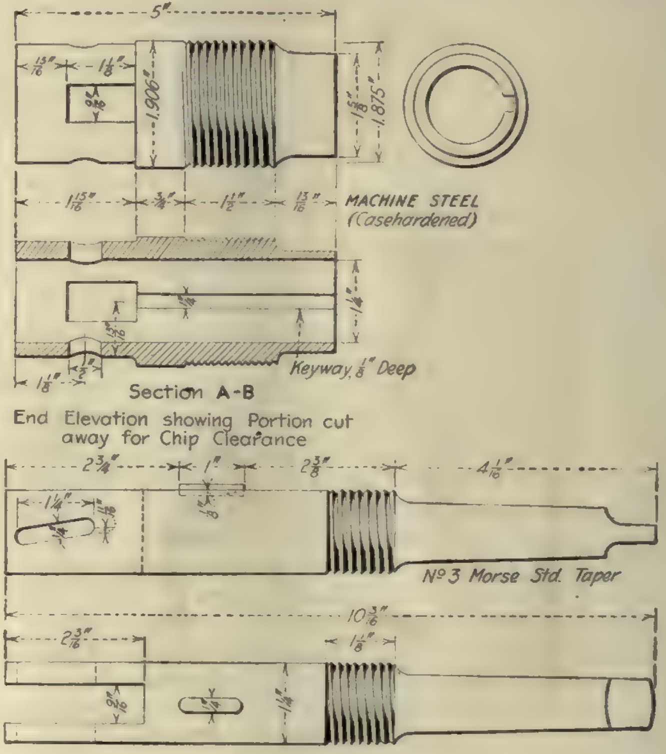
The tool shown was designed in order to perform the operation of undercutting the nose thread of the 18-pounder British high-explosive shell on a 20-in. Barnes drilling machine, this being the only machine available in the shop at that time.

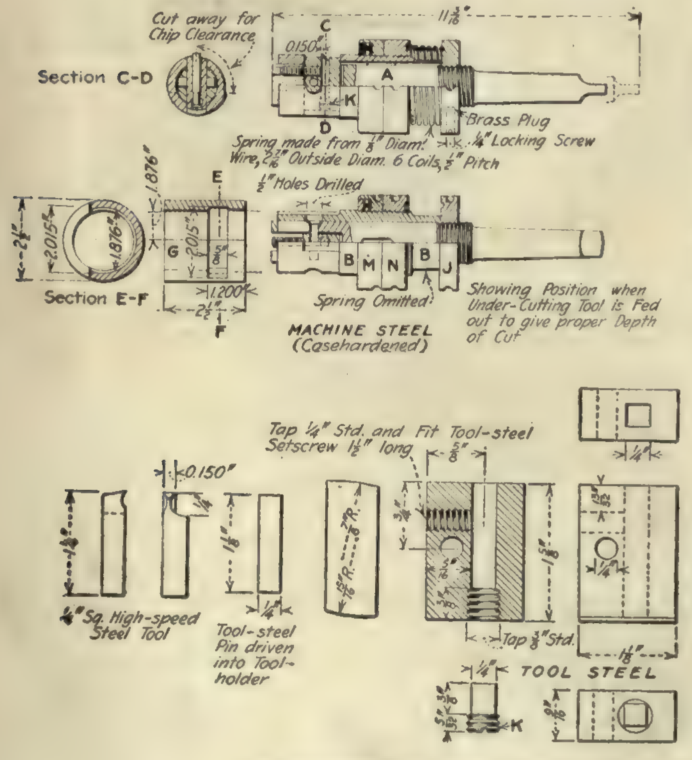
The features kept in mind when this tool was designed were: (1) That the tool was to be fed out positively to the proper depth and also that the undercut must be the proper distance from the end of the shell's nose; (2) that the cutting tools could be readily adjusted both to give proper depth of undercut and distance from the end of the nose of the shell; (3) that the cutting tools should be simple, easy to make and cheap, this last being an important point with high-speed steel at the present price.

With such a tool any small drilling machine can be utilized to perform the above-mentioned operation, thus giving opportunity to use the lathes, especially in a small shop, for other operations.

As will be noticed from examining the general assembly drawing, the center driving spindle *A* is made to fit the drilling-machine spindle and also to slide through the sleeve *B*, driving this sleeve by means of the key shown. The angular slots cut in the lower end of the driving spindle straddle the tool-steel pin, which is driven into the toolholder, thus giving the feed and return motions respectively to the cutting tool.

The gage *G* is a hollow cylinder bored to fit the lower end of the sleeve *B*, which enters the nose of the shell. It has a recess cut to correspond to the proper depth





UNDERCUTTING TOOL AND GAGE FOR 18-POUND HIGH-EXPLOSIVE SHELLS

of the undercut. The lower shoulder of the recess is the proper distance from the top end of the gage and corresponds to the distance from the end of the nose to the lower edge of the undercut. An opening is cut in the side of this gage, shown on the drawing, to enable one to see when the tool is set correctly.

To set the tool, first adjust the collar *J* so that the top of the sleeve *B* will strike it before the upper end of the angular slots strikes the tool-steel pin. This will avoid any undue strains being placed on the pin when the tool is fed to the proper depth, by reason of *J* acting as a stop. Place the gage over the end of the sleeve *B;* slide *B* up the spindle *A* against the action of the spring, until the stop collar *J* is reached. Adjust the tool by means of the adjusting screw *K* until the cutting edge touches the bottom of the recess marked 2.015-in. diameter. Also adjust the set collars *M* and *N* so that with the gage in the above position, the lower edge of the cutting tool will touch the lower shoulder of the recess.

The shells are held in a cast-iron vise, made with a hinge cap or jaw. When the shell is in position in the vise, it is filled with cutting compound. Then the lower end of the sleeve is dropped into the nose of the shell until the ball thrust washer inserted in *M* rests on the nose of the shell. The hand feed gear is then thrown into gear and the spindle gradually fed down until the stop collar resists any further downward movement. The hand feed gear is next thrown out and the tool withdrawn from the shell by quick return motion. An output of 60 per hour can easily be obtained.

This tool was made in a small shop. As will be noticed from the drawing, it shows certain parts casehardened, but not ground. The reason for this is that grinding facilities were at a premium. If a really first-class job was required, these parts could be ground to size after hardening. However, with a little care in hardening, a very satisfactory job can be made, as was proved by the excellent service this tool gave.

A tool designed on similar principles could be made to work in the turret lathe, not only on shells, but on various articles that need recesses cut in them.

Spherical Turning Work

By George MacKean

In Fig. 1 is shown a low-pressure air compressor piston for which it was necessary to devise some rapid as well as accurate means of turning the spherical surface *A*. Fig. 2 shows the rigging used with excellent results. The work, illustrated in dotted lines, is placed on the cast-iron centering block *F*, which has a hardened steel-center bushing *G*, and fits snugly to the 6¾ in. inside diameter of the piston. On the other end is clamped a lathe dog *E*, driven by the faceplate, and the work is ready to put on the lathe.

B is a machinery steel plate about 3 in. wide and 1¼ in. thick, fastened securely to the bed of the lathe with 1-in. capscrews. The swivel link *C* is 1½ in. wide by ⅝ in. thick made from machinery steel and casehardened. This link is fastened to the strip *B*, and to the cross slide by means of two casehardened machinery steel studs *D*, allowing the link to swivel as the tool is fed in.

The tool is held in the toolholder on the cross slide, and the carriage is loose to allow free movement along the ways. As the cross-slide is fed in by the handwheel *H*, the link forces the carriage toward the head end and causes the tool to travel on the required radius. The center distance between the studs in the link *C*

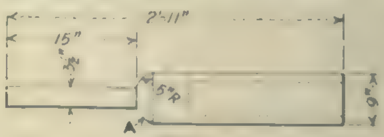


FIG. 1
Work

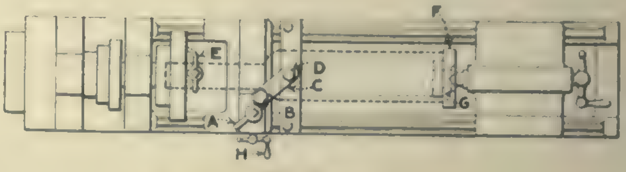


FIG. 2
Turning Fixture

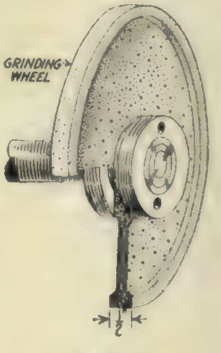
FIGS. 1 AND 2. THE WORK AND THE FIXTURE USED

is 5 in., the same as the radius on the finished piston and the center of the stud *D*, and is located directly under the center of the radius on the piston. This rigging is inexpensive and efficient, giving highly satisfactory results.

Grinding Snap Gages

By Herbert M. Darling

For a long time I have noticed that contributors to the *American Machinist* speak of reversing a saucer wheel in grinding the sides of snap gages. On page 472, Vol. 47, Mr. Valdes shows a quicker method, but I think the best way is to use what I call a "snap gage wheel," which is shown in the accompanying illustration. Of course, wheels that have been recessed on the sides by hand, have been used in some shops for years, but it is only recently that I have heard of a wheel-maker putting one on the market, and then in only one size, that is ½ in. face by 6 in. diameter. This is good for the average run of snap gage work, except in sizes of 5/16 in. or less. Worn wheels may be worked down to ¼ in. or even less on a pinch, but if this is done considerable care must be used to see that they are not handled roughly.



SNAP GAGE WHEEL

Chain-Link Bending Fixture

By Christian F. Meyer

In Fig. 1 is shown a wire chain link *A*, as well as several of these links hooked together to form a chain. These links and chains can be easily and speedily made with the fixture described herewith.

The links cannot accidentally unhook, and it is possible to unhook the last link only. Any other link will be prevented by the following link hanging in it. An examination of Fig. 1 will make this clear.

These links were formerly made by the use of two

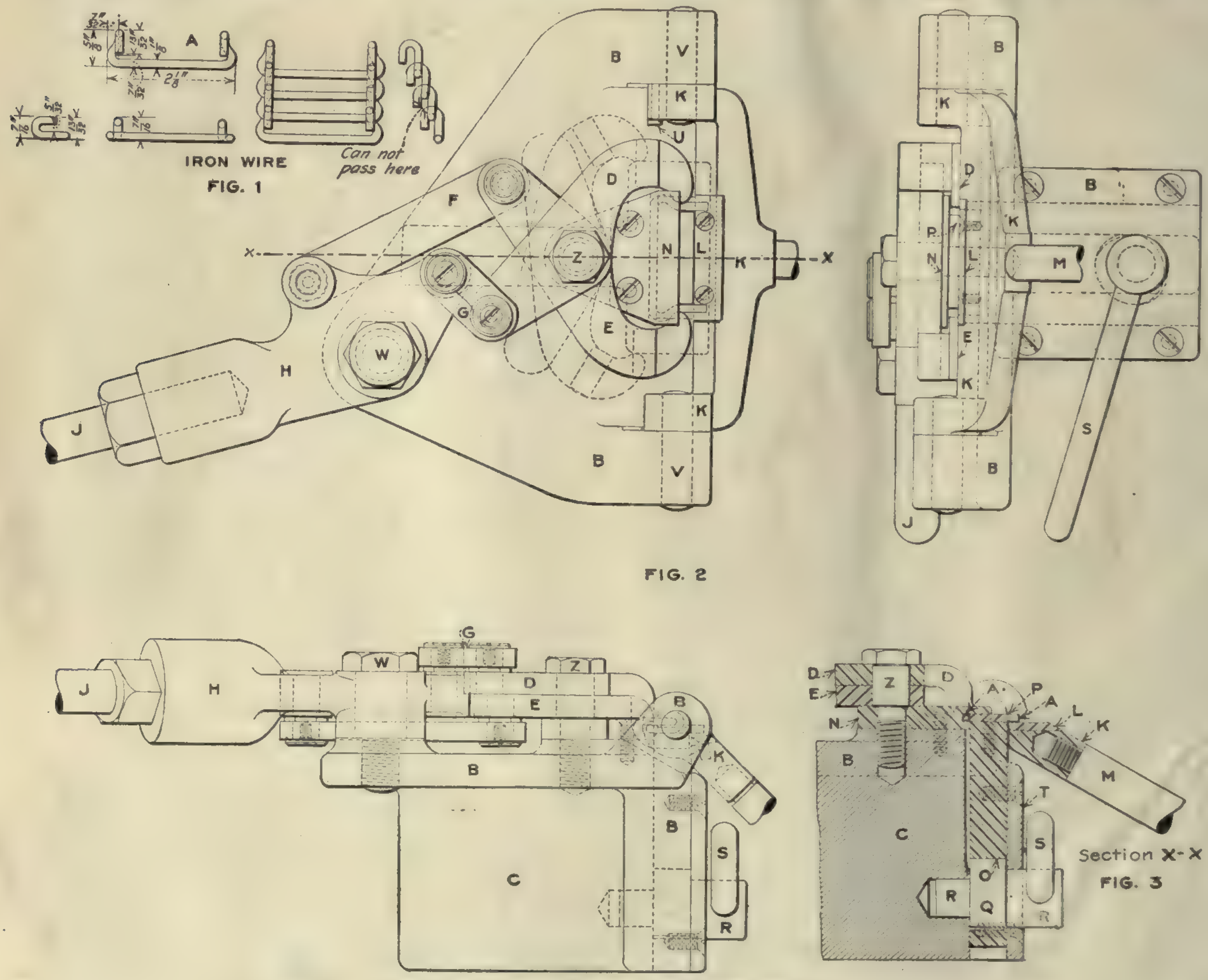
different fixtures, resulting in imperfect work. The new fixture, shown in Figs. 2 and 3, does accurate work three times as fast as by the old method. The cast-iron base *B* has two flanges at right angles to each other, connected and held together by a strong rib *C*, the latter serving to hold the fixture firmly in the vise jaws. Two strong steel arms *D* and *E* are held to a finished boss on top of *B* by means of a suitable bolt *Z*, around which they swing easily. The ends of *D* and *E* are secured to two steel connecting levers *G* and *F* respectively. These, in turn, are fastened to two short arms extending from the cast-iron lever *H*, which revolves about a suitable stud *W* and is operated by means of a round steel bar *J* screwed into it.

This arrangement of levers not only causes the hardened points of *D* and *E* to be at exactly the same distance from the center line *XX* in any position of the lever *H*, but also permits a considerable pressure to be exerted by these points when the lever *J* is operated.

The front flange of the fixture is provided with a finished, square groove into which fits a steel slide *O*. This slide is held in the groove by a cast-iron cover *T* fastened to *B* by four screws. The slide *O* can be forced up and down by an eccentric *Q* revolving about two journals *R* which fit into corresponding holes in the base *B* and the cover *T*. The journals and eccentric are revolved by means of the steel rod *S*, provided for that purpose. The upper surface of the slide *O* has a hardened tool-steel plate *P* fastened to it, which is shaped to give the desired form to the chain link, when the wire is pressed against it by the arms *D* and *E*. Another plate *N*, also of tool steel and hardened, is secured by screws to a corresponding boss on the base *B*. It is provided with a half-round groove to receive the wire for the links, and an extending tongue around which the two hooks of the link are bent. This tongue, or nose, also terminates the upward movement of the slide *O*.

Two cast-iron eyes, cast integral with the base *B*, as shown, are provided with suitable pins *V*. Around these pins swings the lever *K*, made of steel and provided with a handle *M*. The arrangement and shape of the lever *K* are clearly shown by the sketches. In the middle part of this strong lever is fastened a plate *L*, made of hardened tool steel, the purpose of which will be explained.

The fixture operates as follows: The wire for one link, previously cut to its proper length, is placed in the groove in the plate *N* in such a way that one side of it rests against the stop *U*, provided for that specific purpose. The slide *O*, which was down to allow the wire to be placed in position, is now moved upward,



FIGS. 1 TO 3. THE WORK AND THE FIXTURE

thus holding the wire securely in its place. The lever *H* is moved over, causing the arms *D* and *E*, which have been in the position indicated by the dotted lines, to press with their hardened points the extending ends of the wire *A* around and against the steel plate *P* of the lever *O*, thus giving the wire the proper shape. The slide *O* is worked out wide enough to clear the points of *D* and *E* sufficiently so as not to interfere with their work. The nose, or tongue, of the plate *N* and the top surface of the slide *O* prevent the wire from bending upward or downward during the bending operation, thus assuring a perfectly straight and square link. The outer ends of the bent wire now rest upon the plate *L* of the lever *K*. The lever *K* is laid over by its handle *M*, in this manner, bending the ends into the desired hook shape around the nose of the plate *N*, thus finishing the link.

The lever *K* is turned back and the slide *O* moved down, releasing the finished link, which may be easily slipped off the tongue of the plate *N*.

The fixture works quickly and accurately. It is simple and easy to handle and, at the same time, strong and durable. The chain produced by its use is serviceable for almost any purpose in its particular field and can be cheaply and conveniently made in any given size by the fixture described here.

Help Prevent Damage by Proper Packing

By W. D. Forbes

On page 915, Vol. 47, of the *American Machinist*, under the above heading, you called attention to a bulletin recently issued by the Pennsylvania Railroad Co. which in my opinion is open to some discussion.

The railroad has it in its own hands to prevent goods being too lightly packed. The freight agent has the power to decline to accept freight when offered to him if it is not properly packed, and this power he sometimes exercises. Why therefore should the Pennsylvania Railroad Co. ask its shipper to pack properly as a favor when they authorize a man to reject unsatisfactory packing? Improper packing, if it results in damage, is clearly the fault of the freight agent. Another thing in connection with shipping which has to me always seemed unjust, is the fact that if damage is done by the railroad it is the purchaser's and not the shipper's business to make the claim for damages. In contra-distinction to too light packing I wish to call attention to another phase of the question which is illustrated by the following: I ordered some articles, which are usually packed in a neat paper box measuring about 2 in. all around. The weight of the package was less than ½ lb., and to send it by parcel post would have cost 7c. It was only necessary to put a string around the box and tag it with the proper address, this would certainly have required not over two minutes—it was, however, sent to me packed with excelsior in a wooden box 8 x 6 x 4 in., the material being ⅞-in. white pine, it was put together with 14 wire nails about 1¾ in. long and the cover was put on with six screws. Further, it was shipped to me by express at a cost of 27c. It is of course possible that this box was on hand in the shipping room, but it did not appear ever to have been used, and it certainly could not have cost less to make than 16 to 20c. Again, I received an article weighing 9 lb., in a box made of ⅞-in. white pine which had in it over 30 nails so long that it was impossible to get the cover off even with a nail puller without taking considerable time and almost destroying the box. The article the box contained could not have been hurt in transportation save in the event of a railway accident. The express charges on this package were double what they would have been had it been merely wrapped.

In both cases it was an incomprehensible fact that I was not charged for packing. I have found in talking with friends, that my experience in these cases had a counterpart in their own; it would therefore seem that there is a serious lack of attention to the economical packing of small articles in many of our manufacturing houses. It may be considered a small matter, but in these days of keen competition, even small economies should be the rule. There is another aspect which is worth pondering over and that is the impression this waste makes on the customer; he surely can surmise that if such waste is shown by a firm in the shipping department, proportional waste is going on in other departments and that he is having to pay for it. At this time of year shipments are beginning to arrive in households where appilances for opening boxes are generally lacking, and this over-packing, is a serious annoyance to those receiving such packages. It is, of course, better to over-pack articles that may be damaged in transit than to under-pack, yet there seems to be a total lack of judgment on the part of packers in this regard, and it certainly behooves those who are responsible to give their attention to this matter and to see that better judgment is used by those in the packing room, with a view to causing less annoyance to the receiver of packages and affecting a saving to the shipper.

[It is impossible for any freight agent to see each individual package, much less to know if the packing has been properly done in all cases. In making claims for damages, the shipper is generally many miles away from destination of goods and therefore can not tell the amount of damage done unless goods are returned to him.—Editor.]

Drawing and Trimming Shallow Shells*

By William C. Winkelman

This article is written for my fellow craftsmen, who in many cases are expert tool and diemakers, but have never worked in a jewelry factory, where the principle of draw and pinch-off punch and dies is extensively employed in making settings, a few samples of which are shown in Fig. 1.

It is but a few years since I first saw this principle of diemaking used. I improved upon the design by making the draw punch separate, to facilitate sharpening the pinch-off punch, and even drew up shells much larger than it was thought possible to draw by this method. My only regret is that I had not known of this method before. It would have saved me many hours' work and worry, owing to the inevitable variation in the thickness of stock, which caused a corresponding variation in the height of the cup or shell.

For instance, I have in mind a steel shell or back for

a 34-line button, shown in Fig. 2, which I made with a double-action set of dies running at 150 r.p.m. The stock, which was ordered in coils sheared the proper width, varied in thickness throughout the coil. Naturally, it was impossible to maintain a uniform height, which caused considerable trouble and delay. With a punch and die of the pinch-off type, there would have been no trouble whatever.

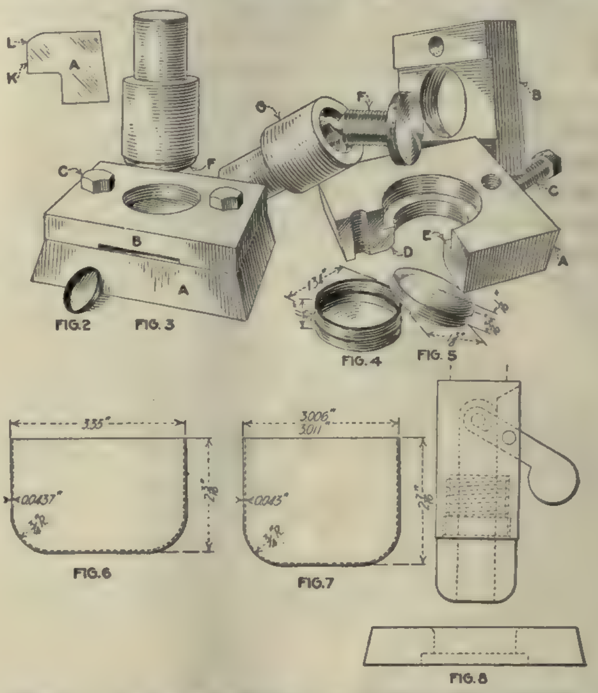
The following is a description of a punch and die used in making the box cover shown in Fig. 5. The stock was 0.014-in. low brass, dead soft, and the press was a No. 2 single action, run at 150 r.p.m. The one feature that I cannot dwell upon too strongly is the fact that, regardless of a slight variation in the thickness of the stock, the cups or shells will always be of uniform height, provided the tools are made correctly and the trimming punch is kept sharp. It is hardly necessary to say that it is always desirable to have the stock of uniform thickness throughout, and it should not vary more than 0.001 in. plus or minus from the size for which the dies are made. When the stock varies too much in thickness, it is natural to suppose that the stock will break and the cup be no good.

Referring to Fig. 3, *A* is the die; *B* is the stripper, held in place by capscrews *C*. It will be noticed that the drawing edge *D* of the die *A* is rounded. The exact amount can only be determined by trial, although a man accustomed to working on these dies can almost always get the correct radius the first time. There is one important point about this radius; that is, it should not run into the straight part of the draw die *A* at a tangent, but should run out as shown in the section at *K*, leaving an abrupt shoulder, as at *L*. This assists the pinch-off punch to trim the cup evenly. In making dies for shallow settings it is only necessary to break the edge with an oilstone. Another important point is that the die should be ground absolutely parallel without any clearance and that the stripping edge *E* of the

FIG. 1. SAMPLE SETTINGS

die must be sharp in order to strip the cup off the drawing punch *F*.

The pinch-off punch *G* is left large for grinding, and is drilled and tapped for some standard thread. The end of the punch is bored as shown. This is to permit regrinding on the face to sharpen, and also to act as a means of keeping the drawing punch *F* concentric with the blanking punch. This latter feature is not usual among jewelry toolmakers, who, so far as I know, make the punch of one piece. In this case, it is necessary, when sharpening is required to anneal the punch, true it up carefully in the lathe, turn back the pinch-off shoulder as well as the draw punch to the correct height and shape, and reharden, with the possibility of the punch going out of round. It would not be right for me to leave the impression that this



FIGS. 2 TO 8. EXAMPLES OF TOOLS AND WORK

Fig. 2—Back for a 34-line button. Fig. 3—Draw and pinch-off die. Fig. 4—Powder box. Fig. 5—Cover for a box. Figs. 6 and 7—Deep shells, first and second stages. Fig. 8—Knock-off for shell die

practice is not permissible or practical, as it is, under certain conditions—when the setting is too small to permit using the loose draw punch, or where so few pieces are wanted that it would not pay to go to the expense of making the improved type of punch.

It will be found necessary to shear the stock somewhat wider than in general practice for plain blanking, and this amount can be determined only by trial. The stripper should be milled with little more than enough room for the stock to pass. This will hold the stock flat and prevent wrinkling, to some extent. With the feed rolls tight and the dies made right, one will find this a very cheap and satisfactory way of making shallow shells.

This principle of draw and pinch-off tools can be advantageously applied to other work. Let us consider Fig. 4, which is the powder box for which the cover, Fig. 3, is made. This box is finished $\frac{11}{32}$ in. deep and crowned on the bottom the same as the cover. On a double-action cam-actuated press, the box is first drawn about $\frac{1}{32}$ in. larger in diameter than finish size. Then it is redrawn and pinched off to the proper height. A very satisfactory job results, requiring no further trimming if the punch is kept sharp. It had formerly been the practice to draw up to finish diameter and to saw off in a speed lathe, which was the cause of no end of trouble. The rib was afterward rolled in on a speed lathe.

This type of punch and die can very often be advantageously used in drawing and trimming steel shells for

automobile speedometers, etc. I will cite the following case: Fig. 6 shows a cup made of 0.0437-in. sheet steel, drawn up on a Bliss cam-actuated cut-and-draw press and then redrawn to the dimensions shown. After annealing, it had been the practice to turn or face off in a drilling machine, the cup being held in a vise with special jaws, while the cutting tool was fastened in the spindle. The cup was then put through the final draw and again sent to the drilling machine to be faced off to the correct height, as shown in Fig. 7. As may be supposed, there were many rejections due to facing off too much and to rough edges. In the latter case it was necessary to send the pieces to the polishing room to be ground, all of which tended to cause an increase in cost of production, with annoying delays.

I had never heard of the principle of the draw and pinch-off punch being applied to steel punchings; but I determined to see what would happen, so I made a punch like the one in Fig. 3. The results were very satisfactory so far as the finished cups were concerned. While the draw punch was new and smooth, they would strip off without any trouble; but just as soon as the punch would rough up a little, they would stick. Therefore, a stripper or knock-off was designed. It operated in the following manner:

In Fig. 8 will be seen a center plunger connected to the arm projecting through the side of the punch, the end of which strikes the top of the die as the punch descends just after the trimmed cup has passed through the draw die, and is free to be stripped off the punch. As the punch is permitted to continue on through the die a little way, the cup is started or forced off for about 1 in., which, as the punch is withdrawn, is stripped clear off by the sharp edge of the draw die. This was entirely satisfactory and was the means of saving two facing operations in the drilling machine, with their usual losses.

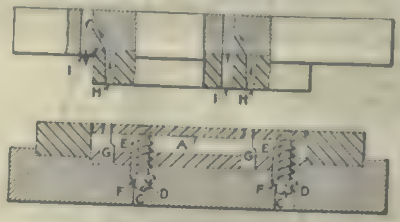
The manufacturers of time fuses might do well to look into the principles here described. Some of the parts that are to be made on presses might better be produced in two operations than by trying to maintain the size in a set of combination dies.

Arrangement for a Large Combination Die

By A. Hanschild

This is one of the larger combination dies where the blank can not be dropped through the bolster, but has to be pushed out of the die by placing springs or rubber between the stripper and bolster. The placing of springs or rubber bumper on the bottom of the bolster is not always possible. To set a die of this kind the stripper plate is screwed down to let the punch enter the die while setting. To remove these screws is an awkward job for the die setter on account of the limited space between the punch and die.

In the illustration a stripping arrangement is shown that can be taken out of the die before setting, and simply dropped in the die after setting. Between the stripper plate *A* and screwheads *C* the washers *D* that are larger than the screwheads and the springs *E* are placed. When the punch forces the blank down with the stripper the compression of the springs is taken up between the stripper plate *A*, and the washers *D*, resting on shoulders of the bolster shown at *F*. Normally the force of the partly compressed spring is taken up between the screw heads and stripper plate or the thread



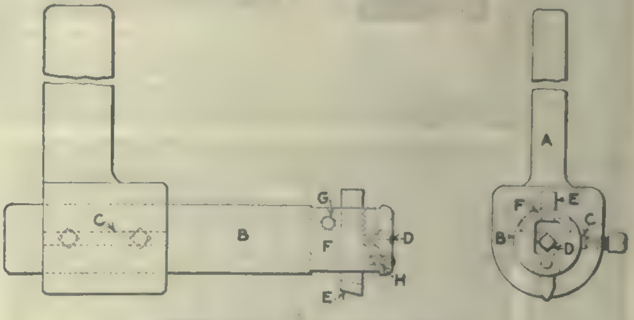
A COMBINATION DIE

of the screws. A good way to dispose of the slugs from small piercing punches is shown in the drawing. After the slugs have been pushed through the blank by the piercing punches *G*, they enter the holes *H* and follow the paths shown by the arrows being dropped back on the blank or on the outside at *I*.

A Handy Adjustable Extension Planing Tool

By Adolph Starr

The illustration shows an extension planing tool that is now being used in a large munition factory with considerable satisfaction. This tool can be used on short and long strokes, and may be of such length as the extension bar will permit. The holder *A* is secured in the tool block, which is immovably clamped in the clapper box. The extension bar *B* can be extended to meet the requirements of the work, and can be turned to plane at any desired angle, thus making it possible to plane a keyway in any location in the hole without disturbing the work after it is set up. The extension bar is tightly clamped by the gib *C* and the setscrews



EXTENSION PLANING TOOL

D. The tool *E* is held in position in the tool block *F* by setscrews. The tool block swings on a taper pin *G*; a spring *H*, held in position by a headless setscrew, keeping the tool block down; while on the return stroke the tool is free to lift by overcoming the tension of the spring. The setscrews *D* are seated in openings, which permit them to lift with the tool block and also to receive a socket wrench for adjusting the tool. To obtain the best results and maximum rigidity from the extension tool, and its holding parts, they should all be case-hardened and ground. A neat fit is essential at all points.

MAKING SHRAPNEL BALLS "Somewhere in France"

Fig. 1 Old Method of Making Shrapnel Balls

Fig. 2 General View of a Modern Plant

Fig. 3 Types of Furnaces & Other Equipments

Fig. 4 Pouring the Lead Ingots

Fig. 5 Dumping the Ingots

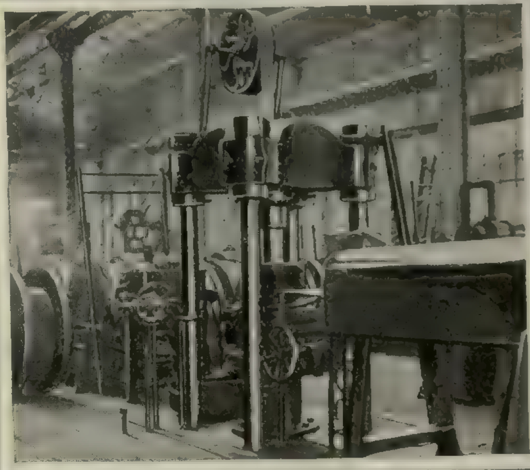


Fig. 6 Pressing Out the Wire

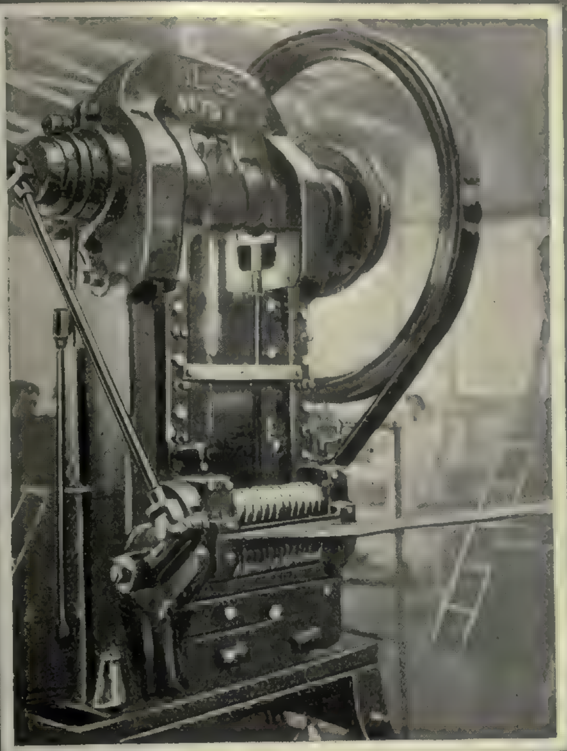


Fig. 7 Stamping Balls from the Wire

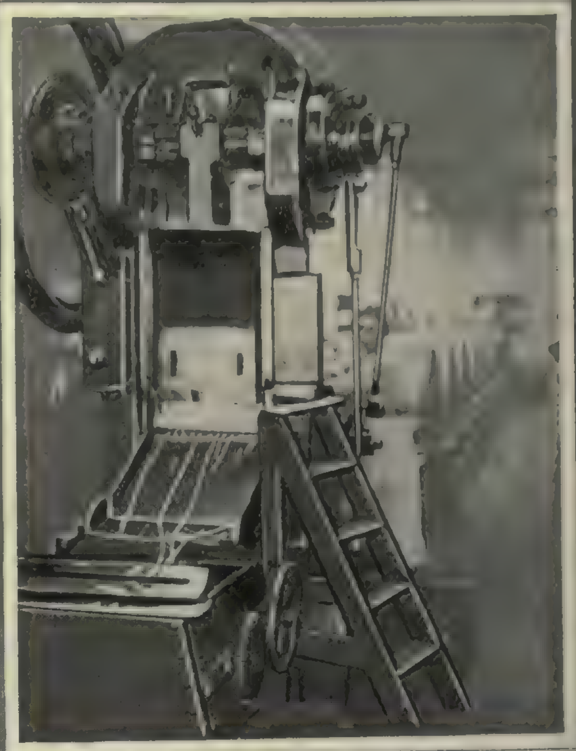
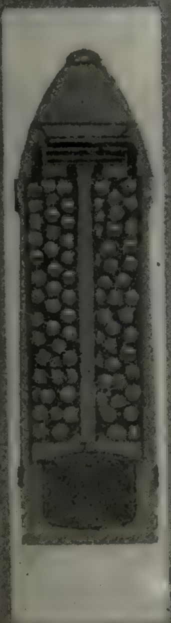


Fig. 8 The Way the Balls Come from Press



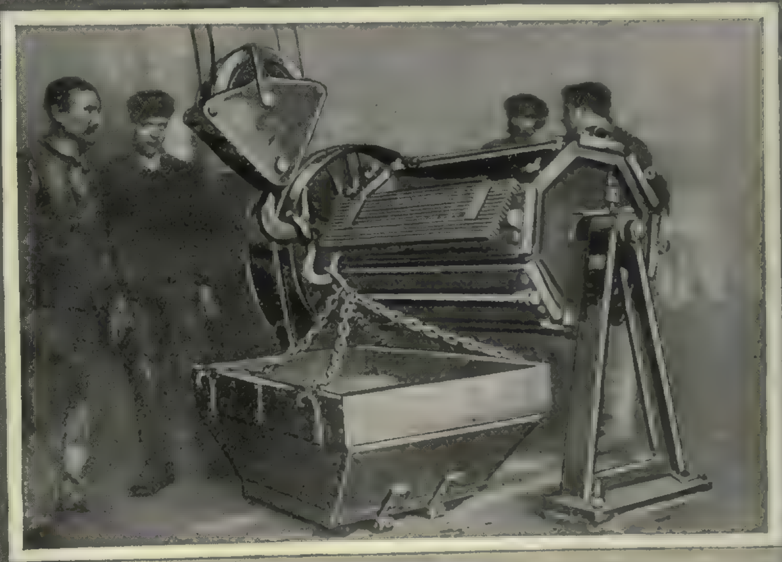
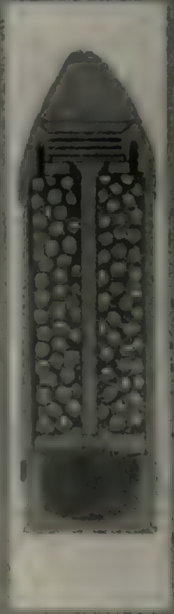


Fig. 9 Dumping Balls into Crane Buckets



THE foregoing pictures illustrate French methods of making shrapnel balls. The first picture shows the old or "bullet mold" method in which the melted metal is poured into multiple molds and allowed to cool. The succeeding pictures illustrate modern French methods, and the reader who has followed our munition articles will at once see how similar they are to the methods in use in the United States. The metal is first melted as shown in Fig. 3, then poured into trunnioned ingot molds of the water-cooled type shown in Fig. 4. When cooled sufficiently the ingots are dumped, and then are taken to the hydraulic press and extruded into wire. These wires are then run through a punch press equipped with multiple dies and automatic feed. The balls thus formed have a considerable amount of fin on them which is removed by tumbling in eight-sided tumbling barrels like the one shown in Fig. 9. The tumbled balls are next dumped into large hopper type crane buckets in which they may be carried to the shell filling department.

Editorials

The New Chief of Ordnance

THE vacancy created by the promotion of Gen. William Crozier to the War Council, has been filled by appointing Gen. Charles B. Wheeler with the title of acting chief. Those who have been privileged to know General Wheeler in connection with his work at the Watertown Arsenal during the past years and to familiarize themselves with the way in which he handled the great variety of work required of this plant, will be deeply gratified that such an efficient officer has been selected for this important position. Courteous yet forceful, always looking for new ideas and methods, and adopting those which seemed suited to the needs of the work being done, his management made the Watertown Arsenal a shining example of a modern shop for handling such a large variety of work.

One of the interesting features of General Wheeler's management was his practice of giving each young officer a year in the shop as a part of his training in ordnance manufacture. By his method, the young officer donned overalls and worked an allotted time in each department of the plant that he might know something of the practical side of the work, and what was equally essential, know the men of the shop from actual contact with them under working conditions. This training, although not of sufficient duration to make thoroughly practical shop managers, was a long, long step in the right direction, and gave excellent results.

From our personal knowledge of General Wheeler's attitude on engineering and manufacturing problems, from his desire to receive and carefully to consider the best advice and counsel on mechanical matters we have the utmost confidence in his ability to handle the many problems of his new office as efficiently as he did both the Watertown Arsenal and the Supply Division in Washington, which in itself, is a most interesting story. His problems are many, and they are more difficult than most of us realize. No one will expect perfection; the man who does anything always makes some mistakes and always expects to be criticized for them. But so long as criticisms are constructive they are welcomed by a man of big caliber.

We feel that the country is to be congratulated on securing such an able officer to fill the position made vacant by General Crozier's promotion, and that General Wheeler can count upon the full coöperation of both the technical press and the engineering fraternity at large, at any and all times.

Production vs. Invention

THE combination of an inventor and a successful business man, in one and the same person, is always a rarity. Today it is more of a necessity than ever, because the lack of such a combination can and does affect the production of needed machinery, especially when the inventor is also the proprietor of the shop.

The inventor, from the nature of things, evolves new ideas with more or less regularity, and by the same process, loses interest to some extent in the things he has already invented. So also where he is the shop manager as well he does not push the manufacture of the machines already invented, but sets about inventing newer and better ones, or more frequently, machines which are entirely different.

A specific case is that of a small machine which is used largely in various kinds of munitions work. The inventor, or more properly the designer, evolved and built an excellent little machine, which had a number of specially good points. It proved very popular in the hands of a few users, and orders were forthcoming in satisfactory numbers; but instead of devoting his energy and his capital to getting this machine on a manufacturing basis, both energy and capital were devoted to getting out a newer machine of a different type.

There is no desire to detract in any way from the credit due the designer, nor should he be hindered in the development of new ideas; but on the other hand, we should not be deprived of the output of good machines which are sorely needed.

We might, perhaps, plan out ideal conditions where the inventor does nothing but invent and has nothing to do with the business end of anything but his invention, yet until that time arrives, and as long as we depend on the output of small individual shops for our machines, we must try and persuade the inventor-proprietor to forego some of his inventing propensities, at least to the extent of avoiding interference with the output of a good machine.

Unless new types of machines are urgently needed, it is clearly the duty of every builder of machines which are needed in connection with war work, to devote his time to increasing his production, or at least in laying plans for such increase when the orders shall materialize.

Labor Shortage or Excessive Turnover

MUCH of the talked-of shortage of labor is more apparent than real. Not that the problem of adequate labor supply is not serious, but for the present at least, the real difficulty seems to be due more to labor turnover than to an actual shortage of man power.

The recent report of the New York State Bureau of Employment attributes the impression of labor shortage, to the continued publication of statements regarding shortage and excessive wages paid in some quarters. The report says:

"There is, at this time the usual restlessness among all classes of people, due to the fact that we are at war and are beginning to realize that we are taking an im-

portant part in it. But, in addition to this, and contributing more largely to the restlessness than anything else, is the constant repetition of the shortage of labor and the frequent publication about abnormal earnings, especially in munition factories. A worker reading of this labor shortage, and these large earnings, gets restless, quits his present job, and goes hunting the elusive one paying very high wages. The different offices of the Bureau throughout the State report a total of several hundred seekers of jobs every day. Many of these refuse to take the available jobs at the wages offered.

"It is time for more sanity on the part of both the employer and employee regarding the present labor conditions. Let us take the figures relating to the actual situation in New York State. The State census of 1915 showed a total population of 9,687,000. Calculating on the percentage basis used by the United States census, there are, at the present time in the State of New York, about 3,300,000 persons engaged in gainful occupations. On the other hand, from the figures given out, as well as from liberal estimates made, the army, navy, and the Red Cross have taken about 140,000 men out of this total of over three million workers. Another heavy military draft will have to be made before the labor power of the State is materially affected.

"Contributing also to this apparent shortage is the fact that we are confronted with the need in the next few months for a great number of workers to do the technical work coming into existence through the needs of the war. Industry in this country has not heretofore called for such a high number of technically trained men. To solve this need, it will be necessary for employers to get together and decide on the number of workers each one should train to supply this coming need. This should be done in each industrial community through the coöperation of employers needing any kind of technically trained men.

"The United States is just now teaching thousands of men how to shoot a gun and handle a bayonet. Is it not just as desirable to teach men in this emergency how to handle a tool and a machine? We have great numbers of men available for the training. Let us train these now, and later absorb them into the industries needing them before we consider the use of large numbers of untrained women."

There will doubtles be a real need for thousands of women before the war is over, but the suggestions given above are well worth careful consideration.

Why We Must Win the War

THERE are so many causes for resentment and for bitterness over the German method of conducting the present war, that we are apt to lose sight of the one great reason that makes her defeat necessary for the safety of the world in the years to come.

The danger is not so much that Germany considers treaties as scraps of paper; should levy indemnities after the manner of the dark ages; murder noncombatants and deliberately endeavor to wipe out the Belgian race and undermine the future of the French; should bomb hospitals; sink passenger vessels; use forbidden weapons and calmly announce that her prisoners would starve unless they were fed by their own countries.

The danger is not so much in the disposition to ignore all that the rest of the world had considered civilized, but that the country which thus becomes the bandit of the world, should have the power to wage war so long and so successfully as Germany has been able to do.

Never was the doctrine that might makes right so forcibly argued. And if we permit its final success, it places a premium on the country which prepares solely for war, which subordinates all other activities, which uses its great minds and its painstaking business methods merely as aids in the great world robbery it has planned for forty years.

One has only to read the utterances of Germany's leading men—from Von Bülow's utterances before the war to the Kaiser's and his men, since the war began—to realize the spirit of world-mastery which is beneath it all. Read Bismark's own account of how he garbled the message of Napoleon the Third so as to cause the war of 1870, that he might secure a huge indemnity for increasing his army, and that the Teuton might rob France of Alsace and Lorraine as he had previously robbed Denmark and Austria.

With no other thought but world-power has Germany built up the huge fighting machine which is now causing untold misery and suffering. Through long years she has stored arms and ammunition, uniforms and other supplies. Her spies have infested every land. And while pretending friendship, she has endeavored to stir up strife between other countries: As between Mexico and Japan and this country of ours.

Wonderfully prepared, magnificiently organized, and without scruples of any kind, the attempt at world-conquest was launched in August, 1914. If it succeeds, we shall have to revise our standards of existence. We shall have to pay indemnities in gold or in territory. We shall have to see smaller countries ruthlessly exterminated or become mere vassal states. We shall have to bend all our energies to building up a war machine of our own in order to be safe against almost certain invasion.

If Germany wins we shall have to obey her mandates as to sending ships to sea, as to trading, as to visiting other parts of the world. Her talk of the freedom of the seas would be but another "scrap of paper."

We fought against such tyranny in 1776; we refused to pay tribute to the Barbary pirates in 1803. Can we submit now and still maintain our beliefs in human rights and liberty?

We do not wish to impose any special form of government on the German people. If they prefer the kind that breaks treaties, that ignors civilized practices, they are to be pitied as well as blamed. But we must insist that as long as they do prefer that kind of government, they must stay within their own borders, and we must prepare to force them there and keep them there until they modernize their ideas.

Now she proposes peace without indemnities or annexation. Ravaged Belgium, France and Serbia are to rebuild themselves while Germany renews her army and prepares for another blow at a more favorable opportunity.

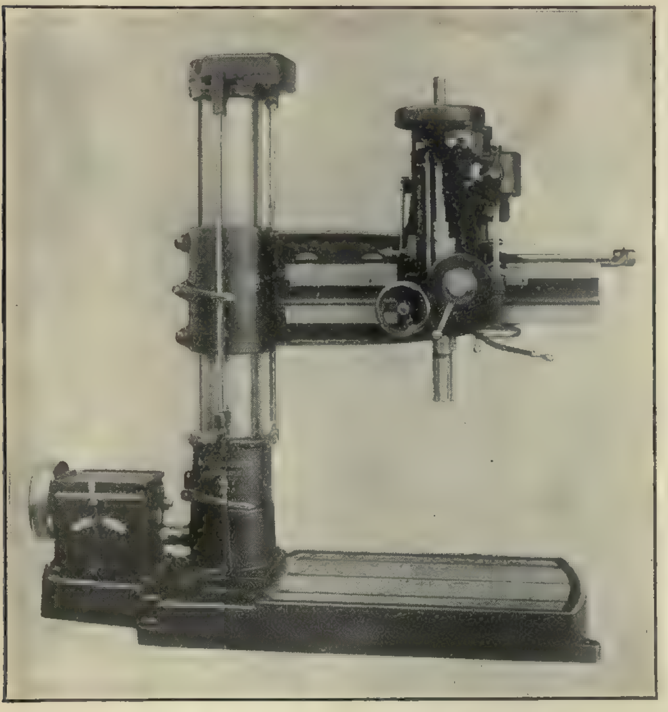
We cannot turn back. As long as a treaty-breaking government has power, it cannot be trusted. Unless we win, the future of the world is dark indeed.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Morris Plain Radial Drilling Machine

The illustration shows the new Morris 4- and 4½-ft. plain radial drilling machine with speed-box drive. It is the product of the Morris Machine Tool Co., Court and Harriet Sts., Cincinnati, Ohio.

The machine can also be arranged for cone pulley, constant-speed motor in connection with speed box, or for variable speed motor drive. The arm slides up and down on a column by power with safety stops in extreme positions. and the column swings around a stump that runs through to the top of the column. At the top of the stump a combination annular- and thrust-ball bearing is mounted, which carries the entire weight of the column and arm. At the bottom of the column there is a plain bearing on the stump. The stump is mounted on a ribbed base. Around the edge of the base is a lubricating channel which drains to a reservoir. The base is so arranged that oil pump and piping can be attached at any time.



MORRIS RADIAL DRILLING MACHINE

Drills to center of, 8 ft. 6 in.; maximum distance between spindle and base, 60 in.; minimum distance between spindle and base, 10 in.; maximum distance between spindle and table, 39 in.; spindle traverse, 16 in.; spindle diameter above sleeve, 1 15/16 in.; spindle, Morse taper No. 5; spindle speeds, cone drive, 19 to 350 r.p.m.; spindle speeds, speed-box drive, 20 to 350 r.p.m.; working surface on base, 36 x 51 in.; working surface on table, 18 x 24 in.; diameter of column, 11¼ in.; height overall with arm and spindle in highest position, 120½ in.; motor, 5 hp.; maximum speed, 1200 r.p.m.; motor, variable speed, 4 to 1; weight crated, about 7500 lb.

The lever at the bottom of the stump, standing in a vertical position, controls the friction clutches on the pulley shaft in the speed box. This lever, which is convenient to the operator, stops every gear on the machine, and in connection with the double back-gear lever on the head gives six spindle speeds. With the speed box, eighteen spindle speeds are available, and on the cone-pulley drive, there are fifteen spindle speeds. The double back gear is mounted on the back of the head, and is fully enclosed. Back-gear clutches and clash gears are made of nickel steel, heat-treated and hardened. The tapping attachment miter gears are also mounted on back of the head and are enclosed in an oil-tight case and run in oil. Frictions are of the expanding-ring type capable of pulling the maximum capacity of the machine, and are controlled from the front of the machine. The friction rings are adjustable. The head is moved on the arm by means of a hand wheel operating through reduction gears, to a rack and pinion.

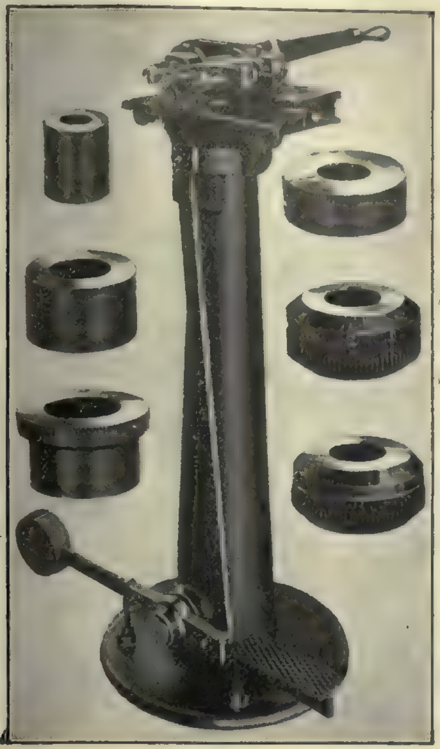
The spindle is equipped with a ball-thrust bearing. The bearings throughout are of bronze with felt wipers—a recess around the bearing acting as an oil reservoir. Through the feed-gear box mounted on the head, six feeds are obtainable. A direct-reading depth gage is provided and arranged to throw the feed out; while a safety feed throw out is arranged at the end of the spindle travel. All the gears are of steel except that on the spindle which is semi-steel, made of one-third scrap-steel mixture.

The speed box is fully enclosed and the gears run in heavy oil. A tool tray is mounted on top of the box. A speed plate is furnished, giving the operator all spindle speeds at certain positions of the lever.

Noble & Westbrook Graduating Machine

The Noble & Westbrook Mfg. Co., Hartford, Conn., is now marketing a special machine for marking graduations and figures on cylindrical or semi-cylindrical pieces, with one operation only. The illustration shows the machine, together with two of the marking dies and some samples of the work done. The graduating die is held in a holder, keyed to the shaft which runs in

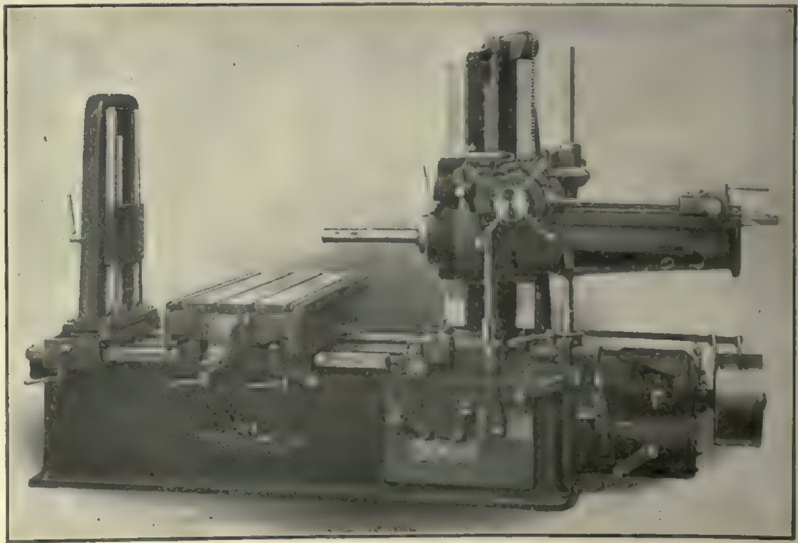
bronze bearings and is provided with collar adjustment. The work is held in place in proper relation to the die by gears, and the depth of impression is regulated by a foot lever and cam. The latter is adjustable, it being possible to regulate the cutting depth to a hundredth of an inch.



GRADUATING MACHINE

Giddings & Lewis Horizontal Boring Machine

The Giddings & Lewis Mfg. Co., Fond du Lac, Wis., has re-designed the boring machine that was formerly manufactured by the Fosdick Machine Tool Co., Cincinnati, and is now placing the new machine on the market. Many of the details as well as several major points have been changed. The machine is now supplied with a double spindle traverse feed which will double the standard traverse of 26 in. This double speed is obtained by collars on the spindle in front of and behind the driving nut portion of the ram. An indicator, placed directly in front of the operating position, is provided to prevent an overfeed of the spindle ram. The gears run in a bath of oil and an indicator at the front of the machine shows the level of the oil in the case. All feeds are engaged by a single lever, making it impossible to engage two at the same time. The clutch lever is supplied with a spring latch that renders accidental engagement impossible. The same lever controls the rapid traverse friction, and has a spring release, causing the friction to relieve as soon as pressure is removed. The operating levers have been changed to bring them directly before the operator.



GIDDINGS & LEWIS NO. 0 HORIZONTAL BORING MACHINE

Wilmarth & Morman Power-Feed Grinding Machine

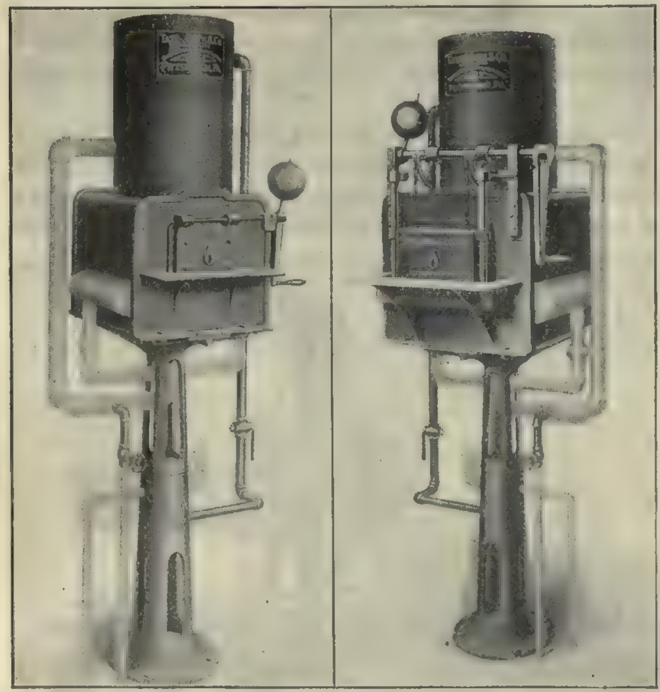
The Wilmarth & Morman Co., Grand Rapids, Mich., is now supplying its No. 1 universal cutter and tool-grinding machine with an automatic feed mechanism. The new mechanism is so arranged that it can be attached with very little work, to hand-feed machines of this type already in use. All the mechanism necessary to obtain eight table speeds and reverse is contained in one unit. The table is driven by means of a rack and pinion mechanism, the pinion shaft being so arranged as to allow the disengagement of an idler gear. This makes it possible entirely to disengage the power feed in case hand feed is desired. A handwheel is placed at the front of the saddle, and a lever at the rear, and either

WILMARTH & MORMAN NO. 1 GRINDING MACHINE WITH POWER-FEED MECHANISM

may be used when hand feed is desired. The entire mechanism is self-contained and none of the working parts are exposed to grindings or dirt. The gears run in a bath of oil. The eight feed changes are 12, 16, 22, 28, 34, 41, 61 and 75 in. per minute.

Tate-Jones Series A and H Recuperative Oven Furnaces

The illustrations show two new recuperative gas-oven furnaces recently placed on the market by Tate-Jones & Co., Inc., Pittsburgh, Penn. Fig. 1 shows one of the series A furnaces, while Fig. 2 shows one of the series H. Series A furnaces are designed for a temperature range of from 900 to 1600 deg. F., while those of series H have a temperature range of from 1600 to 2400 deg. F. The burners operate on the blast system, the gas and air being mixed at some distance from the points of combustion. Provision is made for inserting a thermocouple through the fire brick at the rear, the couple lying in a recess in the hearth. It is believed that this method of placing the thermocouple gives more accurate temperature readings than other methods. The recuperators consist of coils of wrought-iron pipe, especially treated to prevent oxidation. Another feature of these furnaces is that they are built of such a height that any man from five to six feet tall, standing at a working distance from the furnace, can see any work that may be placed in it. The outer casings of the furnaces are of cast iron and boiler plate, and the bases are of cast iron. Series A furnaces are made in 11 sizes from 6 x 4 x 12 in. to 12 x 6 x 36 in., with weights



FIGS. 1 AND 2. TATE-JONES RECUPERATIVE GAS FURNACES
FIG. 1—Series A furnace. Fig. 2—Series H furnace

of from 850 to 1440 lb. Series H furnaces are made in 8 sizes from 5 x 3 x 10 in. to 10 x 5 x 25 in., with weights of from 950 to 1435 lb. The furnaces operate on gas pressures of from 4 oz. to 2½ lb., and with air pressures of from 1½ to 2½ lb.

A Plea for a Book of Tables

By John Price

Every machinist and toolmaker owning or having access to a regular handbook feels that the needs of the trade require something devoid of the frills and round-a-bout details that lead to the real "meat" he is searching for. Many such men have purposely avoided purchasing a handbook on account of the misleading technical padding which nearly smothers the pith of information needed.

For example: A machinist has to cut a spiral gear. He turns to his handbook for the number of the cutter for this particular gear and finds it to be hidden amid a maze of theory and design of spiral gears. In fact he has to wade for his information.

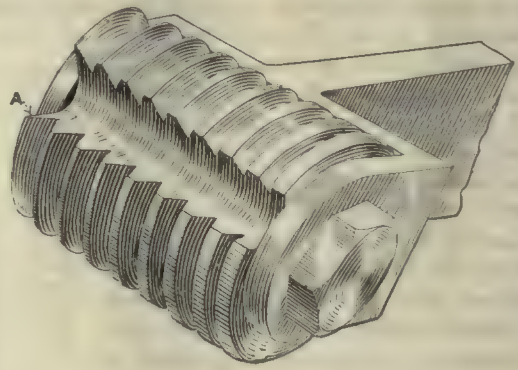
Again: In needing the moves for a milling-machine job involving the use of the index head he does not consult his handbook, because the information is given more clearly and concisely in the chart accompanying the machine.

A book of tables of from 50 to 100 pages containing the vital information for the men in the shop will find a place in every toolbox. This is obvious for the reason that nearly every toolmaker and machinist has a little private collection of small blueprints and copies of tables tucked away in the corner of his bench drawer; and although his handbook contains the same information, he turns to his little pile of "shortcuts," for quickly getting the facts.

Thread Cutting Tool

By F. T. Schell

Being constantly pushed for production, I contrived a tool for threading the crosshead end of piston rods. It is made from round high-speed steel, threaded 10 per inch, hardened and ground to a taper. From the



THREAD-CUTTING TOOL

illustration the advantage of this tool over the single-point threading tool is evident, as the flattened teeth do most of the cutting and the point of the tool is saved to finish the thread. The tool is ground as shown at *A*, to give it a cutting edge.

A Correspondent Goes to France

Robert K. Tomlin, Jr., Managing Editor of *Engineering News-Record*, sailed recently for France to serve the papers of the McGraw-Hill Publishing Co., Inc.,

as special correspondent at the front. Mr. Tomlin was graduated from Harvard University in 1907. During his college course he served for two summers, as assistant in the surveying and railroad field engineering of the Harvard Engineering Camp at Squam Lake, N. H.

ROBERT K. TOMLIN, JR.

After graduation he undertook the tunnel work for the Pennsylvania Railroad Co. in connection with the Pennsylvania Station in New York City. He left this work to go to the New York Board of Water Supply, and was stationed with the Northern Aqueduct Department at Poughkeepsie, N. Y.

His journalistic experience dates from March, 1909, when he became assistant to the editor of the *Engineering Record.* He was subsequently made associate editor, in charge of the municipal and sanitary field, and in 1913 was promoted to managing editor. When *Engineering News-Record* was formed last April by the consolidation of *Engineering News* and the *Engineering Record,* Mr. Tomlin became managing editor.

Brazing High-Speed Steel Tips to Machine-Steel Cutting Tools

By Howard M. Bogart

I note, on page 636, Vol. 47, comment by Mr. Thomas Fish on my article bearing the above title and describing a method of brazing high-speed steel and stellite to mild-steel shanks; also the editorial comment appended. I do not know if tools so prepared would be commercially practical, but I can say they satisfactorily served the purpose for which they were intended.

The stellite does not braze as readily as high-speed steel, but fixed in the shank as described, it will withstand any strain the strength of the stellite is equal to. The failure to secure adhesion can probably be attributed to a disregard of some of the precautions noted in the previous article. The scale must be completely removed, the surface thoroughly tinned and the heat barely sufficient to melt the brass, and not be prolonged beyond the flowing of the brass.

I do not advocate the use of built-up, high-speed tools as a general practice since the extra labor cost more than offsets the saving in material. It pays however in the case of the stellite, by reducing the breakage of the very brittle bits. I have seen no evidence of deterioration in the stellite due to the brazing process.

Personals

George Gorton, president of the Gorton Machine Co., Racine, Wis., recently presented the First Baptist Church of Racine with a club house and auditorium building.

C. S. Ash, formerly chief engineer and inspector of the Wire Wheel Corporation, has accepted a similar position with the National Wire Wheels Works, Inc., Geneva, N. Y.

A. H. Wadell, formerly general manager of the Wadell-Bowen Co., Inc., has again entered the tool and die business with **W. W. Jackson**, superintendent and chief engineer of the Regina Co., Rahway, N. J. The new concern will be known as the Wadell-Jackson Co. and will be located at 494 Mulberry St., Newark, N. J.

At the annual meeting of the Engineering Society of York, Penn., the following officers were elected for the ensuing year: **James Rudisill,** president; **Chauncey D. Bond,** vice president; **M. Haller Frey,** secretary; **Harold A. Russell,** treasurer; **George A. Jessop, Charles L. Berger** and **Howard L. Longenecker,** directors.

Business Items

The Victor Saw Works is the new name of the concern formerly known as the Massachusetts Saw Works. The management, organization, policies and products will remain unchanged.

The Greaves-Klusman Tool Co., Cincinnati, Ohio, has purchased the buildings formerly occupied by the Champion Tool Works. This will be used as an addition to the present plant of this company.

The American Pneumatic Chuck Co., 9 South Clinton St., Chicago, Ill., has been incorporated for the manufacture of air chucks and other air-operated devices for mechanical purposes. John Olson, formerly with the Detroit Pneumatic Chuck Co., will be in charge of design and manufacture. The company will specialize for the present in air-operated equipment for the production of shells and other munitions, but later intends to place a complete line of air chucks on the market. Neidow & Payson Co., Chicago, has been appointed selling agent.

Edgar T. Wards Sons Co. is the new corporate name of the large steel merchants who have operated under the name of Ward for many years. The company is now organized with a capital of $2,500,000, with headquarters in Boston, Mass. The various offices and warehouses in Boston, New York, Chicago, Philadelphia and Newark, N. J., will be continued as before and there will be no interruption to business. The officers are: Edgar Ward, Newton, Mass., president; John Ward, Lynnfield, Mass., treasurer; Herbert V. Lockwood, South Orange, Mass., secretary; Jas. S. Winn, Evanston, Ill., vice president; Leslie Edgcomb, Philadelphia, Penn., vice president; Arthur J. Lockwood, Glenridge, N. J., chairman; H. F. Hall, Collingswood, N. J., assistant treasurer; William E. Adams, Boston, Mass., clerk; Frank K. Biggs, New York, and H. B. Lapham, Evanston, Ill., directors.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Feb. 7, 8 and 9. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect **Nov. 15.**

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Dec. 28, 1917	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$23.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia................	33.75	33.75	29.50
*No. 2, Valley......................	33.00	33.00	31.00
No. 2, Southern Cincinnati...........	35.90	35.00	25.90
Basic, Eastern Pennsylvania..........	33.95	30.00	30.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Dec. 28, 1917	One Month Ago	One Year Ago	Dec. 28, 1917	One Year Ago	Dec. 28, 1917	One Year Ago
Structural shapes ...	$4.20	$4.20	$3.75	$4–4.04	$3.85	$4.20	$3.70
Soft steel bars......	4.10	4.10	3.75	4–4.04	3.85	4.10	3.60
Soft steel bar shapes.	4.10	4.10	3.75	4.14	3.85	4.10	3.60
Plates, ¼ to 1 in. thick	4.45	4.45	4.75	4.39	4.50	4.20	3.60

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Dec. 28, 1917	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York..................	4.25	3.75
Warehouse, Cleveland	3.98½	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Dec. 28, 1917	One Month Ago	One Year Ago	Dec. 28, 1917	One Year Ago	Dec. 28, 1917	One Year Ago
*No. 28 black......	5.00	6.445	6.445	5.25	6.45	4.75	6.445	4.75
*No. 26 black......	4.90	6.345	6.345	5.15	6.35	4.65	6.345	4.65
*Nos. 22 and 24 black	4.85	6.295	6.295	5.10	6.30	4.60	6.295	4.60
Nos. 18 and 20 black.	4.80	6.245	6.245	5.05	6.25	4.55	6.245	4.50
No. 16 blue annealed.	4.45	5.645	5.645	4.85	5.65	4.45	5.645	4.50
No. 14 blue annealed.	4.35	5.545	5.545	4.75	5.55	4.35	5.545	4.40
No. 12 blue annealed.	4.30	5.495	5.495	4.70	5.50	4.30	5.495	4.30
No. 10 blue annealed.	4.25	5.445	5.445	4.65	5.45	4.25	5.445	4.25
*No. 28 galvanized..	6.25	7.695	7.695	7.25	7.70	6.50	7.695	6.75
*No. 26 galvanized..	5.95	7.395	7.395	6.95	7.40	6.20	7.395	6.45
No. 24 galvanized...	5.80	7.245	7.245	6.80	7.25	6.05	7.245	6.30

*For painted corrugated sheets add 25c. per 100 lb.; for galvanized corrugated add 5c.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Dec. 28, 1917	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Dec. 28, 1917	One Year Ago
New York	$15.00	$7.50
Cleveland	15.30	7.50
Chicago	15.00	5.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16 ..	
No. 18	
No. 20	

* Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

***Special Welding Wire**

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Dec. 28, 1917	Cleveland Dec. 28, 1917	Chicago Dec. 28, 1917
Tire	5.00	5.00	4.04
Toe calk	5.70	5.50	4.35
Openhearth spring steel...	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Coppered bessemer rods....	7.00	....	....
Hoop steel	4.04½	....	....
Cold-rolled strip steel.....	9.00	....	....
Floor plates	6.19½	....	....

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4.......	29%	17%
4½ to 6......	44%	32½%	4½ to 6.......	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Dec. 28, 1917	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	36.00
Tin, in 5-ton lots..................	86.00	74.00	43.00
Lead	6.50	7.25	8.00
Spelter	8.00	7.88	11.75

*Government price.

ST. LOUIS

Lead	6.37½	7.13	7.80
Spelter	7.75	7.63	11.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Dec. 28, 1917	One Month Ago	One Year Ago	Dec. 28, 1917	One Year Ago	Dec. 28, 1917	One Year Ago
Copper sheets, base.	31.00–33.50	35–37	41.00	32.50	45.00	35–36	42.00
Copper wire (carload lots)	32.00	36.00	36.00	28.50	44.00	34.00	36.50
Brass pipe, base...	36.50	38.50	47.50	40.00	52.00	41.00	46.50
Brass sheets	30.75	35.75	45.50	33.00	47.00	35.00	44.00
Solder ½ and ½ (case lots)	48.00	40.50	27.50	43.25	28.25	41.50	28.25

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Dec. 28, 1917	One Year Ago
Mill	$25.00	$42.00
New York	30.00	45.50
Cleveland	34.00	38.00
Chicago	37.00	42.50

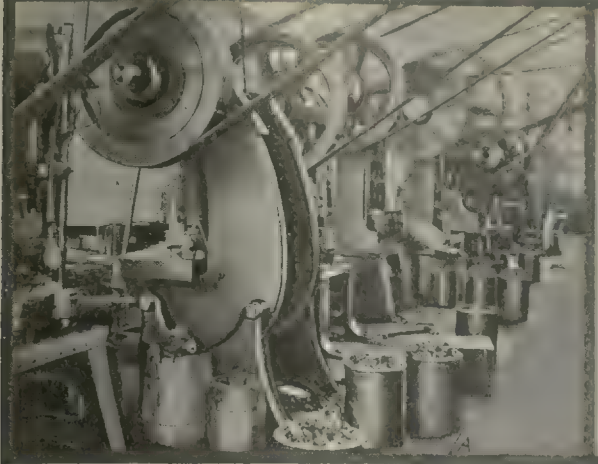
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.................................. 19.00

	In Casks		Broken Lots	
	Dec. 28, 1917	One Year Ago	Dec. 28, 1917	One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.00	22.75	21.50	23.25

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Dec. 28, 1917	One Year Ago
New York	15.50	14.75
Cleveland	17.75	16.00
Chicago	16.00	15.00



PHENOMENAL INCREASE in PRODUCTION

BY M. E. HOAG

The data and illustrations used in this article were secured in the factory of the Boss Nut Co., Chicago, Ill., and show what may be accomplished toward increasing production by better stock handling methods.

THE old method of handling stock in this plant was the same that prevails in thousands of other shops throughout the country, and resulted not only in low production, but also in a number of hospital bills for workmen who injured themselves by lifting weights that were beyond their strength. With the old methods, the punch presses shown in the headpiece, were supplied with large metal pans to catch the nut blanks and cutting compound. This made it necessary for the press operator to dip the compound from the pans and put it back into the individual supply tank with which each machine was equipped. The installation of the Richardson-Phenix filtering and supply system described on page 1111, Vol. 44, *American Machinist*, overcame a very great part of this trouble, but it was still necessary for the workman to shovel the nut blanks into receptacles which later had to be trucked away and lifted and dumped into the tumbling barrels, and again handled and taken to the storage bins. There was also lost time due to inefficient methods of handling the raw bar stock, and many times the tapping machines were idle from lack of blanks.

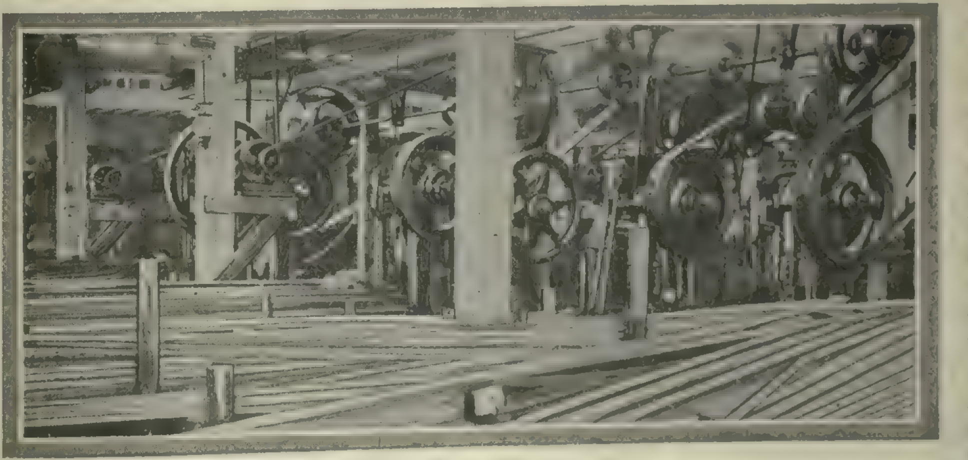


FIG. 2. RAW STOCK STORAGE

As now handled, the rough stock is stacked immediately back of the punch-press operators, and can be reached without unnecessary effort. Each press is kept on practically one size of blanks so it is not necessary to keep the rough stock in storage racks and move it to the presses as needed. It is moved directly from the cars to the racks from which it will be used. A view of presses and stock is shown in Fig. 2.

As now equipped with the filtering system, each press has a sump basin in the floor under it; an iron grating *A* (see headpiece) over the top, prevents stock from dropping through.

Small steel kegs provided with perforated bottoms are placed under the press to receive the blanks, the cutting compound draining through and back into the supply pipes. Truckers remove the kegs when full, and replace them with empties. The punch-press operator is thus enabled to devote his entire time to actual production, and today there is being turned out over 100 per cent. more work than with the old system. This 100 per cent. is a very conservative estimate, as actual data sheets show the increase to be much greater than this. Over 25 per cent. of this increase is credited to the longer life of the tools, partly due to the improved filtering and supply system, and the balance to stock-handling methods. No lifting of stock is required from this point. When a keg is ready to be moved the truck is slipped under it and it is wheeled to the tumbling barrels shown in Fig. 3, where it is dumped into the hopper car shown at *A*. The car is mounted on double truck as shown, and with an electric-driven lift it may be raised to the position shown, or lowered to a pit under the barrels. To receive stock it is dropped to the pit level, which brings its upper edge flush with the floor, and the kegs dumped into it. It is then raised to the upper tracks and out over the barrels, and the blanks dumped into them.

Fig. 3, Tumbling and Handling

Fig. 4, Storage Bins for Blank Stock

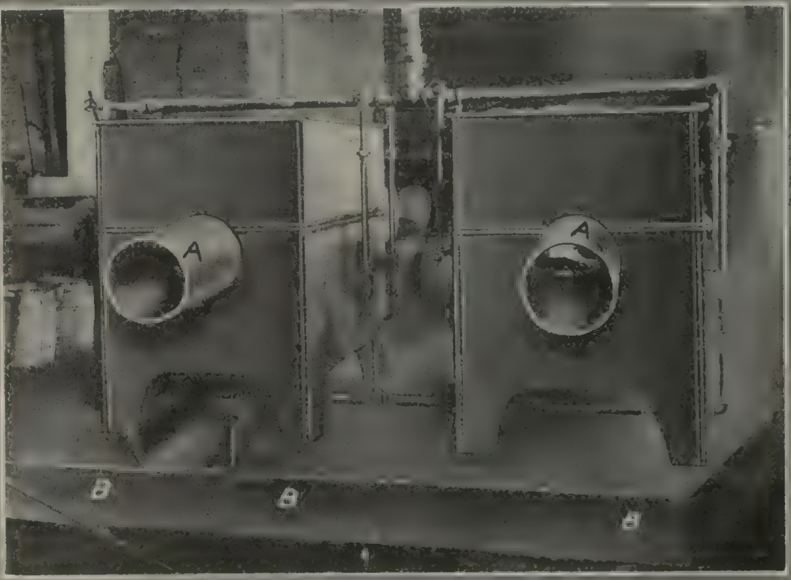


Fig. 5, Annealing Furnaces

Fig. 6, Threading Work

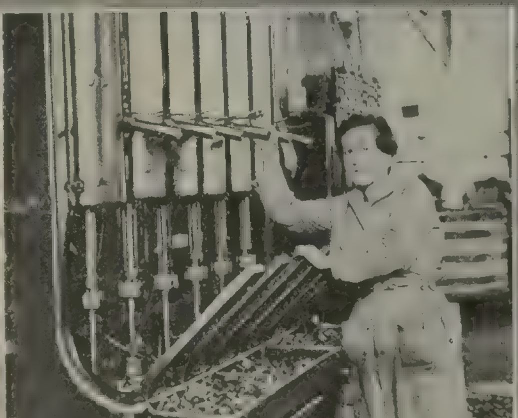


Fig. 7 and 8, Female Employees in Various Departments

After tumbling sufficiently the car is again dropped to the pit level and run under the barrels which are dumped into it. The car is then raised to the track *B* and run out over the storage bins in front of the tappers shown in Fig. 4, and dumped.

It can be readily seen that by this method no heavy lifting is required, and very little man power is used in moving the stock from the time it is unloaded from the car until the nuts are tapped and ready to be shipped.

The Boss Nut Co. also makes bolts and rivets that require annealing, which is handled in the simple oil-fired furnaces shown in Fig. 5. The principal features of these furnaces are the movable steel tubes *AA* which receive the stock. If the stock does not heat evenly, the workman turns the tubes and gives the pieces being annealed an even heat.

When properly heated the work is raked out of the tubes and falls into the tank *B* which is below floor level, and has an incline at the left end. Steel tote pans with perforated bottoms are placed in the bottom of the tank and receive the work as it is raked from the furnaces. When it has remained in the cooling solution a sufficient length of time, the pans are pulled up the incline and allowed to drain and finish cooling, enough heat being left in the pieces to dry them.

Women in the Various Departments

A number of girls and women are employed in this factory, working in every department except the punch press. They receive the same piece-rate pay as the male employees and their weekly pay averages about $15. In some departments these girls make as high as $20 or $22 per week. However, they are not put on the very heavy work but are given the lighter class of work to handle. The one shown in Fig. 6 operates a thread-rolling machine. Others handle the Acme tapping machines, headers, burring machines, and assemble and pack the stock for shipment, as shown in Fig. 8.

The girl at the Acme tapping machine in Fig. 7 has an unusually good uniform for women employees who work around machinery. The bloomers are sufficiently loose to permit putting on over the skirts, yet are not liable to be caught in moving machinery any more than is her hair which is "bobbed."

As stated before in the columns of the *American Machinist*, women employees in machine shops or factories where there is rapidly moving machinery, should either wear caps or have the hair cut rather close.

Training Women for War Work

By Glenn B. Harris

The need of educating women in the vocations, ordinarily and heretofore only followed by men, is daily becoming more apparent. The expenditure of the vast sums of money at the disposal of the Government for the prosecution of the war, will naturally find a large percentage of its outlet in the manufacture of immense quantities of munitions not only for the use of both our own army and navy, but also for these branches of the service of our Allies.

It is fair to assume that of the men directly engaged in the production of munitions, at least 30 per cent. are within the draft age as at present established. In addition there are the skilled men within the age limit who are producing the machine tools and other essentials necessary to munitions manufacture. It is unquestionably true that not one of our skilled mechanics can be spared from his present duties, but on the other hand, it must be recognized that they are subject to call and not immune from the draft.

Under the circumstances it is well to face the problem confronting us of being in a position not only to maintain our present output, but to provide for that greatly increased demand which is certain to follow as soon as our forces are fully under way in Europe.

In Great Britain the worth of women has been recognized by the Premier Lloyd George, who has stated that "Women's work in the war has been a vital contribution to our success. It would have been impossible to produce that overwhelming mass of ammunition used at the Somme had it not been for the work of women. They have shown a devotion, a zeal, and a courage which are beyond challenge."

View of a Prominent Frenchman

The French High Commissioner of France to this country, M. Tardieu, vouched for the efficiency of women in saying "There is no line of mechanics in which our women have not become proficient since the men have gone to war." Surely what French women have done, American women can do!

It must be accepted as a fact that when such eminent men as Premier Lloyd George and M. Tardieu testify to women's worth, the question in what capacities women's services can be utilized along mechanical lines, is one worthy of careful and serious consideration, for it is undoubtedly true that in Great Britain and France women have been so trained that they are skilled in mechanical trades which no woman touched previous to the war, and the intensive system of instruction has proved that an almost illimitable amount of emergency labor has been discovered capable of accomplishing what was heretofore considered a trade mystery, and possible of performance only by men.

Already in this country women's services are being utilized to a considerable extent in machine shops and munitions factories with highly satisfactory results.

Work in the Munitions Factories

In many munitions plants all small drilling and automatic lathe work has been delegated to women, and with a little instruction they become proficient in the use of a micrometer. The different operations intrusted to women have been most satisfactorily performed and great aptidude displayed in acquiring a knowledge of what is required and in the acceptable accomplishment of the same.

One of our very largest industrial establishments engaged in the manufacture of small arms makes the unequivocal statement that on grinding machines (surface and cylinder), shaping machines, milling machines and machines of this class, "women are producing as good work as that of a specialized toolmaker." It would then seem that in mechanical operations within her physical strength, woman is proving herself not only the necessary substitute for man but his equal in the performance of tasks assigned her.

It has been said and truthfully, that a man entering a machine shop is not content to remain indefinitely on

the production of a single article or in following continuously one operation, whereas a woman perhaps possessed with more patience than is man, is entirely satisfied to follow to the end the duties allotted her and thus to become extremely proficient in her specialized work.

There has been considerable discussion as to conservation in wearing apparal as well as in food stuffs and if conservation in this branch of manufacture and consumption becomes a fact, as it is on the other side and likely to become here, a very large number of female operators would immediately be available for the sterner work made necessary by war.

Men Not Displaced

The entrance of women into the mechanical field, is not to mean the displacement of a single skilled workman, since the demand which is constantly increasing and will continue to increase, will be considerably amplified; for not only must the ranks of labor be depleted because of the draft made and those to follow, but there is also to be regarded the imperative requirements of all increased output in munitions and other accessories essential in warfare.

Possibly it would be wise to follow the plan of the English government which has established vocational or training schools throughout the kingdom, although actual experience in the shop in which service is to be rendered would seem to be the preferable plan and the one by which results would be the most quickly obtained.

The Chase

By Entropy

Every live wire wants to spend his time chasing something. After he catches it he loses his interest. We see this phase of human thought exemplified in moving pictures. The first pictures that attempted to depict human experience showed runaway pursuits. The crude and ludicrous attempts of those days now give way to thrillers in which the hero, or preferably the heroine, escapes from one desperate encounter after another for fifteen weeks in succession. Everything we do is based on this same idea. Some years ago men conceived the idea that they would build pieces of mechanism, anything from a waterwheel to a clock, and they built it. When it was done they stopped working on it. They did not consider it necessary to build one after another, all alike because every customer wanted something different from what his neighbors got.

Pride in Workmanship

In those days there was pride in workmanship and design. Every mechanic or craftsman was literally in business for himself, for even if he drew day wages from the master, he worked for something besides money.

Now we have changed it all. We think of the good old days when men took an interest in their work, and we sigh and say that such things can never come again because workmen are deteriorating, but we overlook the fact that we have really taken away from most men the true incentive to do things. Men work for money because that is all that we offer them or allow them to take.

We hire a man and assign him to a milling machine. We give him a thousand castings, a blueprint, a fixture, and some milling cutters, and we tell him exactly what to do and possibly tell him what motions to make. If he shows any idea of originality, we fix a cold stern eye on him and tell him what meek and lowly folks young men should be, and thereby throttle any possible ambition on his part.

The lamentable thing is that this will probably be worse before it is better. The present pressure to subdivide every kind of work so that the veriest tyro cannot go far wrong, reduces the possible interest, which that operative has in our work, to one of plain dollars and cents. He says, for example, "You will not let me know what I am working on, not even what function it performs in the finished machine. You reduce my knowledge of this machine to such an extent that I do not know whether this part of this shaft fits in some hole that someone else has made, or whether it fits in the open air. All I want from you is money, so that I may buy something; possibly the very machine, a small part of which I may be making parts for. Give me money, and plenty of it, or else give me an opportunity to see what I am doing and allow me to take an active part in producing it." That is the frame of mind to which we have reduced the men on whom we depend for profits, by the extension of the factory system to our machine shops.

Remedies

What can we do about it? Everything. We can return the element of the chase to the work by pitting one man against another, or one factory against another factory. We can let our employees know what they are working on by letting them see the rest of the shop, instead of issuing passes to them permitting them to enter nothing but their own departments. If we cannot send them around to other parts of our works in other cities we can have moving picture films to show them. If we really desire to get any of the craftsman's old enthusiasm back we must decrease the subdivision of work so that each man will make something in which he can take a just pride. This is by no means easy; nor is it economical in the ordinary sense. It can only be economical as it increases the interest of the employee and creates a desire to spend more time upon the work in hand. How much chance for gain there is, is of course, a variable in different shops. On the average however, the operator who really works up to his comfortable speed more than half the time we pay him for, is the exception. Of course if he is simply a watchman, standing around to stop things if they go wrong, then it is not so very necessary that he should be very active, yet we might gain as much in work not spoiled if we could get his interest, as we would from the other class of men.

This sounds very Utopian, and very unscientific, but we have to weigh the ultimate advantage to the industry against the disadvantage of continuing to man our shops with men whose sole aim is to take the last dollar possible for the least possible time and exertion. If we go on as we are now, every rush of business will surely bring on this holdup that we are experiencing, a thing which did not occur to any such extent under the old craftsman method, when both employer and employee were anxious to live and let live.

Use of Diamond Tools in the Shop—I

By FRANK A. STANLEY

A description of a variety of purposes to which diamonds may be put, such as turning, boring and reaming appliances for brass, iron and steel, hard rubber and compositions. Details of speeds, feeds and output are given.

WHILE diamond cutting tools for working metals and other materials have long been used in certain shops, they are by no means so well-known to mechanics in general as they should be, for a properly selected and shaped diamond has remarkable properties in the way of retaining its cutting edge for long periods of time, and producing surfaces of great accuracy and fine degree of finish.

These diamond points or cutting tools, formerly used principally for simple operations in the lathe and for shaping grinding wheels and the like, have more recently been adopted for a great variety of purposes, some of which will doubtless be of interest to readers of this journal. It will probably be of considerable interest to many to read that diamond tools are now used in the automatic screw machine for forming, turning, boring, and cutting off operations; in the lathe for boring and turning both large and small work in various materials; in the drilling machine for counterboring and similar operations, and in other machines for finish reaming cast iron and other pieces where holes are to be sized accurately.

The illustrations in this article have been selected with the view of showing typical jobs actually machined with diamond tools made by Thomas L. Dickenson of New York City.

Automatic Screw Machine Work

The first example, Fig. 1, is a small plug, part of a primer, which is produced from a hard rubber rod on a Brown & Sharpe No. 1 automatic screw machine. Four diamond tools are used in this work. The hard rubber piece when finished is $\frac{7}{16}$ in. diameter on the body, $\frac{3}{8}$ in. diameter on the formed neck and $\frac{1}{2}$ in. long over all. The turning of the body is done with a box-tool cutter, Fig. 2, which consists of a shank $\frac{5}{16}$ in. square by $1\frac{1}{4}$ in. long carrying a flat diamond cutter, which is inserted in the nose as shown. The diamond is 0.06 in. thick, and is shaped with 7 deg. clearance to give a free cutting edge.

The boring tool which enlarges the hole from 0.150 in. to 0.176 in. is shown in Figs. 3 and 4, the latter being an enlarged detail of the tool shank and diamond cutter. Here the diamond is inserted in a slot at an angle of 60 deg. with the center line of the shank, and is so shaped as to have 2 deg. back clearance from the cutting point which is finished to a radius of 0.020 in. The thickness is only 0.040 in. as the tool shank is, of course, small in diameter, that is only 0.140 in.

A view of the forming tool is given in Fig. 5 and the cutoff tool is shown in Fig. 6. Both circular tools are made to the general form and dimensions in the plan view of Fig. 6, the forming tool being wider than the cutoff, and having a straight instead of a bevel edge. In other respects the two circular cutters are alike. The enlarged detail in Fig. 7 shows the setting of the cutoff diamond, and gives a back clearance of 1 deg. from the cutting edge, and a width of diamond of 0.07 in. so that the cutter clears the thickness of the circular steel holder by 0.010 in. on a side. The forming diamond is set in the same fashion and with 1 deg. back clearance on each side.

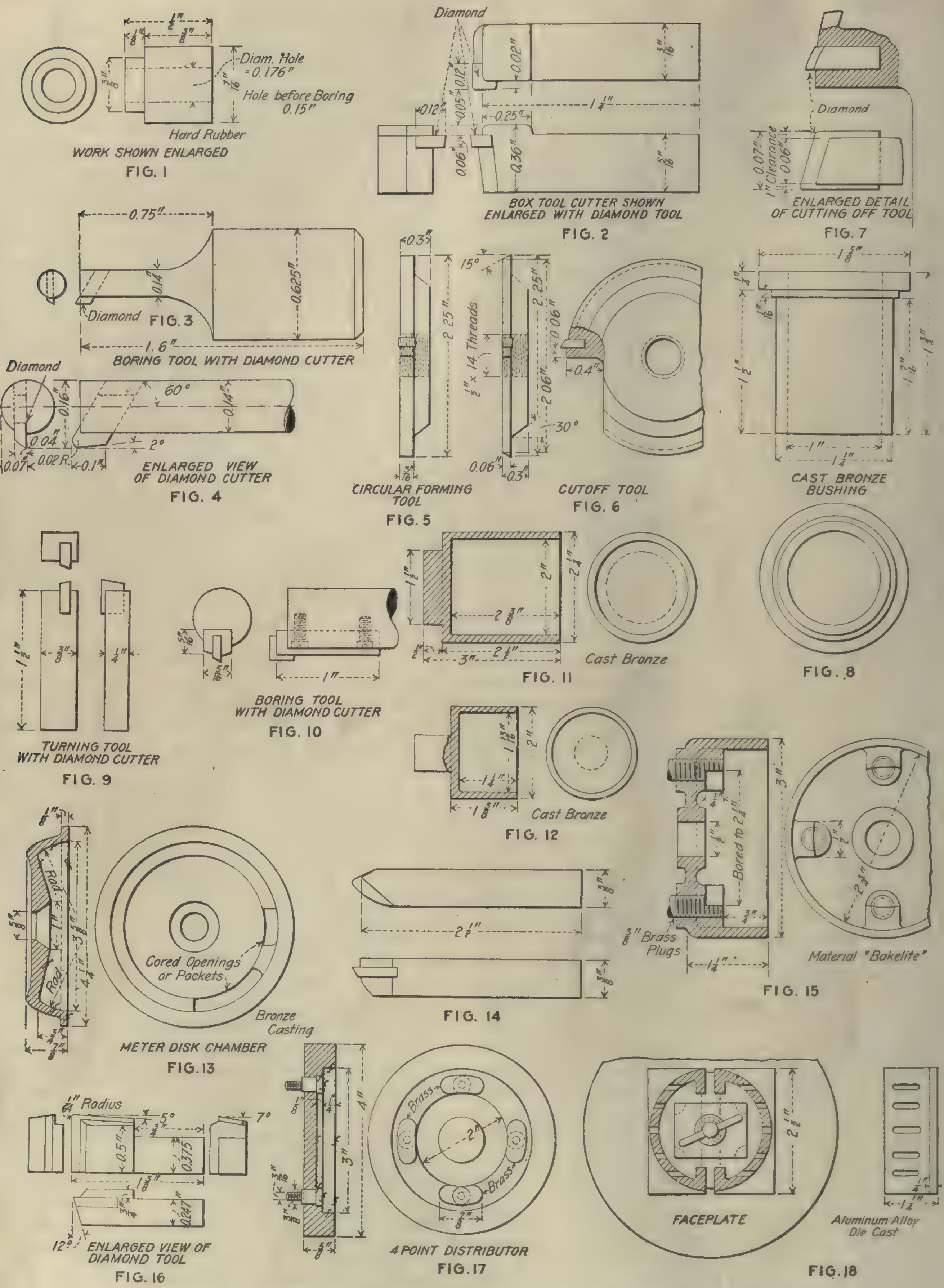
The rubber parts made with these tools are finished from rods 5 or 6 ft. long. The material is very severe on steel tools making it difficult to hold the work to size owing to the rapid dulling of steel cutting edges, and with reduction in spindle speed to a point where ordinary tools stand up the output is necessarily limited. Before the introduction of diamonds on this particular work, 300 pieces per day was about the maximum output from the machine. After the diamond tools were introduced the spindle speed was increased to about 2600 r.p.m. and an output of 3000 per day was obtained. With this work as with various other parts illustrated as produced with diamond tools high rates of speed are regularly employed with light feeds and usually slight depth of cut.

Operations on Brass and Bronze

Fig. 8 gives the general dimensions of a bronze bushing, which is finished from the casting by means of diamond tools. The bushing is cored out in the foundry and is finished inside as well as out. The important dimensions are the body diameter $1\frac{1}{4}$ in. and the bore 1 in., and both outside and inside diameters are held exact to size by the diamond cutters. The turning tool is shown in Fig. 9, and consists of a flat diamond cutter, secured in a steel holder $\frac{1}{4}$ in. wide, $\frac{3}{8}$ in. high and $1\frac{1}{2}$ in. in length. The boring tool, Fig. 10, has a diamond in a steel piece 1 in. long and $\frac{5}{8}$ in. square, the steel block itself being inserted in a slot in the boring bar as illustrated and secured by two small screws. Both the turning and boring diamonds are provided with suitable front rake or clearance to give them free cutting action, and they also have 2 or 3 deg. clearance from the cutting edge toward the back.

The bushing is run at over 2000 r.p.m. for turning and boring, the diamond removing 0.003 in. on a side in finishing and feeding 0.002 in. per revolution of work. Two other pieces of somewhat similar form are shown in Fig. 11 and 12. The first of these is a cylinder 2 in. in diameter inside by $2\frac{3}{8}$ in. deep, the other piece, Fig. 12, being a piston to fit the cylinder bore. The shape of the casting in Fig. 11 is such as to permit it to be readily chucked by the base for the turning and boring operations. The plunger casting, Fig. 12, is poured with an extension at the rear to give a grip for the chuck jaws, this hub or shank being cut off after the piece has been machined.

The diamond turning and boring tools for these two pieces are practically identical with the tools shown in Figs. 9 and 10. Like other work of this character the surfaces are turned down nearly to size by high-



FIGS. 1 TO 18. VARIOUS APPLICATIONS OF DIAMOND-CUTTING TOOLS TO MACHINE WORK

Fig. 1—A hard-rubber bushing. Figs. 2 to 7—Diamond tools for automatic screw machine work. Figs. 8 to 10—Bronze bushing and tools. Figs. 11 and 12—Bronze cylinder and plunger machined with diamonds. Figs. 13 and 14—Diamond tool for turning spherical seat. Figs. 15 and 16—A recessing job. Fig. 17—Another piece bored and faced. Fig. 18—Handling a die casting

speed steel tools leaving 0.003 or 0.004 in. to be removed with the diamond tools. The rate of feed for inside and outside cuts is 0.002 in. per revolution.

It is of interest to note that diamonds seem to stand up indefinitely on such work. For example, one diamond was used continually for the turning of the plungers for a period of over 9 months before it required reshaping and then the trouble was due, not to wear on the cutting joint, but to chipping of the lower surface through an accident in removing the work from the chuck. In this connection it may be well to call attention to the desirability when setting up such tools in the turret lathe of allowing say, a good ¾ in. or 1 in. between the tool and the work when the turret is run back in order that there may be ample leeway for removing and replacing work in the chuck without liability of striking the point of the diamond.

Other Work on Cast Parts

The casting in Fig. 13 is of interest because of the requirements in turning out the interior to a perfectly true spherical surface. This piece is a meter disk chamber, and when assembled it carries a diaphragm, which fits at all points on the spherical seat. As shown by the sketch the casting is 4¼ in. outside diameter, and the mouth of the opening 3⅝ in. across. The work is handled in a special lathe with swiveling mechanism for the tool slide, and the surface is turned out by means of the curved-face diamond tool, Fig. 14. Another important cut taken in the work with the diamond is the conical surface extending from the bottom of the spherical seat to the central bore of the casting.

With the diamond the highest degree of accuracy is obtained in spite of the cored openings in the wall of the castings which ordinarily would cause trouble if the usual steel tool were employed.

Operations on Composite Parts

In Fig. 15 is shown a "Bakelite" case 3 in. in diameter with four internal bosses into each of which is screwed fast a ⅜-in. brass stud. The operation here is to bore out the seat in the bosses to 2¼ in. in diameter, the cut being half in the brass studs and half in the casing in which they are set. The diamond tool for this work is shown to an enlarged scale in Fig. 16. The diamond proper is a flat section set in the enlarged head of a steel holder, the general dimensions of which are given in the illustration. It will be noticed that the diamond has a radius of 1/64 in. on the cutting point; a cutting clearance of 7 deg. at the side, 12 deg. at the front, and a back clearance of 5 deg.

Several machines are in constant service on these cases shown, and from last accounts one diamond tool had finished over 100,000 pieces, another 45,000 pieces, still another 30,000 pieces, and all three tools were still in suitable condition for indefinite service.

The illustration, Fig. 17, shows a piece of work somewhat similar to the one just described except that the cut has to be taken across the composition of which the case is made and at the same time over four brass contact members. This is a 4-point magneto distributor, and the brass heads set in the casing are ⅞ in. wide over all, so that nearly half of the surface to be finished is represented by the brass parts. The diamond tool used is practically the same as the one shown in Fig. 16. In both instances with the work in Figs. 15 and 17, the machine spindle is run at a high speed, and the feed for boring and facing is, of course, quite fine. The advantage of the diamond in making such cuts over two materials of different character is quite apparent upon inspection of the finished work. The keen edge of the diamond and its free cutting qualities make it possible to pass over different materials without liability of its being pressed back slightly by the harder material with attendant lack of uniformity in the adjoining surfaces.

Another form of surface where the free-cutting action of the diamond tool is shown to advantage is seen in Fig. 18, which represents a die casting of aluminum alloy, which is semicircular in outline, and which has a series of openings cast in the body. These slots extend over half way across the surface which is to be turned and with ordinary tools they would present a real difficulty in the finishing to the required degree of accuracy. With the diamond, however, there is no trouble in turning the interrupted surface accurately and with a fine degree of finish.

The work is set up on the faceplate as indicated, two pieces at once to complete the circle, the castings being located against a central spacing device and held by the fingers while the short clamp-plate is tightened with the thumbscrew. As only a light cut is taken no great amount of pressure is required to hold the work in place. The machining of such pieces with the diamond has demonstrated the advantages of high rates of speed of rotation.

It seems to be desirable to run the work at the highest spindle speed obtainable for the diamond will stand up at any speed, and the high velocity gives at the same time an increased output and a splendid finish on the surface of the material. As a matter of fact, when the diamond was first applied to this particular piece, Fig. 18, the work was tried out first with the spindle running at comparatively low speed, with the result that the surface appeared somewhat the same as if it had been operated upon by a dull steel tool, or one ground to improper rake and clearance. With the speeding up of the work, the character of the surface was improved to a degree that gave it an appearance of having been polished, there remaining no indications, whatsoever, of any tool marks or feed lnies from the diamond point.

Slackers in the Shop

By D. A. Baker

Within the past few days I have had occasion to talk with quite a number of executives in charge of machine and tool shops, who are more or less actively engaged with work in connection with Government contracts for tools, jigs, fixtures, gages, etc., which are eventually to be used in the getting out of materials which will be needed in our war against the enemy.

In every case their talk has led around to one subject, the "don't-care-spirit" of our toolmakers and machinists of the present day. As one man said to me only today, "A gage which used to cost about $4 we are now compelled to charge $16 for, not because it is worth it, or because of any advance in material or

wages, but simply because of the present-day spirit on the part of the men. Knowing as they do that practically every tool shop in the country has all the work that it can attend to, they are naturally independent and care free." This is especially true in the City of New York, probably more so than in any other locality because of the congested condition, and the nearness of one shop to another. In dozens of cases it is only necessary for a man to go from one floor of a building to another, or merely step across a hallway in order to land another job and go to work.

Apparently few of our mechanics realize that they have a vast responsibility in the conduct of the present war; that upon them fully as much if not more than upon the man in the trench depends our prospect of future victory. But I am hoping when once they do fully realize the situation, when it is brought home to them that before our boys can be supplied with rifles and cartridges, before our gunners can be supplied with shrapnel and high explosive shells, before the highly complicated time-fuse so necessary to these shells, and other details of a like nature can be made, it will be necessary for them to make the thousands of gages, jigs, fixtures and special machines that are to be used in such production.

Unfortunately our Government, through its agents the exemption boards, seemingly lacked judgment in its drafting of large numbers of skilled men from trades directly connected or allied with the production of munitions, and has therefore thrown a much greater burden on those of us who are left behind than would otherwise have been the case. This, however, is only a greater reason why each and all of us should make the greatest effort to bring to a termination the most unfortunate and appalling disaster of all ages.

Increase in Wages

Looked at in any light, the toolmaker or machinist who lays down on the job at this day and age is a slacker; for, while it will be admitted that living has increased in cost to a remarkable extent in the last few years, it must also be admitted that the toolmaker's and the machinist's wages, as compared with other trades have been increased in a just proportion. They are today, comparing their hours of labor and the steadiness of their work, in one of the most highly paid branches of skilled labor. There is no reason today why anyone with mechanical skill need be out of work or lose a single hour if physically able to work. In fact at present there is hardly a shop which is not only working full time, but in addition asking their men for overtime at advanced rates.

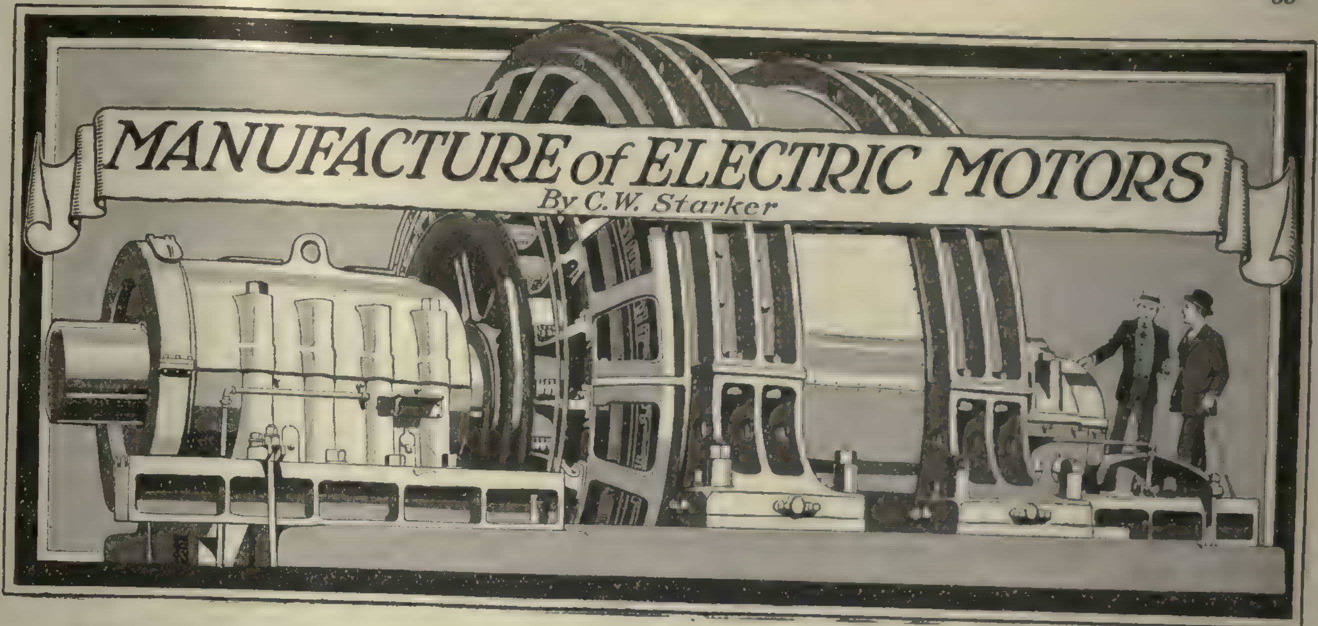
All this is due to just one thing: The necessities of our Government, the need for haste, the knowledge that the loss of a day, or possibly an hour may mean the loss of hundreds, possibly thousands of our boys "over there." You who read this, brother mechanic, think it over. Compare your position with that of your brother in the trenches. Perhaps you are standing at your machine watching the chips curl from an interesting job, perhaps you are sitting on a comfortable stool at your bench, with an open window in front of you from which you can see green trees, or perhaps looking out on the street with its interesting passing traffic. Certainly you have little to worry about and your lot is far from being a hard one. On the other hand "over there," he may be standing in mud in a rain-soaked trench, possibly someone near to share his misery, possibly alone. His view, the sky in one direction, a short section of trench in another, and if he is able to see more, it is but a barren shell-swept wilderness. This comparison alone should be enough to open your eyes, and unless you are doing not only your bit, but every bit that you are capable of, it should make you feel the deepest shame. But in addition remember this: "Over there," they are not taking vacations on a Monday morning nor in between; nor are they punching a time clock, working eight-hour days, nor getting time and a half and double time for overtime. While our favorite alarm clock over here is called Big Ben, and is made in a factory out in our Middle West, with a voice completely under our control, awaking us only as we wish, it is very gentle compared with the alarm clocks they have over there called by the milder name, Big Bertha, and hailing from the shop of Herr Krupp in Essen. Those alarms are set to go off at all times day and night, with a jarring voice that has been heard the world over, and for which as yet no control has been found.

Question of Advancement

Forgetting duty to country, let us look at the matter from a more selfish standpoint; that of self-preservation or self-advancement if you like. Today, the mechanic who wishes to advance himself has an unlimited field. Never before in the history of the country has there been so great an opportunity. Not only is the variety of work greater than ever before, but also the quantity. Furthermore, there has never been such a scarcity of skilled men to handle the work.

Herein lies a golden opportunity. You, who today are working at the bench or machine, must, if you would qualify for a better position, gain that experience which is so necessary for the competent filling of a better position. This experience can come to you only through your own efforts to acquire it; this may be in several ways and none of them should be neglected. While it is true that a great deal may be and is acquired by observation and reading, the best experience is acquired by putting into practice, and actually doing ourselves that which we have observed others do or which we have read of others doing. For that reason if for no other, we should always work as if each job was for ourselves, and that on each job there was a sure bonus to be earned, and that the time saved in doing a perfect and satisfactory job, added to that bonus. This in fact is an actuality. The experience which we get from the doing of each piece of work is our bonus. Not only is it a bonus, but it is a bonus that is immediately placed to our credit in a savings bank of the most unique kind because the bonus of experience, which is placed to our credit grows bigger the more we draw on it. This is not only plain common sense, but it also means dollars and cents to the man who follows out the principles here stated; and just as men with large capital are able to get into and follow big business, so is the man with large experience able to advance himself in his particular field or line of endeavor.

Once more brother, think this over, but whatever you do or think, do not be a slacker.



MANUFACTURE of ELECTRIC MOTORS

By C.W. Starker

VIII—Rotor Cores and Shafts

Cores in electrical apparatus are laminated structures built up from sheet steel. In the revolving parts, called rotors or secondaries in the case of alternating-current motors and armatures for direct-current machines, there are two typical constructions, the spider type and the riveted type. The use of the one or the other construction depends on the size of motor and on considerations of economical manufacture, rather than on the kind of current or on any difference in regard to quality and serviceability of the completed apparatus.

IN FIG. 74 *A* illustrates an alternating-current rotor core and *B* illustrates a direct-current armature. Both of these are of the riveted type. The laminations or punchings are built up on arbors between end-plates of malleable iron or steel plate and then clamped together tightly on a building fixture. This building-up process and the building fixture are shown in Fig. 75. The fixture is constructed so that perfect alignment of the individual punchings is secured, and a smooth appearance of the walls of the slots, in order that the winding, that is the armature coils in the case of wound rotors or the bar conductors for squirrel cage motors are securely held, and at the same time readily put in place. Filing of the core after building is undesirable as it tends to increase the iron losses and is costly. After building, and while still under pressure on the fixture, the cores are taken to the horizontal hydraulic riveting press, Fig. 76, where the rivets are upset under pressure up to 30 tons. Four to six rivets are used in the core, so placed as to be well out of the magnetic path.

With this construction, cores of varying width as required for different motor ratings are readily obtained, using the same punchings and end plates. This permits a minimum number of different dies, punchings, and other parts. Where coil supports are required on wound rotors these are made part of the end plate castings. Blower vanes for artificially ventilating the machine are also readily made part of the rear end plate. The front end plate on direct-current motors is shaped so as to form a support for the commutator bush. It permits the ready removal of the shaft from the armature without disturbing the winding, and also the removal of the commutator separately. The pressing on of the commutator and pressing in of the shaft are both done on the horizontal hydraulic press, shown in Fig. 77. A minus allowance of 0.004 in. on an average is made to secure press-fits of 5 to 10 tons between rotor core and shaft.

Finger plates, made either from heavy punchings, ($\frac{3}{32}$ in.) or with separate sheet-steel fingers riveted or spot-welded to one of the punchings, are used where necessary to prevent excessive spreading or flare of the core, when put under pressure. One of the spot-welded finger plates such as used on direct-current armatures, and the Thomson spot welder used for this work are shown in Fig. 78. These same plates are used frequently in the core as ventilating plates, and together with the axial ventilating holes in the punchings provide an effective cooling, where the slot number is sufficiently low, that is the tooth relatively wide. On alternating-current rotors a large number of slots is used to secure high performance and this together with the small air gaps through which air current would have to pass, makes the use of such finger plates as a rule inadvisable, except on large sizes. As the rotor or armature, due to variations in punchings or coils is likely to be unbalanced, which would result in vibration of the machine when running, provision for balancing is made

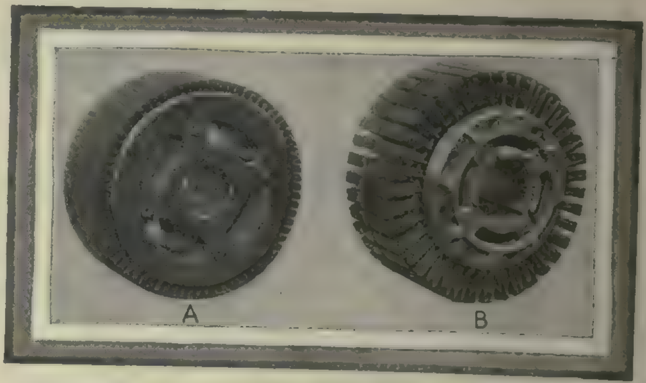


FIG. 74. ROTOR AND ARMATURE

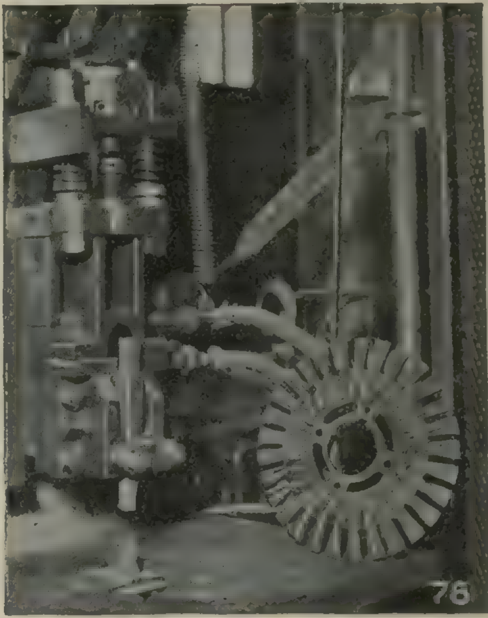


Fig. 75, Building Rotor Cores.

Fig. 76, Hydraulic Press for Riveting Cores.

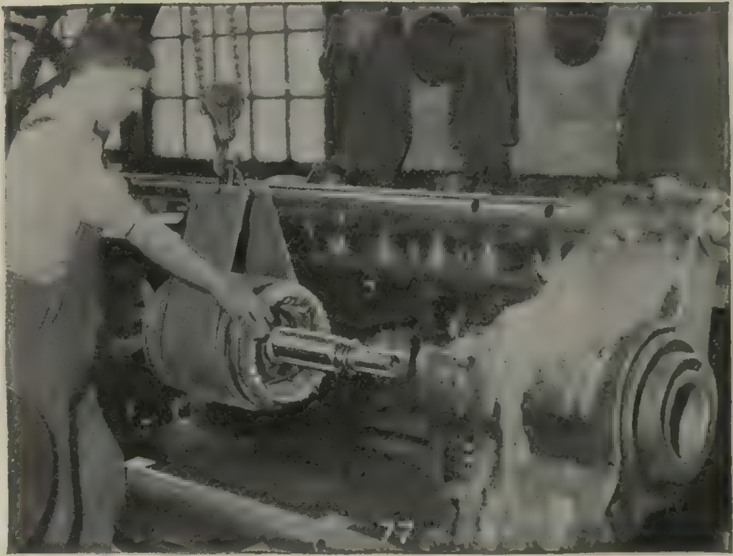
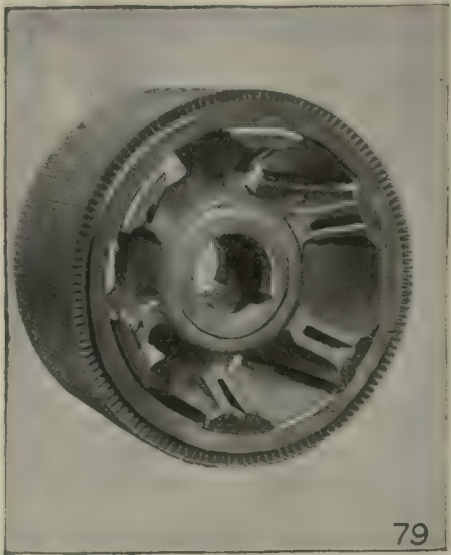


Fig. 77, Hydraulic Press for Shafts and Commutators.

Fig. 78, Finger Plate and Spot Welder.

Fig. 79, Spider Type Core.



by pockets in the end plates for receiving quantities of lead or by similar means. In alternating-current rotors for certain applications, as for instance, elevator service, where absolutely noiseless operation and smooth starting are required, the cores are preferably skewed; that is built up with the center line of the slots at an angle to the axis, the pitch usually being about one slot. With the built-up riveted core this is readily obtained, except that the cutting of a straight keyway after riveting is required.

The limitation of this riveted construction is merely a question of cost. When a point is reached, where the value of the punching centers exceeds the cost of a spider and end plates, the construction shown in Fig. 79 is used. The center of the rotor punchings is then punched out and used for other work, such as smaller punchings, and the rim of punchings remaining is built-up on, and keyed to a cast-iron spider between end plates made of cast iron or rolled up from bar steel. This construction is entirely satisfactory and has been successful for many years before the riveted construction was known, but is in no way superior to the riveted construction. In fact, where cost considerations are of no importance as compared with standing-up in extremely severe service, riveted cores are used no matter of what

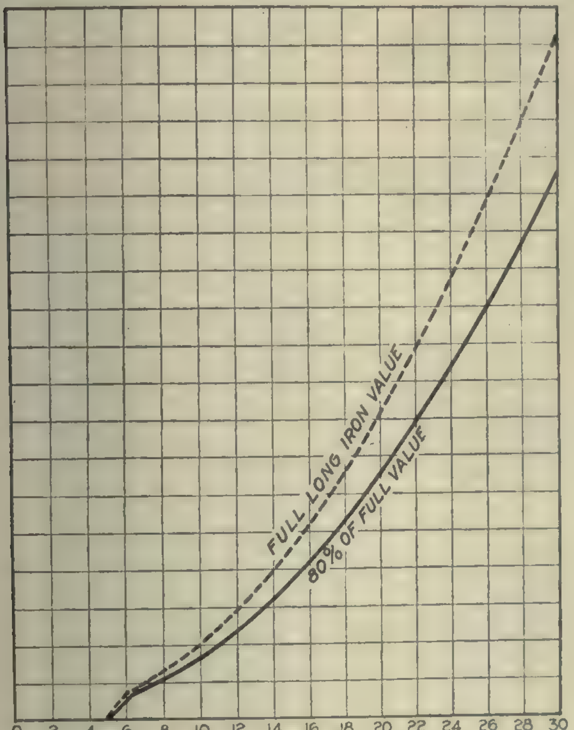


FIG. 80. CURVE USED IN DETERMINING ROTOR CORE CONSTRUCTION

size. On electric locomotive motors, for instance, cores of 40 in. or more in diameter and about the same in length are successfully riveted and preclude, of course, any working loose of punchings on the spider or keys. However, normally on industrial motors the dividing between the two constructions is determined by cost considerations, particularly at the present time, when the cost of electrical sheet steel has risen to more than three times its former value. This is done by means of curves such as Fig. 80, which give the value of punching centers or circles per inch width, that is, built up 1 in. high for a certain thickness and grade of sheet steel. Factors for other grades or other thicknesses or for other price conditions are readily established. By multiplying the amount in dollars obtained from the curve for punchings of the proper diameter, with the number of inches width of the core used, a comparison between the cost of a spider and the cost of solid punchings is quickly made, and the construction determined as either riveted or spider type.

The dividing line for alternating-current rotors is usually around 16 in. core diameter, a motor of about 30 to 40 hp. For direct-current motors where deeper slots are required and a greater depth of iron below the

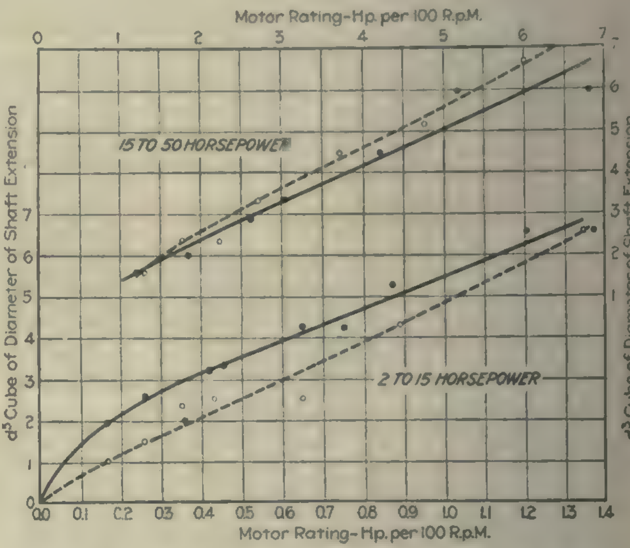


FIG. 81. CURVE OF COMPARATIVE SHAFT SIZES

slot for magnetic path, the dividing line is even higher, namely, around 19 or 20 in. core diameter.

The machining operations on spiders or end plates present no unusual features and the finish turning or grinding of the core on the outside is not done until after the winding is completed, therefore, it will be referred to later. The manufacture and design of punchings for electric motors has been described in detail in the *American Machinist* on page 529, Vol. 44, and page 895, Vol. 45.

The first question regarding a motor shaft is: What is it made of? It has to transmit the torque of the motor by means of coupling, pulley or pinion, therefore, it has to stand with safety, the entire torsional stresses at a maximum overload. More important are the bending stresses imposed on the shaft by belt pull, tooth load, or by misalignment. Other stresses such as starting and stopping, or the application of brakes as in crane or elevator service, finally abuse of the driven machinery, such as entering of a cold billet between the rolls of a motor driven mill, must be given due consideration. Shaft dimensions alone do not answer the question fully; material is the first consideration. There are two kinds of shaft material used by the different motor manufacturers. Machinery steel is the general product on the market for shafting. Its characteristics are quite indefinite, the term covers any bessemer or open-hearth steel, the tensile strength may be anywhere between 50,000 and 90,000 lb. per sq.in., with a yield point anywhere between 25,000 and 50,000. If it is bessemer

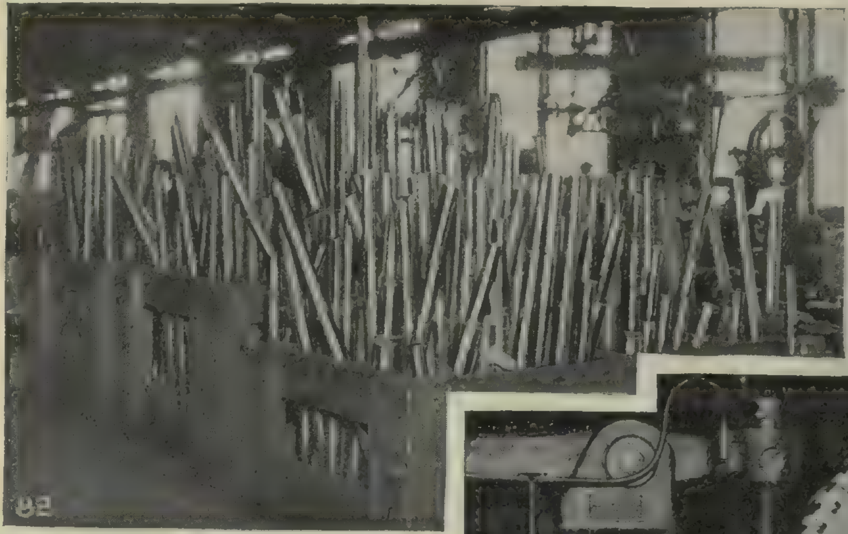
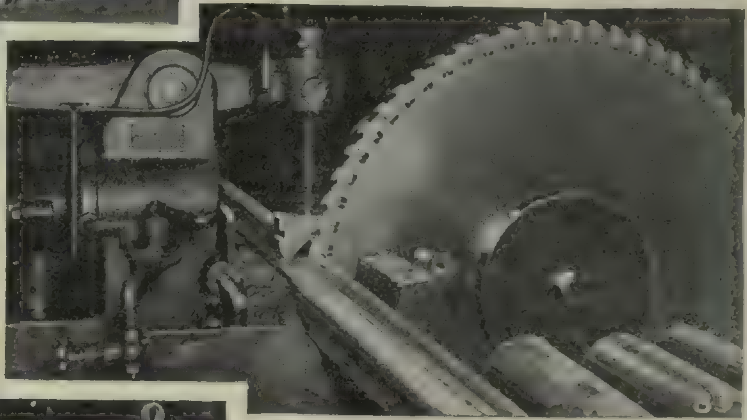
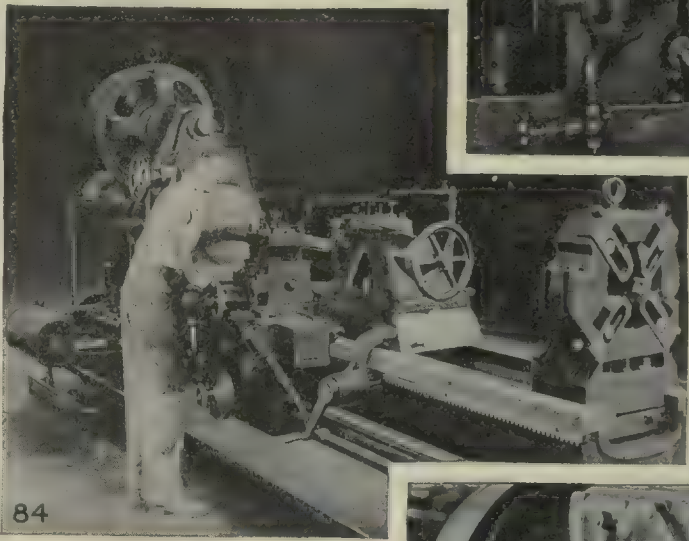


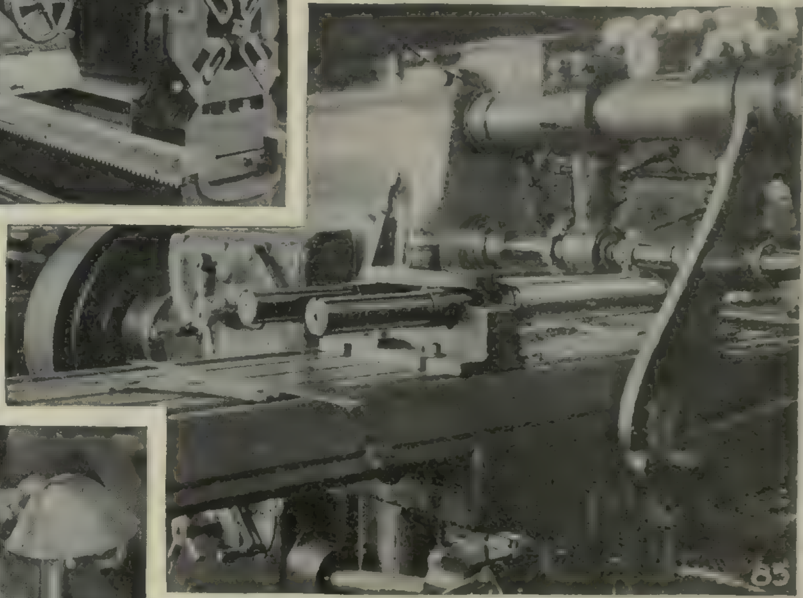
Fig. 82, Stock of Special Shafts.

Fig. 83, Cutting-off Saw for Shaft Stock.

Fig. 84, Roughing Lathe.







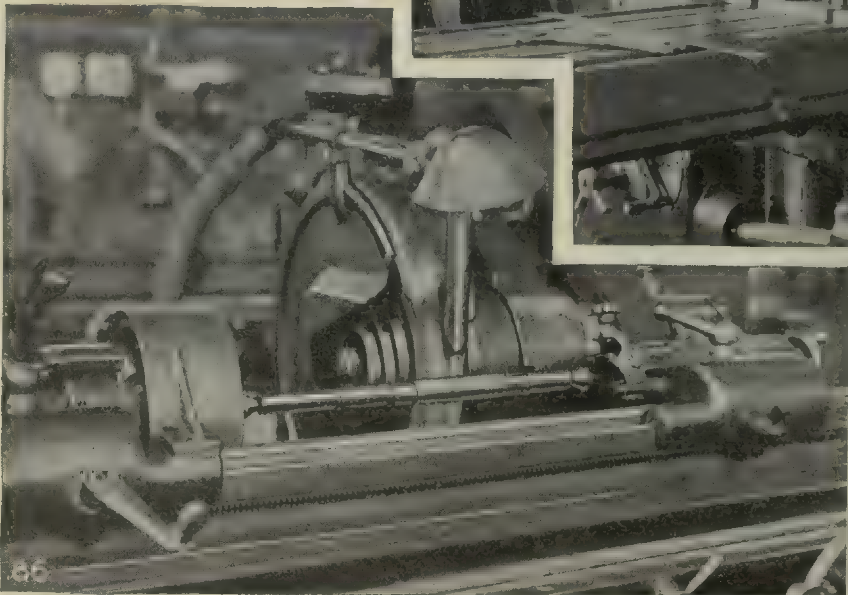


Fig. 85, Milling Keyways.

Fig. 86, Shaft Grinding Machine.

steel, it is likely to be brittle on account of high phosphorus, a very undesirable property for motor shafts. Axle steel on the other hand, such as exclusively used on the motors under discussion, is purchased under a definite specification and must have the following characteristics: Tensile strength 75,000 to 90,000 lb. per sq.in., yield point not less than 40,000 lb., elongation not less than 18 per cent. in two in., contents of manganese not more than 0.60 per cent., phosphorus and sulphur each not over 0.06 per cent. The true elastic limit is very close to 40,000 lb. Further, the specification covers definite tests carried out in both the supplier and the motor manufacturers laboratory, so that only product of very definite, high-grade quality is worked up into motor shafts. The result has been that shafts broken in service are practically unheard of and if they occur, it is due to an accident to the driven machinery of quite unusual circumstances.

Calculating Shaft-Diameters

The necessary diameters of a shaft are as a rule readily calculated on the basis of trosional or bending moments acting at certain definite points. In planning a line of general-purpose motors, however, the matter becomes complicated by the uncertainty of the underlying data. Such motors are used for all sorts of applications from severe hoisting or mill work to running a small lighting plant. The mechanical application, gearing, belting, etc., may be carried out with various sizes of pulleys or pinions, various belt tensions, and also with various degrees of perfection. However, the motor is expected to withstand any reasonable amount of abuse and faulty installation. Determining of shaft sizes becomes under these conditions a question of establishing a basis for calculation, that is, a matter of judgment and experience. Certain overloads, minimum pulley diameters, and maximum width of face of pulleys, are assumed and shaft stresses calculated for maximum reasonable belt tensions. Similar calculations are carried through for minimum diameter of pinion, etc., and finally shaft stresses and bearing pressures are determined from which the diameter of shaft in the bearing is established and tables prepared giving limiting pulley sizes, pinions, etc. In actual practice service experience and competition between manufacturers has led to a fairly uniform policy. We give in Fig. 81 a curve showing comparative shaft sizes (in the cube of the diameter, since permissible bending and torsional stresses increase with the cube of the diameter) and motor rating in horsepower per 100 r.p.m. for similar lines of motors of two of the leading manufacturers.

Unfortunately the efforts to establish a common standard of shaft size for a given rating between all motor manufacturers has as yet been unsuccessful. Such a standard would have obvious advantages for pulley manufacturer, motor user and maker, but these would, at least in the present state of the art, be more than offset by the severe handicap a compromise between manufacturers would impose on the general layout of a line of motors, planned with different grouping of ratings on individual frames and adapted to conditions peculiar to each manufacturing plant. As a preliminary step, however, it has been proposed to establish irrespective of motor rating, certain standards for bearing diameters, reduction in diameter between journal and extension, length of extension in relation to diameter, and finally size of key and keyway. A uniform policy also has been established between all the principal manufacturers of motors in regard to the use of a third bearing, a point on which at times divergent opinions exist. Contentions against the need of a third bearing may be supported by favorable experience on actual installations, but the fact that one can take a chance unpunished, does not make the practice advisable. A positive limit cannot be set, but it is now recognized and recommended as good practice to use outboard bearings in geared applications of general-purpose motors for ratings larger than 75 hp. at 850 to 900 r.p.m. and belted motors larger than 200 hp. at 500 to 600 revolutions per minute.

Permissible manufacturing variations in the diameter of shaft extensions are also of particular interest to the user who fits his own pulley, coupling or pinion. In this respect, the rule has been established that for diameters less than 1 in. the allowable variation from nominal shall be minus 0.0005 in. to plus 0, and for diameters 1 to 2 in. inclusive, minus 0.001 to plus 0. Pulley bores to be such that U. S. Standard plug gage correct to nominal diameter, will pass through, but the bore to be no more than 0.002 in. in excess of nominal up to 2 in. and 0.003 in. above 2 in. Inasmuch, as shaft extensions of general-purpose motors must be suitable for either pulley, pinion or coupling, the latter two must be fitted, reamed, to secure the proper press fit.

Value of Standardization

All these attempts at standardization are very desirable steps, taken by the manufacturers to overcome as much as possible the handicap the electrical industry is laboring under, due to diversity of product, variety of sizes and modifications demanded by the market. It is to the interest of the user of motors to assist in this direction, inasmuch as unfavorable manufacturing conditions ultimately find their expression in the price of the product. The flexibility of the electric motor tempts to special constructions; rather than making a slight change in the mounting of motor some users are inclined to request a modification of the motor. A special shaft dimension seems a small matter, but the accumulation of such specials, Fig. 82, handicaps a standardized manufacturing process, increases cost, delays other work, and necessitates with a large corporation special clerical work. The accepted standards are so broad, that they should be applicable almost universally.

Straight, cylindrical, shaft extensions are the recognized standard practice on general-purpose motors. Tapered shaft extensions are used on mill type and street car motors, but should not be specified on universally used general-purpose motors. Shafts on machine tools, etc., to which the motor is applied by coupling, etc., are hardly ever tapered, so that a tapered motor shaft would necessitate one coupling half to be bored straight, the other conical. Further, a slight manufacturing error in the amount of the taper would materially alter the distance between the face of the coupling, gear or pulley and the center line of the motor, that is, result in difficulties in the alignment. The overhang for wide faced pulleys is objectionable and the threaded shaft end with large nut customary on tapered

shafts also has disadvantages, both from space and safety considerations, while the use of a long bolt screwed into the shaft center is a mechanically inferior construction. There is, therefore, no good ground for such modifications from the standard shaft extension, and while there is no general demand for the tapered shaft which would justify contemplating it as a future standard, this case is given as an example of individual demands which are a handicap to the industry and should be avoided.

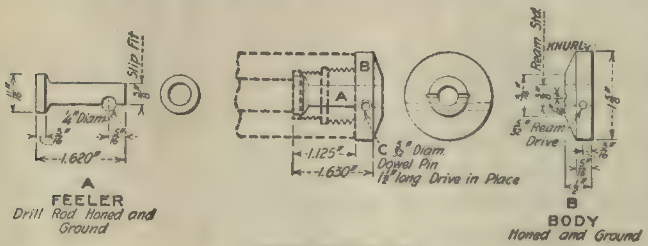
In the manufacturing process of motor shafts the first operation is cutting off from bar stock to the required length. This is done on large circular saws with inserted cutters. One of these machines is shown in Fig. 83. Then follows rough turning on powerful lathes, driven by 30 hp. adjustable speed motors 350 to 1050 r.p.m., Fig. 84. The milling of keyways, with several shafts in multiple is done on large milling machines as shown in Fig. 85. Next follows the finish turning, which includes machining of oil throwers on the shaft, except in cases where these are more economically machined separately and shrunk on the shaft later. The final accuracy is obtained by grinding on wet grinding machines such as shown in Fig. 86. The pressing in of the motor shaft into the rotor cores is done on horizontal hydraulic presses, one of which has been shown in Fig. 77.

(To be continued)

A Gage for Depth of Recesses

By C. H. Dengler

The illustration shows a form of feeler gage which is being used on airplane motor work. It consists of the feeler *A*, to which the knurled body *B* is attached by



A FEELER GAGE

driving a dowel pin *C* into a reamed hole in the body and engaging a recess in the feeler. The dotted lines indicate the part to be measured. The gage is very simple and has proved durable in service.

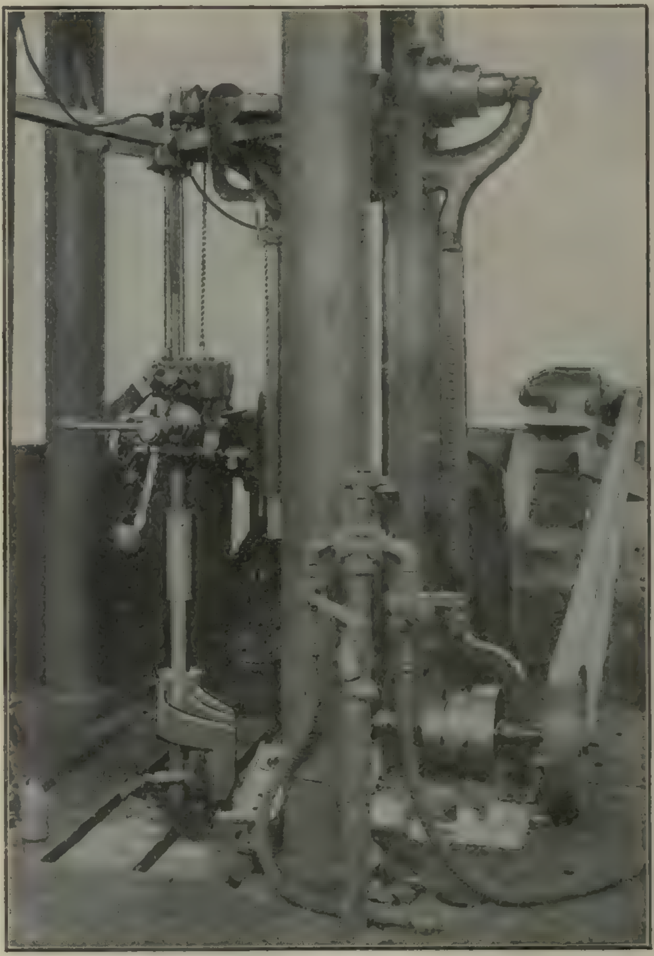
An Emergency Repair Job

By G. J. Hopkins

The accompanying illustration shows a device by which a difficult operation was done simply and rapidly and with such means as are at hand in any machine shop.

In a large shell-forging plant, it became necessary to true up the counterbored holes used for centering the die holders on the bases of the 700-ton hydraulic presses. These bases were not only heavy and imbedded in concrete, but were more or less inaccessible due to the upper structure, the cylinder being supported at a height of several feet on four columns placed 4 ft. apart. The heavy work done on the presses having battered the counterbored holes out of true, it was decided to bore them out and put in removable bushings.

A 20-in. Superior drilling machine was removed from its base and clamped to the press base in the manner shown. An extension arbor was turned up to fit the drill socket. The lower end of this arbor was guided by a bearing held by a four-arm spider in the hole below the depth of the proposed machining. Keyed and set-screwed to the arbor was a special tool-carrying casting, on which was mounted a cross-slide and toolpost removed



TRUING UP THE COUNTERBORED HOLE

from the compound rest of a lathe. Some nice laying out was necessary to make the comparatively bulky tool-carrier swing inside the hole to be bored which was $15\frac{3}{4}$ in. diameter by $1\frac{3}{4}$ in. deep, but so carefully was the work carried out that the job was finished to a limit of 0.002 in. in an average time of about 23 hours for each press.

Amalgamated Machinery Corporation Gets Large Orders

The Amalgamated Machinery Corporation, Chicago, Ill., announces a three-quarter million dollar order for gun-boring machines and lathes, and a half-million dollar order for shell-boring machinery.

With its present capacity of turning out ten machines a day the company is in a position to handle not only these large orders, but additional ones, as well, and yet assure their patrons of 30-day delivery.

The Micrometer Head in Toolwork

BY HUGO F. PUSEP

In the modern toolroom it is constantly necessary to move work, during the machining processes, with a considerable degree of accuracy. A few applications of the ordinary micrometer head are shown.

THE problem of direct measurements while performing intricate machining operations in precision tool work, is one that has been considerably discussed, both in regard to the use of commercial measuring instruments to suit different conditions, and the application of special measuring devices adapted to the work in hand. At the present time most of the measuring in toolroom machine work is done by the old slow cut-and-try method. There are a number of cases where this not only serves the purpose, but is unquestionably the best course to take, but where the method of direct measurements can be applied machining time is reduced, the quality of the product is improved, and guesswork is eliminated to a great extent.

The purpose of this article is to show how the commercial micrometer head can be used to advantage for taking direct measurements on the various machine tools of the modern toolroom. There are on the market small precision boring, and drilling machines equipped with micrometer heads or vernier slides, but it would be safe to say that a very large majority of toolmakers have never seen one. With a few cheaply made accessories the commercial micrometer head can be made an indispensable tool in precision work.

In Fig. 1 is shown a Brown & Sharpe micrometer head. The small end measures $\frac{3}{8}$ in. diameter by $\frac{3}{4}$ in. long and supplies the medium by which it can be secured to machine tools by a suitable adapter bracket.

EXAMPLES OF LATHE WORK

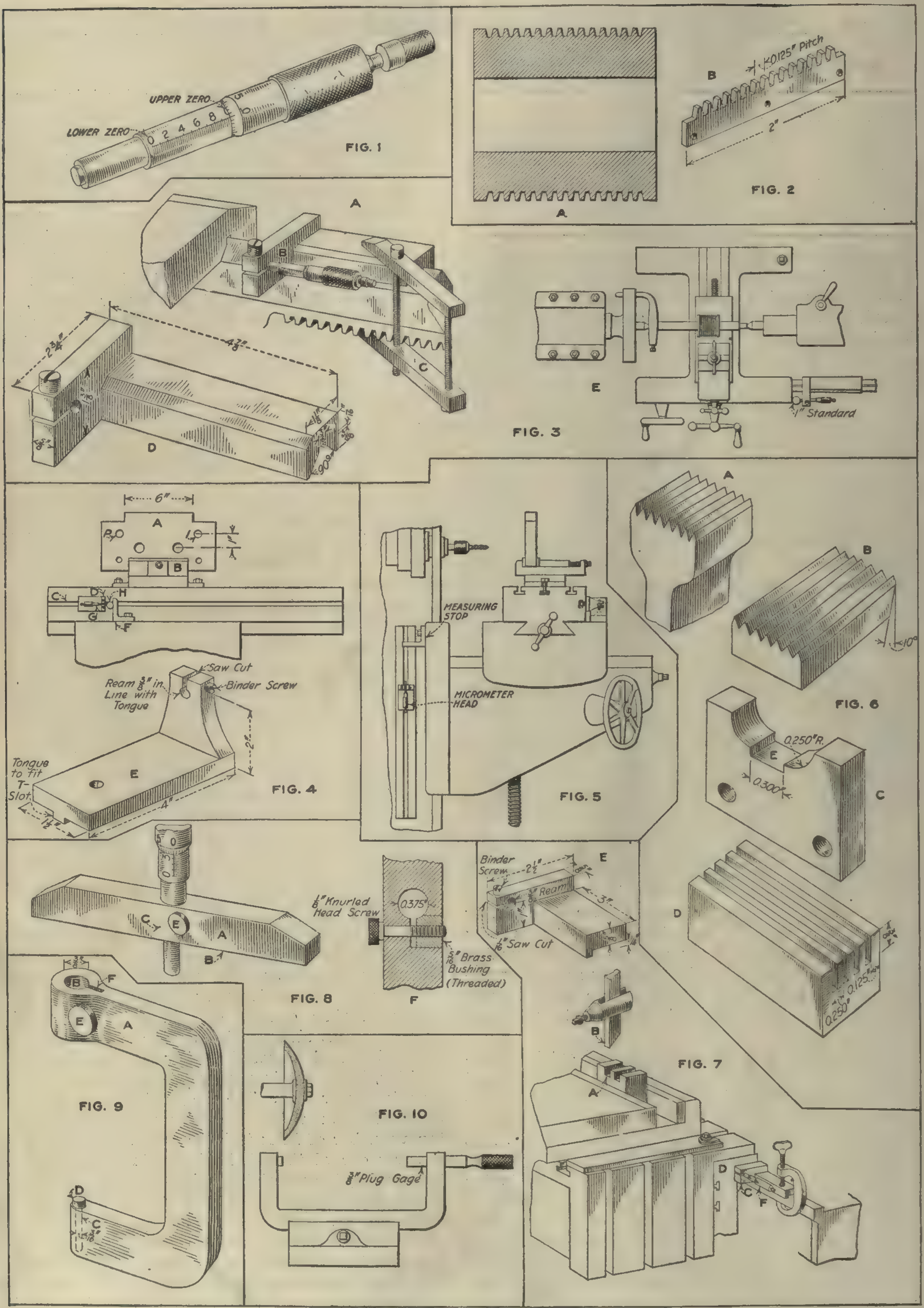
The small racks *B*, Fig. 2, are used in the construction of adding machines and are milled in quantities, while held in a special holding fixture, with the form milling cutter shown in cross section at *A*, Fig. 2. These racks were kept to very close limits, and therefore the making of the form cutters or straight hobs was quite a problem, more especially the cutting of the tooth grooves to the proper pitch. The hobs were finally machined as follows:

The blanks were turned to the correct outside diameter on a toolroom lathe, and the 15 grooves roughed out. Then a master finish forming tool, the exact counterpart of a rack tooth, was secured in the lathe toolpost and brought approximately in line with the first roughed-out groove, nearest the tailstock center, on the hob blank. A micrometer head was fastened to the front V of the lathe bed as shown at *A*, Fig. 3. *B* is the retaining bracket and *C* the parallel clamp the top jaw of which bears on the retaining bracket, and the bottom jaw below the carriage feed-rack of the lathe. The micrometer head was then adjusted until a 1-in. standard disk could be just slid between the end of the carriage and the micrometer spindle, while the latter was set at upper zero; after this the carriage binder screw was tightened, and the lathe was ready for grooving the hobs. The graduations on the cross-feed handle were also set at zero after the tool had been fed to the proper depth on the first groove. For the next groove the carriage was moved 0.125 in., which was easily accomplished by setting the micrometer head at 0.875 and feeling with the 1-in. standard as before. The next setting of the micrometer was 0.750, then 0.625, and so on until the lower zero mark was reached. A 2-in. standard was now secured, the micrometer turned back to upper zero and the whole procedure repeated until all 15-tooth grooves had been cut. At *D*, Fig. 3, is shown a form of retaining bracket which will fit any toolroom lathe having V-shaped ways. The advantage of this type of retaining bracket is that it can be used on a lathe of any size. Note especially the saw cut and the binder screw, by which the micrometer head can be quickly adjusted, and then clamped securely by tightening the screw.

At *E*, Fig. 3, is a diagrammatic illustration, showing the lathe set-up for cutting the tooth grooves in the hobs, a cross-section of which appears at *A*, Fig. 2. A look at the diagram will demonstrate the advantage of this method. All direct measurements of the spacing of tooth grooves are eliminated entirely, and in this particular instance the relieving of the teeth in the hobs, after the tooth spaces have been cut in a milling machine, was also accomplished in a similar way with a micrometer head equipped relieving lathe. A first-class job, in regard to accuracy was the result. From the example given, it can easily be seen that there is a wide field of usefulness for the micrometer head in precision lathe work. All kinds of form milling cutters having steps, shoulders, recesses or radii a given distance apart, can be cut very accurately. This method is not limited to work between centers only. It can be utilized also in chuck work, when it is necessary to square a bottom of a bored hole from the finished face to a very close limit, also in gaging the depth of recesses.

MEASURING EQUIPMENT FOR THE MILLING MACHINE

The up-to-date toolroom of a big manufacturing plant can easily equip its milling machines with expensive vernier slides, when it is demonstrated that a great saving of time can be effected on machines thus equipped. But although the small shop toolroom can seldom boast of a special vernier-equipped jig boring machine, it can obtain equally satisfactory results with the micrometer head. The one great advantage of this method is the fact that whenever a jig or fixture having a number of holes to be bored on the same plane, has any one of these holes bored in correct relation to its sides, the remaining holes can then be bored to finish size without any other measurements than the moving of the milling machine knee, or the table, to conform to the various micrometer readings. In order to equip the toolroom milling machine for this work it becomes necessary to provide suitable holding brackets for the micrometer heads, both for the table and the knee. Besides these brackets, measuring stops are



APPLICATIONS OF MICROMETER HEADS TO VARIOUS TOOLS

required, and must be so positioned as to be square, and in line with the micrometer spindles in conjunction with which they are used. As there are a great number of milling machines adapted for toolroom work, each of them differing in some essential of design; it would be difficult to proportion the necessary brackets and measuring stops, which would fit any make of milling machine. This, however, is not a handicap in a small toolroom, because as a general rule all boring work is reserved for a particular machine, best adapted for this purpose.

In Fig. 4 is shown a front view of a milling machine table, set-up for boring the six bushing holes in the jig leaf *A*, while held in the milling machine vise *B*. Here the T-slot *C* for the table feed trip blocks is made use of for clamping the micrometer head retaining bracket *D* to the front of the milling machine table. An enlarged view of this bracket appears in perspective at *E*, Fig. 4. The small angle iron measuring stop *F* is fastened to the saddle with a cap screw, entering one of the tapped holes of the table-gib screws.

For this particular job another micrometer head had to be secured to the column of the milling machine in order to take care of the vertical adjustments. The way of fastening the micrometer bracket to the T-slot of the vertical feed trip blocks, and the angle stop for measuring, to the knee by a gib screw is shown in Fig. 5. The bracket for holding the micrometer head to the column of the milling machine is not shown in detail. It is very similar to others of its kind already described, consisting merely of an angle iron having suitable holes, saw cut and a micrometer head binding screw. There are some makes of milling machines not having convenient screw holes or T-slots, which could be used as clamping mediums for the micrometer heads and measuring stops, and in that case a few holes can be drilled with a breast drill and tapped out to take the necessary clamping screws. This is required in only very rare instances, but where it becomes necessary, the few tapped holes of small diameter will not impair the machine in the least.

Boring a Jig Leaf

Let us revert to Fig. 4. The operation of boring the jig leaf *A* is as follows: The milling machine spindle is brought in line with the hole *P*, which is then bored to its finished size. Now the micrometer head *G* with the bracket *D* is adjusted so that a 1-in. standard disk *H* will touch both the stop *F* and the micrometer spindle, while the latter is set to read upper zero. The micrometer head on the column and the stop on the knee of the milling machine are adjusted identically. The table of the milling machine is now moved 6 in. in order to line up the spindle with the location of hole *I*, which is accomplished by feeling with a 6-in. standard length rod between the stop and the micrometer spindle, while the micrometer is set at lower zero. After the hole *I* is bored, the milling machine table is raised 1 in. on the column, the adjustments being made exactly as already described, with the exception of using different length rods. No description is necessary for the locating of the remaining holes in the jig leaf *A*. The set of standard length rods supplied with every micrometer set, and without exception found in every toolroom, can be utilized here admirably. Where a special length rod is required, one can easily be made out of drill rod, and the ends hardened, which should then be stamped as to length and, on completion of the job, turned into the tool-supply room ready for future use.

The shaping machine is even yet considered by the old timers as a machine tool for rough work only. But, I am sure that all up-to-date toolmakers agree with me in the assertion, that provided a method is found for accurately determining the movement of the shaping machine table, many jobs formerly machined on the milling machine, could be accomplished more economically and satisfactorily on the shaping machine. Here is where the micrometer head will solve the problem. In Fig. 6 are shown a few examples of precision shaping machine work. The thread chasing tool *A* is used to finish chasing taps and thread gages. At *B* is shown an insertable die blade, used in a large self-opening die for munition work. Both of these jobs were finished with a spring-threading tool, such as commonly used in the lathe, the spacing of the required accuracy being obtained by the use of the micrometer head. The 0.250-in. radii in the screw machine form tool *C* were machined in a shaping machine; a form tool of the correct radius being fed to depth, then the shaping machine table moved 0.300 in., and the operation repeated. The final operation being that of shaping the groove *E*. A gang toolholder block *D*, consisting of four 0.125-in. grooves equally spaced, was also finished in the shaping machine to the required degree of accuracy. It must be remembered, that where a considerable amount of stock is to be removed, the job should be roughed out to the layout lines before the shaping machine is set for the final finishing, thus eliminating all possibilities of shifting the job under a heavy cut or dulling the edges of the finishing tool, as in the case of the flat forming cutter *C*.

In Fig. 7 is shown a typical shaping machine set-up for accurately shaping the two slots *A*. After roughing out to within $\frac{1}{64}$ in. the finishing tool *B* is fed down to the right depth. Now, the micrometer head *F*, with its holding bracket *C* is adjusted, taking measurements from the point *D* of the shaping machine table (as already explained under the heading of lathe and milling machine work) and the remaining slot finished. A bracket that can be adapted to any make of machine is shown in detail at E, Fig. 7.

A Few Precautions

If accurate results are expected, the toolmaker should never attempt to tighten a gib in the milling machine, or the shaping machine, after the micrometer head has been set. The milling machine table, knee and cross-feed slide should be adjusted before beginning any accurate work, so that there is no play in any of the slides. Leaving the various slides half tight, is a good fault in precision work, and applies equally well in lathe, shaping or milling machine work. The reason for using 1-in. standard disk for the first setting of the micrometer head is that it is easier, and more accurate, to "feel" a setting of a micrometer than to tell the size of a piece to be measured by merely screwing the micrometer spindle down on it. Let anyone who is not sure of my meaning try to test his micrometer with a Johansson block, and he will be convinced of the logic

of my argument. Of course, any size "feeler" block for setting the micrometer head could be used, but the 1-in. standard disk is the handiest, both in regard to the simplifying of subsequent measurements, and the fact that nearly every toolmaker has in his tool kit such a standard. The micrometer spindle should be squared to the measuring stop, or the part of the machine against which the measurements are taken. Let the micrometer head holding bracket be in such a position that it need not be disturbed until the job is completed. If all ordinary precautions are taken from beginning to completion of a job, it will surprise any mechanic, who has not used the micrometer head in precision work, to find how easily and accurately the necessary measurements are obtained.

Some Other Uses

In Fig. 8 is shown a home-made micrometer depth gage. On fine gage work it is sometimes necessary to measure to 0.0001 in. the distance between steps, or projections on a gage. As there are no regular micrometer depth gages made that will read to 0.0001 in., oftentimes, these fine measurements are left entirely to guess. Now, a micrometer head reading to 0.0001 in. can easily be mounted as shown. The body *A* is of tool steel and hardened; the face *B* being ground and lapped square with the hole *C*. To adjust this gage ready for use, the micrometer head while being set at upper zero, is inserted into the hole *C* in the body *A*, while the latter is held on a surface plate, resting on face *B*. The knurled clamping screw *E* is now tightened and the gage is ready for use. At *F* is a section of the gage body, showing how the knurled head binding screw works. It might be said that the depth gage thus made has the graduations reading backwards; that is, the next whole number from upper zero is 9, then 8 and so on until the lower zero mark is reached. But this is hardly a handicap, considering the real advantages of the tool, and one can soon get accustomed to it.

The present extraordinary demand for small tools has made it very difficult to buy micrometers, especially those of the larger sizes. In Fig. 9 is shown a home-made micrometer frame, to be used in conjunction with a commercial micrometer head. It is made of ¼ x 1-in. cold-rolled steel, upset at end *A*, and hot-bent to shape. The frame shown in the sketch was made for 3- to 4-in. sizes. For much larger sizes, correspondingly larger stock for the frames can be used. A few words as to the method of lining up holes *B* and *C* might not be amiss. No attempt was made to produce anything fancy; the ⅜-in. hole *B*, and the $\frac{3}{16}$-in. hole *C*, were laid off approximately in line, and then drilled and reamed to size on an ordinary drilling machine. Now, a hardened tool steel plug *D* was driven into the anvil end of the frame, the projecting end being of the same diameter as the micrometer-head spindle. With a ⅜-in. plug in the hole *B* the micrometer frame was set up in the grinding machine vise, as shown in Fig. 10, and after being indicated true with the surface grinding machine spindle, the anvil was ground with a dish wheel, thus bringing it square with the ⅜-in. hole. The knurled binding screw *E* and the saw cut *F*, Fig. 9, will complete the job. Micrometer frames like these are easily made, and considering their accuracy, when the micrometer head is set to a standard gage or by the Johansson blocks, it should solve the special micrometer problem in many shops. Several sizes of frames can be made up, and one micrometer head will answer the purpose for all of them.

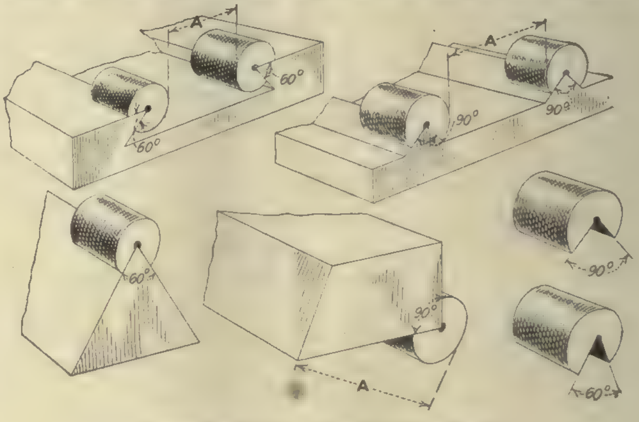
The several examples that have been shown of the uses to which a commercial micrometer head can be put do not cover the entire field of its possibilities. They might, however, suggest other methods of application to mechanics heretofore unfamiliar with this handiest of measuring tools.

Buttons for Measuring Angular Work

By L. C. Blomstrom

The illustrations show buttons that may be used in measuring external and internal dovetails, table V's, triangular and irregular shaped pieces and similar work when it is impracticable and in most cases impossible to measure over sharp edges.

The buttons are cylindrical plugs with cutaway sectors. Angles of 60 deg. and 90 deg. will be found most useful,



BUTTONS FOR ANGULAR WORK

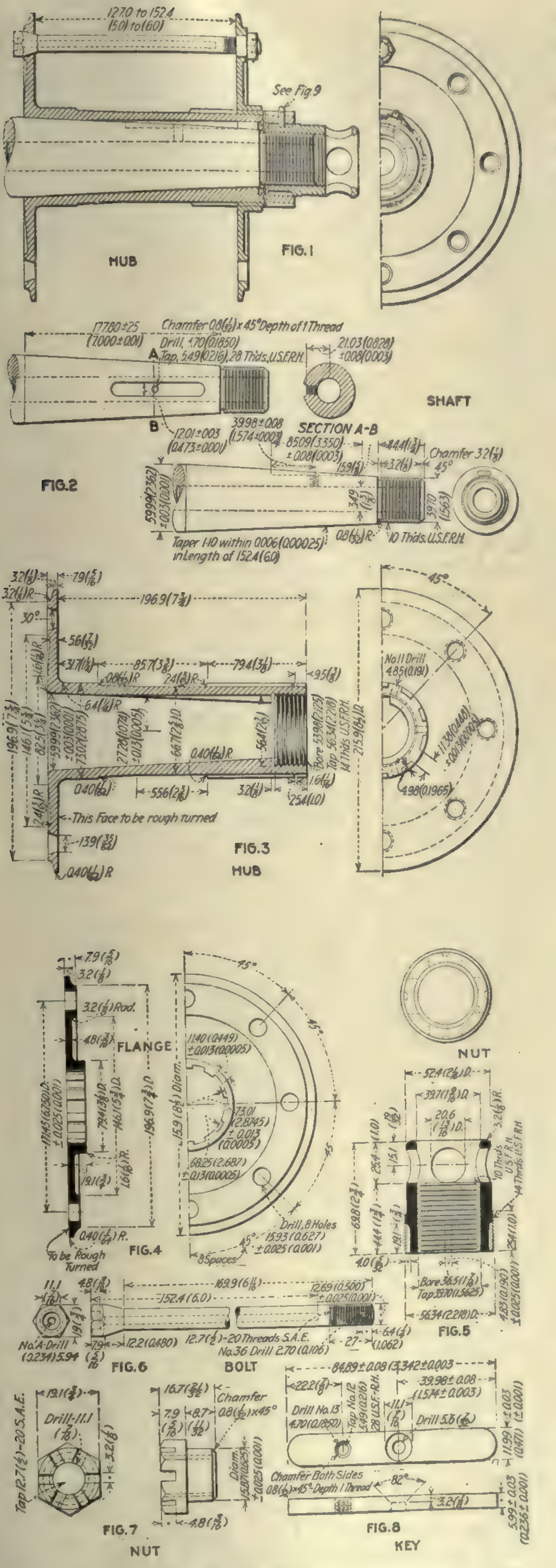
but they may be made of any angle and of any size. These buttons have a large field of usefulness in the toolroom, and considerably shorten the time required to check some classes of angular work.

Standard Hub for Airplane Propellers

By Fred H. Colvin

One of the important questions in connection with the building of large numbers of airplanes relates to the size, proportion and methods of fastening of the propeller hub. There are many kinds of propeller-hub fastenings in use, some with the multiple splines, which are not only difficult to make and fit, but which also effectually prevent the lapping of the taper on the engine shaft with the taper in the hub. They have also been more or less unsatisfactory in many ways.

The new standard hub adopted by the aviation section of the United States Army is shown in the accompanying illustration. This gives both the shape and the dimensions of the various parts of the hub and of the end of the engine shaft. These particulars have been very carefully worked out as a result of experience both in this country and abroad. The illustrations, Figs. 1 to 9, show the hub and shaft for propellers and engines of from 110 to 170 hp. As will be seen, the

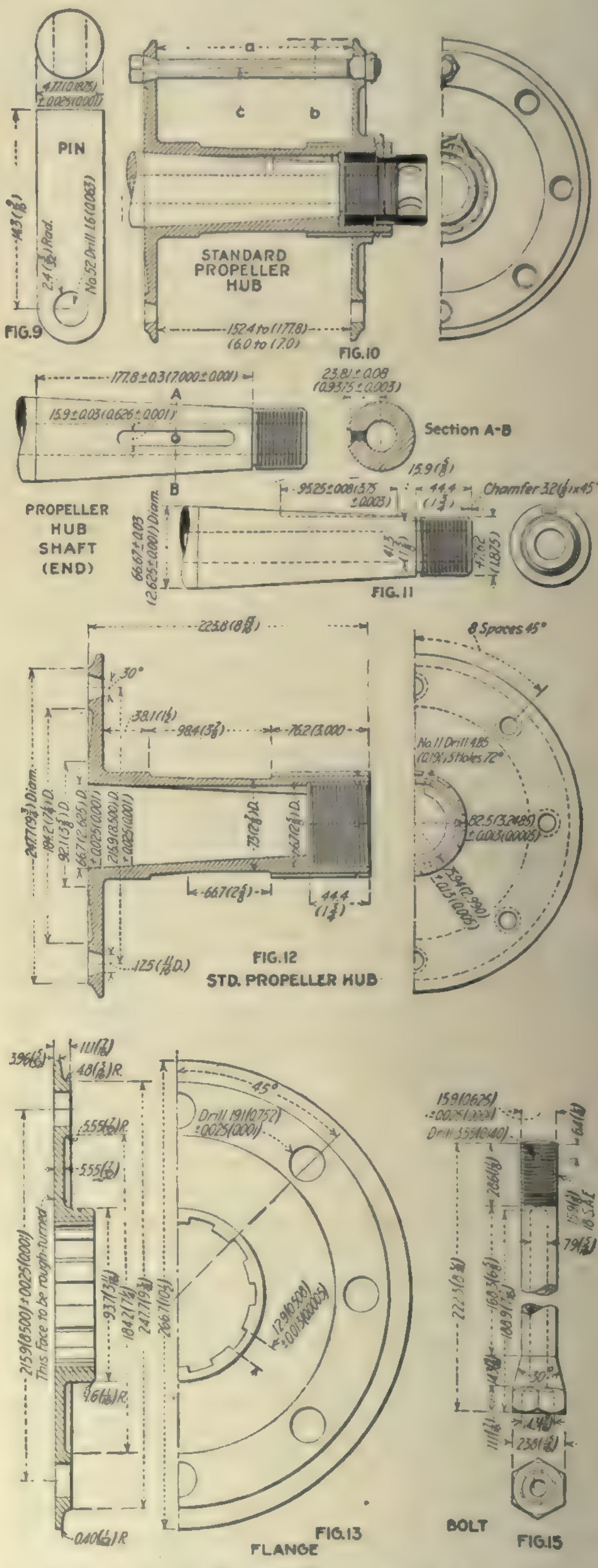


FIGS. 1 TO 9. DETAILS OF STANDARD PROPELLER HUB, 110 TO 170 HP.

Fig. 1—Assembly of hub. Fig. 2—Engine-shaft end. Fig. 3—Hub. Fig. 4—Flange. Fig. 5—Shaft nut. Fig. 6—Bolt. Fig. 7—Nut. Fig. 8—Key. Fig. 9—Locking pin

dimensions in most cases are given in both English and metric measurements.

The shaft is given a taper of one in ten, and the hub is prevented from turning by a straight key held in place by a flat-headed standard A.S.M.E. machine screw. The hub is forced in place on the taper by the long nut by means of a bar put through the holes at

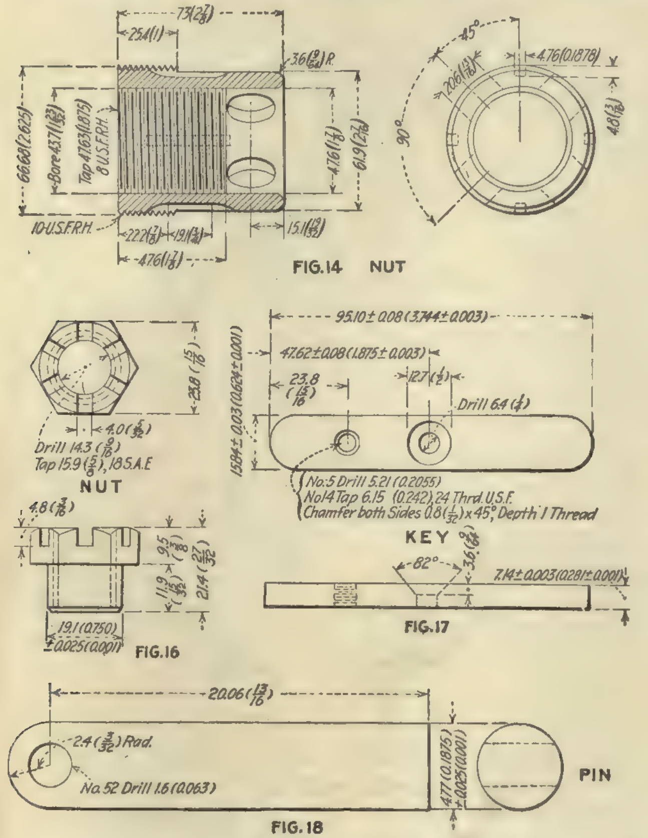


FIGS. 10, 11, 12, 13 AND 15. PARTS OF STANDARD PROPELLER HUB, 170 TO 250 HP.

Fig. 10—Assembly of hub. Fig. 11—Engine-shaft end. Fig. 12—Hub. Fig. 13—Flange. Fig. 15—Bolt

the end of the nut, and the nut is then prevented from turning by the pin, which drops into one of the four slots around the circumference of the nut.

The inner flange is integral with the spool or barrel of the hub, but the outer flange has a movement of 1 in., allowing for hub variations of from 5 to 6 in.



FIGS. 14, 16, 17 AND 18. PARTS OF STANDARD PROPELLER HUB, 170 TO 250 HP.
Fig. 14—Shaft nut. Fig. 16—Nut. Fig. 17—Key. Fig. 18—Locking pin

in thickness. The outer flange is prevented from turning by ten splines; and as five of these splines are drilled to receive the locking pin, it gives a large number of positions in which the nut can be securely locked in place. This pin is held in position by a wire

COTTERS FOR BOLTS OF STANDARD PROPELLER HUB

Diameter, In.	Length, In.	Drill for Bolt, In.
1/16	5/16 to 3/4	No. 48—0.076
3/32	1/2 to 1 1/8	No. 36—0.106
7/64	7/8 to 1 3/8	No. 30—0.1285
1/8	7/8 to 1 3/4	No. 28—0.140
9/64	1 1/4 to 2 1/4	No. 21—0.159
11/64	1 5/8 to 2 1/2	No. 11—0.190
13/64	2 to 3	No. 2—0.221

running through its head and around the hub, a groove being provided for this purpose. The ends are twisted together in the usual way.

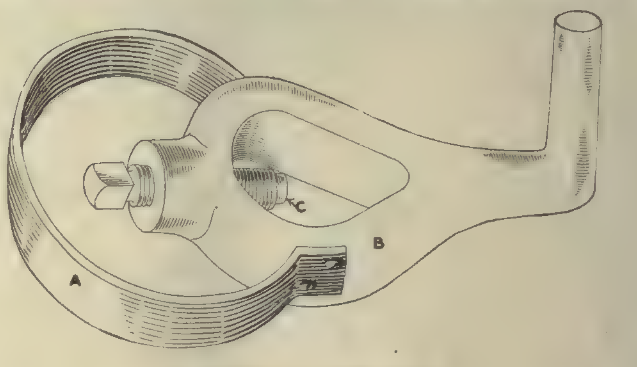
The bolts have a taper head to insure a perfect fit in the inner flange, and the nut on the outer end has a projecting sleeve that goes through the outer flange, so that the thread of the bolt does not come in contact with the flange at any point. It will be noticed that the engine shaft is hollow and that the bolt is drilled for nearly its entire length. It will also be seen that the key has a tapped hole at the front end through which a screw can be used as a jack in lifting the key out of place, should it become jammed in any way.

Figs. 10 to 18 show the details of the standard hub for engines of from 170 to 250 hp.

A Safety Lathe Dog

By Fred Fruhner

The accompanying illustration shows a means of making the ordinary lathe dog a safety one. A piece of cold-rolled steel *A* is bent in circular form with its ends flattened. These flattened ends are provided with



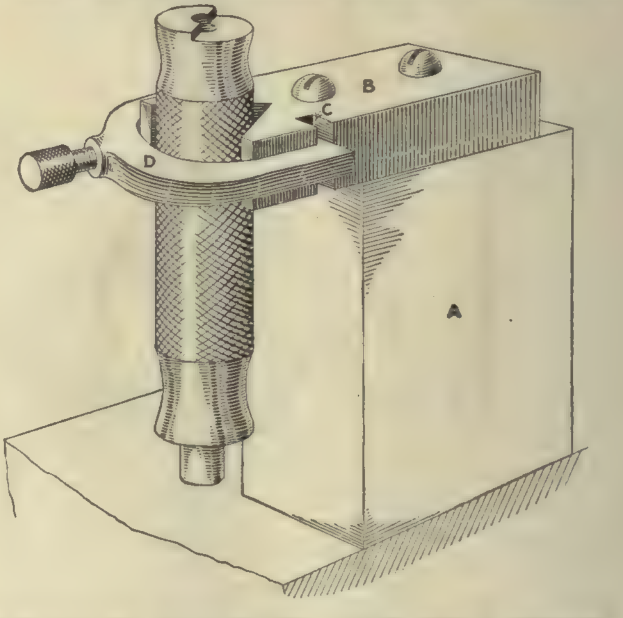
A SAFETY LATHE DOG

holes to receive screws for attachment to the lathe dog *B* as shown. This steel piece is of such size that the clamping screw *C* is permitted to clear the opening in the dog which receives the stock.

A V-Block for Holding Plugs and Gages for Grinding

By Joseph Herdina

The illustration herewith shows a V-block for holding length or depth gages while grinding. To a cast-iron base block or angle plate *A*, which is provided on its upper face with threaded openings is secured a



A V-BLOCK FOR HOLDING END GAGES WHILE GRINDING

V-block *B*, by means of screws as shown. The V-block is provided on opposite sides near its inner end with grooves or channels *C*. A clamp *D* is employed to hold the work to the V-block as shown. A depth gage is shown held in position for grinding. One end of the gage is first ground, then the V-block with attached clamp is removed and reversed, tightened in position, and the gage ground on the other end.

Series for Executives

Inventors and Patents

BY GLENN B. HARRIS

An article, page 621, Vol. 47, treated the relationship existing between patents and the manufacturer, and it is the purpose of the present article to give some advice to inventors regarding the manner in which they should proceed in protecting their inventions by letters-patent, also to offer a few suggestions as to lines of endeavor, which may prove of value.

THE average inventor has had no experience with patents, and the thought in his mind is that the idea of which he may be possessed is original with him and in its entirety. As a matter of fact there are but few inventions which are broadly speaking, new. An examination of the patent office records—in the class of patents to which an invention pertains—while not absolutely essential, is usually of great benefit to an inventor in enabling him to ascertain just what has been done in his field of effort and to give him suggestions concerning possible changes in the construction of his own work which he may deem advisable and of advantage. An examination of patents most closely resembling his invention, also enables him in a measure to obtain a fairly clear idea of whether that which he has invented is sufficiently different from that which has previously been done to warrant the expenditure of money necessary to the procurement of a patent.

An inventor frequently labors under the impression that an idea which occurs to him, a machine or fixture which he has invented and is using, is not patentable; or if so, that it is not worthy of patenting.

AND the question of patentability is not one that can be definitely determined by the layman, and this holds especially true of a minor improvement. A slight but neglected improvement frequently may be invaluable and just what was needed to make a device marketable, but the inventor failing to take advantage of the protection afforded by a patent, not infrequently finds that another has also conceived his invention and obtained a patent thereon, thereby depriving him of the protection which might have been his. This does not necessarily mean that the invention has been disclosed by the negligent inventor to the patentee. In fact the two may reside in widely separated parts of the country, and be absolutely unknown to one another.

What to invent is a question which cannot be readily determined, and what may seem to be absolutely worthless as a money producer, may prove of the utmost value. As a striking example of this statement, reference is made to the telephone and the phonograph—both of which were looked upon with the greatest scepticism imaginable, and were declared by those of undeveloped discernment to be nothing more than interesting toys or curiosities and not susceptible of profitable exploitation. The fallacy of this judgment is now apparent and appreciated by all.

Goodyear who discovered the process of vulcanizing rubber which has proved such a boon to mankind in making possible the production of thousands of articles of every day use, and which in this era is absolutely indispensable, was for years the laughing stock of his neighbors and associates who declared his ideas chimerical, not possible of accomplishment; and even if carried to a successful end in the production of satisfactory articles, still to be without any possible chance of pecuniary profit. Fortune only came to Goodyear after years of persistent effort and deprivation, which at times amounted almost to starvation. These cases are cited only on account of their prominence. There are thousands of instances of a decried invention proving a money-maker beyond the fondest hopes of the inventor, and at the same time proving of inestimable value to his fellowman.

MACHINISTS and shopmen, generally will produce a device which will simplify and materially cheapen the cost of production of an article, greatly expedite a certain operation to be performed or make production more accurate and uniform, yet will see only the application of their discovery to their personal uses, or to the uses of the shops in which they are engaged; they fail to regard the probable general adoption of their inventions and their application in fields foreign to their own. It should be a self-evident fact all things being equal, that what proves useful to one should prove of equal benefit to others.

If an inventor—or we shall call him the originator of an idea—has something which he believes to be of value, his initial procedure is to make a drawing which will, as nearly as possible, disclose the supposed invention; then he shall sign his drawing as soon as completed,

in the presence of two witnesses who should also sign in that capacity; also the date of execution of the drawing should be added. As a matter of precaution and as additional evidence of the time of inventorship, the date of conception should be placed on the original sketch or drawing.

In the event of a model or working machine being constructed, it should be shown and explained to others at the earliest possible moment, and acknowledgment of this disclosure obtained. A receipt for any expenditure of money in connection with the invention should be obtained and carefully preserved. If inventorship should be claimed by another, the dates thus established are beyond reasonable question.

IN SELECTING a patent attorney the utmost care should be exercised that he be well known for his ability and character, and it is preferable that all dealings be personal rather than by correspondence. It should be taken for granted that the attorney understands no feature of the invention so well as does the inventor himself. Every point should be made absolutely plain and clear, and every advantage or point of merit should be explained. The capable attorney will eliminate from the inventor's statements, the chaff of invention; nevertheless he is placed in a position to take full advantage of such explanation and information when it becomes advisable that he should.

The specification should be full and clear, and in the simpliest possible language; and where a drawing is necessary to a full understanding of the invention, it should be sufficiently detailed to render the invention easily and clearly understandable when read in connection with the specification.

It is always a safe plan for an inventor in that part of his application for a patent which is known as the claims, to ask for more than is deemed possible of procurement, and to put so to speak, the burden of proof on the examining corps of the Patent Office to show that the claims cannot be allowed in the form set forth in view of patents heretofore granted, and shall in all instances of exception be cited by the Patent Office as references, and specifically mentioned by name and number, in order that an examination of these exceptions may be made.

OFTEN this examination is one to which great care and consideration should be given and no point should be overlooked. The construction of the previously patented machines or devices should be carefully weighed and careful analysis made as to differences in construction between the references and the article for which application for patent is made. These differences in construction should be made clearly apparent to the attorney, as well as any supposed advantage in the alleged invention over its predecessors in the same line. This data is of the utmost help to the attorney in framing his reply to the examiner's objections, and in aiding to convince the examiner that what is contended for is that to which the inventor is justly entitled.

It is greatly to the benefit of an inventor to claim too much rather than too little. The excess can always be eliminated, but should an application for patent issue be minus claims it might have contained its amplification is hardly possible, as re-issues of patents where the claims are enlarged are looked on with extreme disfavor not only by the Patent Office but by the courts, because these re-issues are supposed only to correct mistakes; and it is held that where an inventor does not claim all that he might properly have claimed in the first instance his reserve implies in fact a dedication to the public of the unclaimed subject-matter. Therefore let the inventor note the necessity for not only employing a skilled attorney but for making him extremely familiar with the invention; also in making the construction of all cited references absolutely clear and well defined, in order that amendments, when required, may be most intelligently made, and yet that these amendments be of such character as not in anyway to sacrifice the inventor's right in fullest measure to the protection which is his due.

The true test of successful inventorship from a money point of view is shown by ability to produce something that is commercially valuable.

The inventor should aim for cheapness and simplicity of construction combined with efficiency in operation and durability in use. This requirement of detail is essential to success.

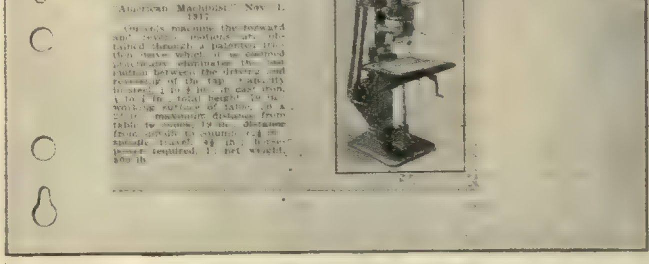
ANOTHER thing, many criticize and condemn an invention off-hand; but such superficial criticism and condemnation usually come from those least qualified to pass judgment. The really competent critic will carefully weigh each point in favor of a new construction or device, and will not be the one to discourage an inventor; on the other hand, he will make such helpful suggestions regarding changes as may tend to perfect the invention.

Useful and highly profitable inventions have been produced by those who have no knowledge of engineering, mechanics or any of the arts or sciences. There are some men in the field of invention so versatile that ideas come to them practically as fast as they can be placed on paper, while others may require months, even years of constant application and work for the evolution of a single idea.

Method of Filing Index Cards

By Horace Horsley

The following is a description of my method of filing the index cards now being published by the *American Machinist.* I file the items that interest me in



SAMPLE LEAF OF BOOK

the form of a looseleaf book, a sample page from which is shown. Possibly this method of filing will be of interest.

Cartridge Case and Shell Inspection Systems

BY F. H. KORFF
General Manager, Gits Electric Co., Chicago

One of the main requisites to efficiently producing any parts in quantity, is an adequate inspection system. A well-balanced production system is of no avail if the inspection factor be lost sight of.

IT HAS been the writer's experience, in the manufacture of cartridge cases, that one of the greatest evils to combat has been the seeming inability of the factory to combat and overcome defective work. It is the writer's opinion that defective work is largely caused by one of two things or possibly both. First, negligence on the part of the executives and men; second, improper coördination of the inspection methods with those of production. To overcome this inspection difficulty the following systems were devised by the writer:

Cartridge Case Inspection System

An inspector should be appointed whose duties will be to inspect all work made on the presses, allowing a discrepancy of not more than 0.003 in. on each draw. He should continually go from one press to another examining the work for scratches, pits, etc. If he finds work that is becoming scratched he should immediately notify the press foreman and see that the trouble is rectified.

Another inspector should be placed at the tapering press to try all cases in the gun gage and to examine them for defective sides, etc. If a case does not fit the gun, it must be run through the tapering press again.

As these shells are inspected at the tapering press, they are placed in boxes and thence transported to the lathes.

We will assume that a crate holds fifty cases. As the cases are put through the various machining processes, a majority of them become defective, due to poor tooling, etc. But these defective cases must not be laid aside. They must be kept in the crate and continue with the original lot. All defective cases must have a tag inserted in the primer hole specifying the defect by code number only.

The inspector must be provided with one or more gages and required to go from one lathe to another inspecting the shells with the gages. When gages are given to an inspector, they are not to be taken away from him and given to other inspectors, for each inspector will be held responsible for his particular inspection, and accurate records cannot be kept if gages are changed from one man to another.

When a crate of cases has been machined, an inspector will remove all defective or rectifiable cases and keep a record of them; this record to be in the superintendent's office not later than the following morning.

The rectifiable cases as they are removed, must be placed in crates according to the defects. So far as possible, the various defects, must be segregated; for instance, all of No. 1 in one box and No. 2 in another, etc.

The crates of cases leaving this inspector will then be transported to the tapping bench, at which point when the tapping operation has been completed, another inspection must take place.

From the tapping bench after being inspected, the crates will be transported to the finish reaming machine. After reaming (before cleaning) another inspection must take place, to eliminate the possibility of defective shells entering the final inspection room.

Tool Equipment

All tools for cases, upon being ground, and subject to a severe check in the toolroom, should be delivered to the supervisor of gages, tools, etc. The tool and gage equipment must be made and checked by master gages, and subjected to a rigid inspection prior to being issued to the tool setter.

Brass checks are to be issued by the gage and tool supervisor, and each evening all gages must be turned into his office for inspection before going into use the following morning. This rule is imperative and must not be disobeyed.

As necessary tool changes are made, a new tool ground to proper shape and thoroughly inspected, will be issued from the tool crib in exchange for the old one, which may need grinding or readjustment.

The Workmen

The duties of the operators running the various machines consist of what the name implies. They must be operators and nothing else; not inspectors or tool setters.

Prior to their being permitted to handle a machine, its particular operation must be thoroughly explained to them, and the necessary movements incident to same in order that they may become 100% efficient in the shortest possible space of time.

Inspection System for Shells

The rough shell forgings, after the proper visual inspeciton, should be placed in crates equipped with ball-bearing castors; these crates to hold only a certain number of shells, previously agreed upon.

We will assume that a crate holds fifty shells. As the shells are put through the various machining processes, a majority of them will become defective, due to poor tooling, etc. But these defective shells must not be laid aside. They must be placed in the crate and continue with the original lot until they reach the final inspection bench, where it will be decided as to the proper disposition of them, whether they are to be sent to the "hospital" for repairs or thrown out as tool scrap.

The Tool Equipment

These extra sets of tools should be made for each machine. The tool equipment should be made to gages and specifications and subjected to a rigid inspection prior to being issued to the tool setter. Operators should not be permitted to change or adjust tools.

All tools for shell work upon being ground and subject to a severe inspection in the tool room proper,

either by the toolroom foreman or someone capable of doing so, should be delivered to the tool crib. As the necessary tool changes are made, a new tool ground to proper shape and thoroughly inspected will be issued from the tool crib in exchange for the old one, which may need grinding or readjustment.

The Workmen

The duties of the operators running the machines, and the explanation necessary to become efficient, etc., should be the same rules as set forth under the head of workmen in the preceding paragraphs on cartridge case inspection.

Maintenance men and porters should be provided whose duties consist of keeping all machines and counter shafting thoroughly oiled and clean; to see that all belts are tight, and are developing the power required from them. Operators must not oil or clean machines or adjust belts. Their duty is to run the machines, and nothing else.

Inspection and Supervision

We will assume that all the machines are properly tooled and equipped and in a state of operation.

The foreman, or patroling supervisor starts at the first operation and thoroughly inspects the first piece made. He must have a complete set of gages for inspection. If the piece is properly machined, he stamps it with a small punch to identify it, then goes to the next machine and so on through the department. When he arrives at the starting point, he checks the last shell made and if it is perfect marks it with his punch.

The above method enables him to have a certain cycle of operations to perform and at the same time be continually among the men to settle disputes and see that the department is running smoothly. The above is very important, for lack of proper supervision is one of the greatest evils to which most factories are subject, and proper production cannot be obtained unless it is overcome.

If, upon inspection of a piece, the patroling supervisor finds that it is under or over size, he immediately calls the machine-tool setter, whose duty is to adjust all machines, setting up, changing tools, etc.

Final Inspection

As each crate of shells reaches the final inspection bench, it is entered on a record as follows:

Number of crate; number of good shells; number of defective shells; machine and men's numbers performing the different operations.

With a system outlined as above, it is safe to say that production will be brought to its highest rate.

Harry to His Uncle

Herein Harry, a youngster two-thirds through the apprentice school of a large manufacturing establishment, revealeth his somewhat sudden departure therefrom, and narrateth some of his experiences and observations in the shop manufacturing some kind of things for Uncle Sam, whereto he hath been attracted by rumors of pay envelopes bulging with real money.

Dear Uncle—When I wrote you, asking your advice in regard to my leaving, for a time, the shop where I passed two years of my apprenticeship in order to take advantage of the high wages prevailing at present, I knew that you would laugh, as the postmark on my letter would "give me away," showing that I had already made the change without waiting for your reply.

Well, here I am. I have worked two weeks, have earned more than half as much every day as I got in a week as an apprentice, and really believe that I have learned something, too. The contrast between the work and the surroundings is even greater than I had anticipated. Although everything here wears an aspect of headlong rush and hurry yet I can't believe that the production is so rapid as appearances might lead one to think. The "hurry-hurry" policy, combined with the surprisingly large percentage of unskilled employees, necessitates the return from the inspectors of a vast number of parts for correction. The extreme rigidity of the requirements, also, makes the number of returned parts very large, dimensions which, in the finished mechanism will "touch nothing but air" being held to 0.0005 in. or even less. Many of the men had never even looked inside a machine shop till they came here. Dozens of them not only cannot read a micrometer but are unable to use a snap gage intelligently.

Some of the men who set up the automatic machines (the number of which is legion) evidently don't yet know it all. But the atmosphere is very stimulating, urging us to do our best and fastest work, and at the bottom of our minds is what we may not speak of, but never forget, that we are doing our bit to help our Uncle Samuel carry on his part in the war. Of the purely technical points that I have observed I will write you later, when I've had time to reduce to some semblance of order the thronging impressions in my mind.

The human environment is very interesting. I have heard my elders speak of the shop as a world in miniature, containing men of the most diverse types, but in the scene of my previous labors there was but a dull monotony, just a lot of young fellows trying more or less strenuously, according to their several dispositions, to acquire a knowledge of the trade, and the instructors who often seemed to me as uniform and undifferentiated as if cast from the same pattern.

Here, beside me works a canny Scot who grumbles at the speed required, at the machine he operates (which he calls a capstan lathe), and at every other created thing, yet does an immense amount of work and daily excites my admiration by his thorough knowledge of the trade acquired by seven years' apprenticeship and I know not how many years' subsequent service. Near him is a tall and stalwart Greek, a magnificent specimen of physical perfection. He is a barber by trade, quite new to our business, but earning as much money as any of us, and, I have learned by talking with him that he is saving every cent possible to support his

family while he is absent, for he intends to enlist as soon as he has made their immediate future secure. He tells me that of all his countrymen in this city there is not one who does not own at least a hundred-dollar Liberty Bond.

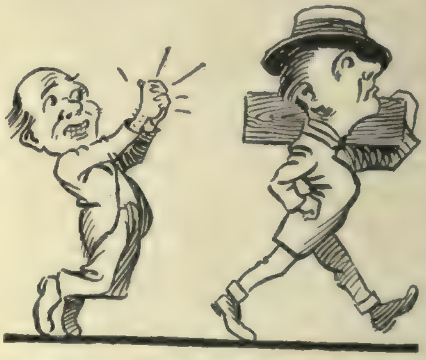
Not far away is a Swede, a fine looking man when dressed for the street, but in the shop the dirtiest man and the best workman I've yet seen. In working hours all the errant oil and grime in the establishment seem to gravitate toward him. He has made but few acquaintances, as his alleged English is almost unintelligible, but I have discovered that he speaks most beautiful French, and to those of us fortunate enough to understand that tongue he has revealed, bit by bit, and almost under compulsion, something of his history. He speaks five languages fluently, is a graduate of an ancient and famous university in his native land, and is also, as he says, "technicality educate," which I take to mean that he has a degree corresponding more or less to our M. E. He is a storehouse of information concerning the many countries in which he has traveled and worked. Another neighbor, a Russian, is his equal in linguistic acquirements, and surpasses him in one respect, as his English is far better than mine. It is almost a liberal education to hear these two men exchange experiences and opinions, when we can induce them to hold their colloquy in a lingo intelligible to their listeners. I am glad every day that my parents, in my babyhood, talked English and French to me, so that I really have two "mother tongues," for I find, to my surprise, that many of those on whom some people look down as "ignorant foreigners" speak more or less French, so that I have made many acquaintances and learned many things because I can talk with them. Never again can I share the insular, parochial belief so common among us that we, and the other English-speaking tribes, have a monopoly of desirable qualities.

What a melting pot our country is, if one may judge from this lesser world, this microcosm, the shop! There are here, I'm told, natives of twenty lands claiming as mother tongue at least that number of languages and dialects. Talking with some of them and hearing their tales of the tyranny and oppression in the lands from which they come, one can understand something of their passionate loyalty to the ideas and ideals for which, to their minds, America stands. Some of them, it is true, hold notions of what the country should be and do that to me seem wildly Utopian, but that America is the land of liberty and opportunity they all agree.

Two of my neighbors, the Swede and another, are running engine lathes, and I am learning much by watching them. One of them working on a thread-cutting machine uses a "coolant" that is new to me, though probably old to you, the juice of the tobacco which he chews incessantly. Both have convinced me of the truth of what you have told me, that while lathe- and planer-tools ground to a uniform pattern are necessary for the relatively unskilled, a real workman can do more and better work by shaping them according to the dictates of his experienced judgment, suiting them to material, speed and feed. These two do this, and their results "lie over" anything I've seen, even in the "intensively-operated" shop where my short time in the trade has been spent. In a recent number of the *American Machinist* someone speaks of the machine shop as "a land of pure delight" to one who has eyes to see the humorous features of life therein. This is certainly true of this shop. We have several men who say that they have "always worked on the tool job" till tempted by high wages to stoop to the lower levels of the business. One of them picked up and curiously examined a height-gage that the foreman had left on a bench, then said "That's the queerest combination square I ever saw. Why, the blamed gaget hasn't no sixteenths marked on it."

Soon another alleged ex-toolmaker picked it up and after testing the edge of the scriber with his thumb remarked scornfully "That little thing won't stand up to no cut. The shank is too limber." Another "type" of which we have several specimens arouses my distrust. They have left the scene of their labors amid the loud lamentations of employers who despair of ever being able to fill their places. I believe they are all humbugs, bluffs and four-flushers. Am I right, or are you laughing at the youthful cocksureness of my judgments?

One man, operating one of a large group of similar machines, plumed himself on never having had a part rejected by the inspectors. The explanation came when someone saw him chuck a lot of parts into a neighbor's box, taking at least an equal number from it to replenish his own. Two men working near him thereupon held an interview with foreman and inspector, arranging to have returned to them all their spoiled parts, and the next day dumped them into the culprit's box when he wasn't looking. When the report of his day's work came back, he howled loudly of a "frame-up," whereupon the foreman had the unsatisfactory parts brought in and exhibited the depredator's private mark on every one of them. The sinner then "got the gate," to the unmixed joy of his outraged neighbors and shopmates.



Though the vast majority here are young, there is a considerable number of old men. One of them says that he knows you, and worked with you twenty years ago. He left the trade at forty-five, as the shop where he had

been closed up and he couldn't find work elsewhere because of his "extreme age." Just think of that. He is apparently as well able as I to do a full day's work, and tells me that he never lost a day in twenty years, yet all his accumulated skill and knowledge must go to the scrap heap at forty-five. What will he do when the present demand for his services is over, and must I look forward to being "junked" in middle-age, if I live so long?

You have kindly abstained from asking what I do with all my money, whether I put it into $1000 bonds or into real estate, but I will tell you. Aside from necessary expenses, and the purchase of tools and books (wherein I'm sure of your approval) I'm saving every red cent. The sight of these old fellows eagerly grasping an opportunity to work a few months or years longer has sobered me, and I propose to lay aside a "stake" for the proverbial rainy day. We work only eight hours a day here, though I should be glad to put in twelve, if they would allow it. I believe that, after the war, there'll be a field for Yankee machinists in some of the European countries, and I plan, after going back to finish my "time," to go across. With that in view, I'm studying a foreign language. I'll bet ten cents you can't guess which it is. HARRY.

Boring and Reaming Tools For 220- and 270-mm. French Shells

By JAMES FORREST

The French type of shell is difficult to machine internally on account of its closed flat bottom and the overhang of the boring bar required. The contours of these shells are shown, and it will be seen that the inside surface is a combination of straight bore, taper bore, radius, and flat surface. How this surface is machined, and a description of the tools involved, is set forth in what follows. As the operations and tools are the same for both shells, with allowances for different dimensions, the article will treat of the 270-mm. shell, but applies equally to both.

THE machined shells, ready for nosing, are shown in Fig. 1. The shells are finished internally from the rough forging in two operations: a roughing operation, and a finish-reaming operation, the former averaging 15 min., and the latter 18 min. for each shell. The reamer used for roughing is shown in Fig. 2. The cutting tools are high-speed steel, and the contour of the whole reamer is an exact duplicate of the inside of the finished shell, with the cutters set back 0.8 mm. for finish or 0.315 in. from the contour.

The bore of the rough forging is 177 mm. for the 220-mm. shell and 225 mm. for the 270-mm. shell, and the roughing cutter removes 4 mm. of metal a side, leaving the roughed-out bore of the shells 185 mm. and 233 mm. respectively. The cutting speed is 62 ft. per min. and the feed is 0.175 in. per revolution. This gives an output from one operator running one machine of from 35 to 40 roughed or finished shells per day of 10 hours.

The last two tools, on each side of the roughing reamer, are made 1 in. square, in order to stand up against the much heavier stress and wear brought upon them, than on the other tools. These last cutters do all the cutting on the straight part of the shell, and have been cutting for about 15 in. before the other tools begin to cut on the taper.

After a year of continuous use, 24 hours a day, some of these roughing reamer bodies had holes worn in them, opposite the last cutter bits, about 1¼ in. diameter and ½ in. deep, by the continual wear of the chips, and it would be well in making new tools to have them fortified against this wear by a hard-steel, renewable insert.

The form of the dog point shown at Fig. 3, *A*, is the correct one; not rounded as at *B*. The radius at the point should never be greater than the thickness of metal removed at each cut. See Fig. 3, *C*. The roughing cutter leaves a series of steps in the taper. This is rather an advantage than otherwise; when the finish reamer begins to cut here it picks up the high points first, and gradually cuts them away until a smooth taper results. There should be a plentiful supply of cutting compound to keep the cutting tools cool and to wash out the chips.

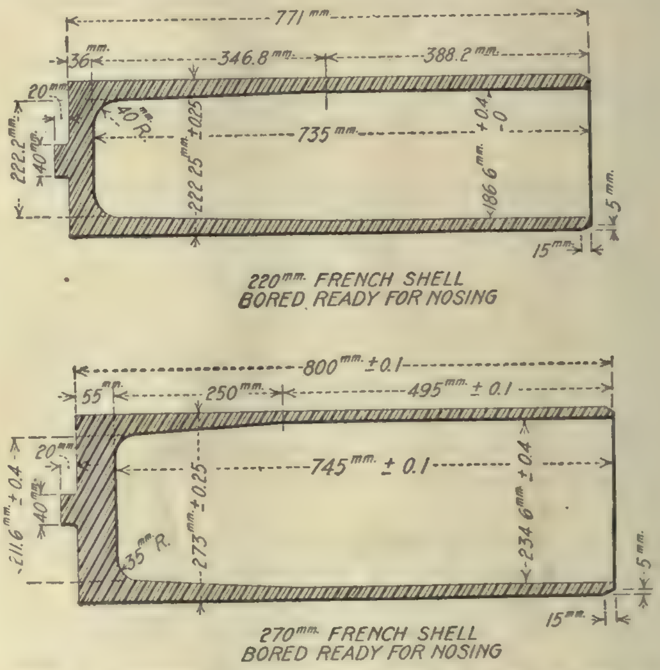


FIG. 1. SECTIONAL VIEWS OF THE 220- AND 270-MM. FRENCH SHELLS

With a pressure in the pipe line of about 100 lb. per sq.in., and a flow of 15 gal. per min., which is about what two ½-in. pipes can supply, these shells can be roughed in one run of the roughing reamer, leaving them ready for finishing. The cutter can be run down by the power feed until the nose cutter is about 3 in.

from the bottom of the shell, and then the hand feed should be used to finish the operation.

The cutting lubricant is led down from the boring bar, in through the two $\frac{3}{8}$-in. holes in the taper shank, then down the 1-in. hole in the center of the reamer, and is directed outward. The bottom blade does not require the $\frac{3}{16}$-in. holes in front of it as there is always enough flow along the bottom of the shell to keep it cool. It requires two men with an equipment of gages, to do all minor repairs, such as renewing nose cutters and keeping up the sizes on roughing reamers for about every 20 machines in operation.

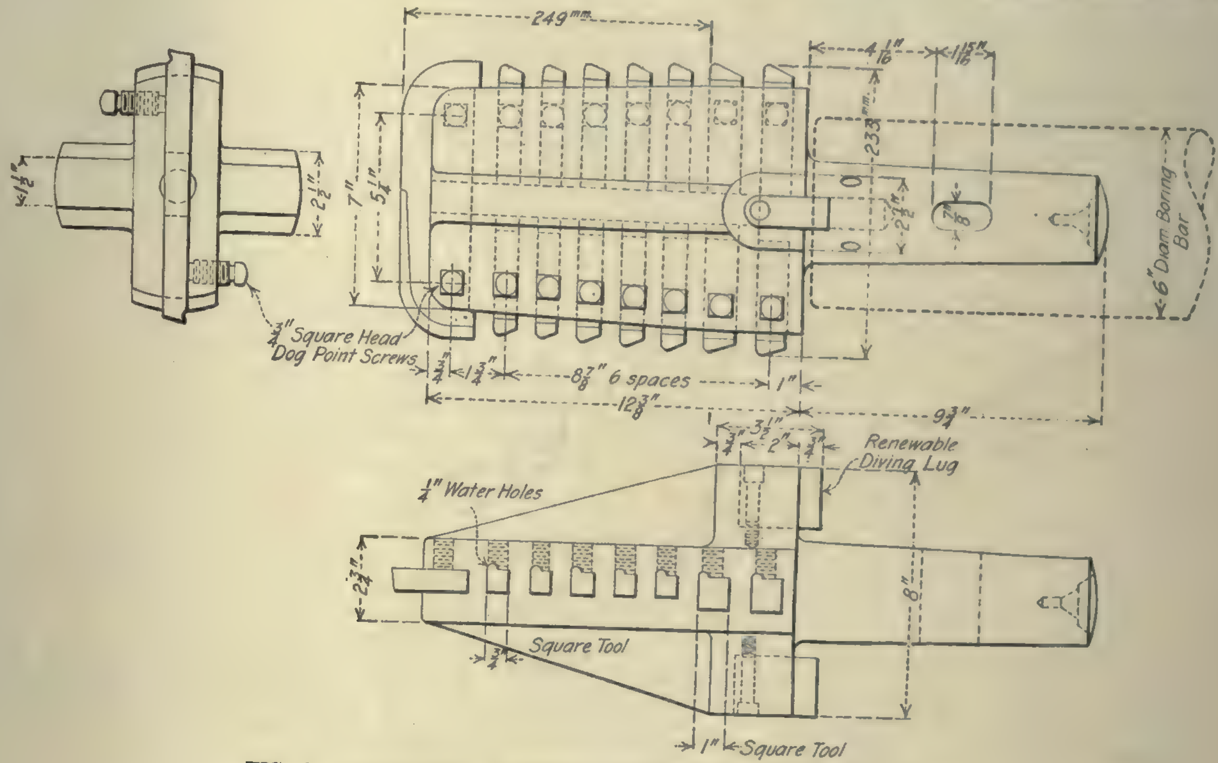


FIG. 2. CAST-STEEL ROUGHING REAMER FOR 270-MM. SHELL

directed upon the points of the cutting tools through the series of $\frac{1}{4}$-in. holes drilled at the forward top corner of each tool. There are also a series of grooves cut in the nose-cutter slot to lubricate it.

A facing-off tool of the dimension shown in Fig. 4 is mounted on the boring bar, and as this is located by gage from the nose cutter, it faces to length, chamfers for the nosing die, and to let the operator know when the reamer is near the bottom. The shells as roughed have 0.9 mm. or 0.035 in. a side for the finishing reamer.

The finish reamer is shown in Fig. 5. It has $4\frac{5}{8}$ x $1\frac{3}{4}$ in. high-speed steel blades set on the quarter, and a

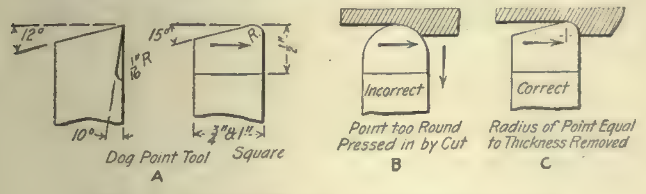


FIG. 3. CORRECT AND INCORRECT TOOLS

nose cutter set at such an angle with reference to the rotation of the shell that the chips will fall away from the cutting edges as soon as they become detached.

There is a 1-in. hole down the center for the cutting compound, let in through two holes in the shank, located opposite the terminus of those in the boring bar. The $\frac{3}{16}$-in. holes along the front of the blades keep the cutting edges flooded, and the $\frac{5}{16}$-in. holes in the body of the tool are for the purpose of washing out the chips; these latter holes are drilled on an angle so that the flow is

After a reamer has been in continuous use for 9 or 10 hours, the cutting clearance will wear off, and if the reamer is still over the minimum limit size, the portable grinding machine can be used to grind the clearance.

On shells of the size here referred to there is 0.4 mm. allowance between the high and low limit on the bore,

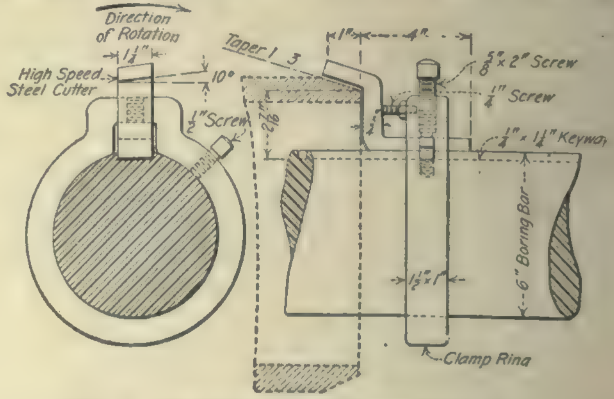


FIG. 4. FACING AND CHAMFERING TOOL

and a reamer may be backed off by the portable grinding machine sometimes as often as four or five times before finally becoming too small for use. In finishing, the shell is run at the same speed as for roughing, 26 r.p.m., giving a cutting speed of 62 ft. per min., and the feed is also the same, 0.175 in. per revolution. This can be increased to about 0.25 in. per revolution while

the blades are cutting on the straight bore, but this is too fast for the taper.

The time for roughing compared to reaming is in the proportion of about 8 to 10, therefore, there should be 8 machines roughing for every 10 machines finish-reaming. The same style of chamfering and facing tool is used in the reaming operation as on the roughing. Independent, four-jaw chucks were used on the machines, but production could be increased by the use of air-operated, universal chucks.

The reamer blades are machined to size, leaving 0.010 in. for grinding.

After hardening, the blades are ground all over on a surface-grinding machine to remove slight distortions, surface cracks, scale, etc., and also to give uniformity of size. The front rake is 8 deg., lip ½ in. wide, and washes out with ⅛-in. radius to cause the chips to curl out and slide on the surface of the body of the reamer, finally to break off and be washed out.

The nose cutters are machined out of ¾ x 2½-in. stock, and those for the roughing reamers are made out of finish-reamer noses, which have become too small to be used on that operation. The benches in the toolroom have a number of reamer holders spaced all around and bolted in place, and they allow the workman full opportunity for turning any part of the tool into the most convenient position for work to be done on it.

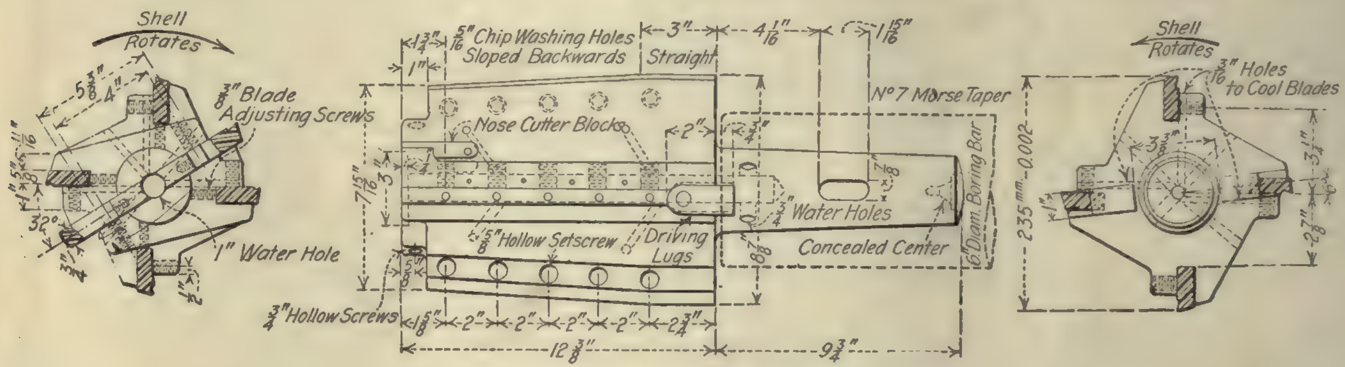


FIG. 5. FINISHING REAMER FOR 270-MM. SHELL

The average time for getting a reamer ready in the toolroom is as follows: Setting up blades, 35 min.; diameter grinding, 10 min.; backing off, 35 min.; honing and fitting nose, 25 min.; total, 105 min.

On these shells the nose cutters are used in all, eight times; first, in the 270-mm. finish reamer, and when they wear too small, in the 270-mm. roughing reamer.

When they become too small for these operations they are removed, fullered out to the correct size again, ground up to gage, and once more used in 270-mm. finish and roughing reamers. After this they are cut down and made to 220-mm. finish gage size, used on this and on the roughing reamer, then in turn fullered out to size, ground up, and used on both 220-mm. reamers again. If necessary they can now be drawn down into ¾-in. square stock for roughing-cutter bits, and by this time they have paid for themselves by service. After these reamer bodies had been in operation for a few months, it was found that the steel had become crystallized and had to be annealed.

With 50 machines tooled as described, a production of from 1000 to 1200 bored shells is possible every 24 hours, and this can after a few weeks training be accomplished by unskilled labor of the class found at the employment-office gate every morning. For this production about 40 roughing cutters and 60 reamers will be required to enable the tool men to keep the situation well in hand.

In conclusion it may be said that each reamer is stamped with a serial number for purposes of record and identification of toolmaker working on it.

Free Radio Class for Men About To Be Drafted

A free evening class to train men as radio operators for the Signal Corps will soon be started by the Stevens Institute of Technology at Hoboken. Those who actually expect to be called to the colors will be admitted into the class if prompt application is made to Professor L. A. Hazeltine, head of the Department of Electrical Engineering under whose supervision the course will be conducted.

The definite object of the course, which will require four evenings each week, is to develop radio or buzzer operators who shall be able to send a minimum of 20 words per minute. Upon finishing the course which requires about 200 hours, less for some and more for others, a certificate of attainment will be given. The course is offered specifically for those who desire to enter a cantonment, trained and ready to do a specific job.

The authorities at Washington state "that drafted men who attain the required proficiency are practically certain of rapid promotion and increased pay in the Army. The rank of corporal and sergeant with a wage of from $36 to $51 a month, awaits the majority of men thus trained; and in proportion as a man so instructed shows this ability and interest, promotion lies ahead of him to the position of Master Signal Electrician, with a wage of $81 a month."

Arbor Kink Prevents Marring the Work

By H. R. Gilliam

On page 911, Vol. 47, a contributor explains how by oiling the face of the shoulder and the work he prevents marring the face of the shoulder on a lathe arbor caused by the work slipping when a heavy cut is taken.

If he will use paper between the arbor and the work, he will thereby greatly lessen the chances of the work slipping and at the same time safeguard the shoulder from injury.

IDEAS FROM PRACTICAL MEN

Shaving Machine for Fuse Caps

By Donald A. Baker

The "type 80" fuse cap shown in Fig. 1 was first finished on the inside and bottom, and tapped on an automatic. An attempt was made to finish the outside on a semi-automatic, but it proved unsatisfactory, so a hand shaving machine Fig. 2, was designed. It not only handled the work in good shape, but boosted production from 500 to 2000 per day.

Referring to Fig. 2, *A* is the frame of cast iron; *B* is the cross-slide which was made unusually heavy, being 7 in. wide as compared with the 3- or 4-in. width common to the usual type of turret-lathe cross-slide. This cross-slide, Fig. 3, carries a roughing tool *C*, held in the tool block *D*, and a finishing tool *E*, held in another tool block *F*. The cross-slide is operated by the hand lever *G*, placed at the right of the operator. An side are used to clamp it, thus holding the tool securely. The new machines are made with machine-steel spindles pack hardened and ground. These spindles run in cast-iron boxes, provided with sight-feed oilers, and have in addition a $\frac{3}{8}$-in. slot *H*, Fig. 2, about $\frac{1}{2}$ in. deep, cut at the bottom of each bearing. This slot is filled with felt to act as an oil retainer and self-oiler in case the sight-feed oilers are allowed to run dry. This construction gives ideal bearings; after several months of continued hard service they are still as good as when new.

The spindle is made adjustable endwise, so that no adjustment has to be made in that direction with the tools. This adjustment is obtained by the two nuts *J* and *K*, while at *L* is a thrust ball bearing. At *M* is a hardened steel washer that is keyed to the spindle and acts as a thrust bearing. In connection with the screw in the nut *K* it prevents any tendency of the nut *K* to work loose. At *N* is the driving pulley, wide enough to

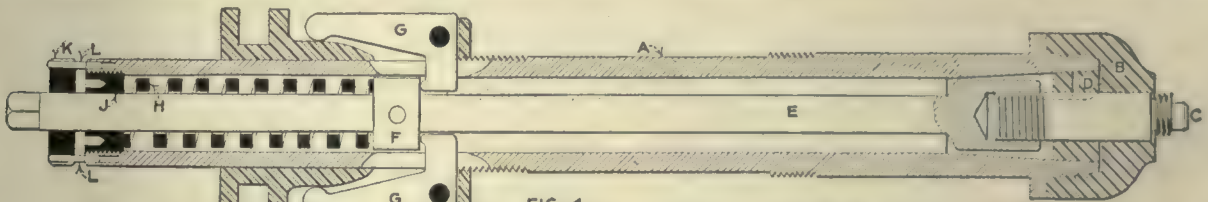


FIG. 4

FIG. 1

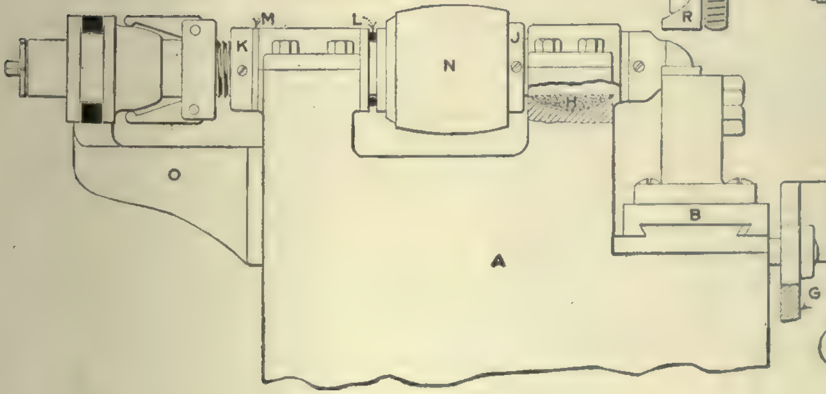


FIG. 2

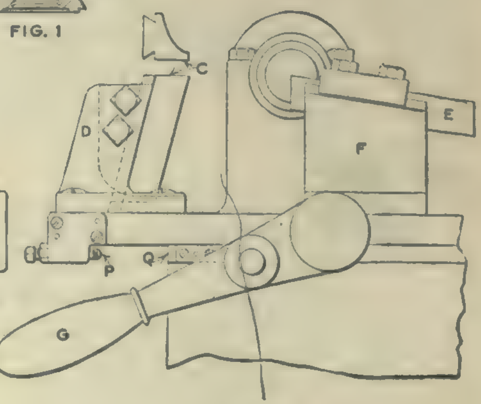


FIG. 3

FIGS. 1 TO 4. THE FUSE CAP AND THE SHAVING MACHINE
Fig. 1—Fuse cap. Fig. 2—Shaving machine, side view. Fig. 3—Shaving machine, end view. Fig. 4—Longitudinal section of spindle

end view of the roughing tool is shown above the cross-slide in Fig. 3, while an end view of the finishing tool is presented at *R*, Fig. 2, as is the clamp used to hold it. The holder for the roughing tool is split part way through with a milling saw, and the two bolts at the take a 4-in. belt. A cast-iron bracket *O* is bolted to the left-hand end of the machine, to which is pivoted a hand lever that operates the chucking arrangement.

A better idea of this can be gathered from Fig. 4, which is a sectional view of the assembled spindle, in

which A is the spindle, bored out its entire length and having a taper ground in its front end. The nose of the spindle is threaded as shown, and over it is fitted the hardened and ground nosepiece B. Sliding in the nosepiece is the threaded arbor C, which is also hardened. This arbor has a keyway cut in it and is kept from turning by a pin projection from the bushing D, which is driven solidly into the taper at the front end of the spindle.

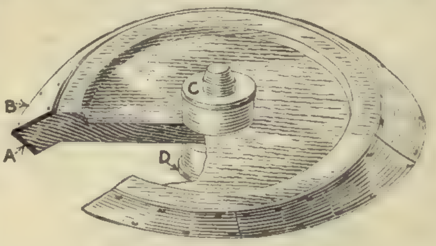
The rear end of the arbor C is also threaded, and onto it is screwed the draw rod E. This rod extends back through the spindle and has pinned on it the hardened steel collar F, which takes the thrust of the two fingers GG. These are made of machine steel and pack hardened. Back of the collar F is a heavy coil spring H held in place by the plug J. This plug is threaded into the end of the spindle and has spanner holes in it, as shown. At K is a collar that is held in place on the draw rod E with a headless setscrew and has driven into it two pins LL. These pins fit loosely into two holes in the end of the spindle.

When operating the machine, the hand lever at the left is first pulled to the right. This pulls back the draw rod and the arbor C as far as they will go, but still leaves C far enough beyond the end of the nosepiece B to hold the cap after it is screwed into place. With the cap in place, the lever G, Fig. 3, is brought up and the cap rough-turned. The lever is then depressed and the cap finished with the finishing tool at the back of the cross-slide. At P and Q, Fig. 3, are shown the stops that regulate the travel of the cross-slide.

A Pattern Protector

By F. P. Terry

While visiting a local firm recently I was somewhat interested in the way the foreman patternmaker "armoured" his patterns, which I believe is worth copying in other shops. The method adopted may be understood from the illustration which is from memory. As will be seen the faces A and B are covered with thin sheet-iron plates, also the faces C and D on the boss, while the two core prints are made of mild steel.



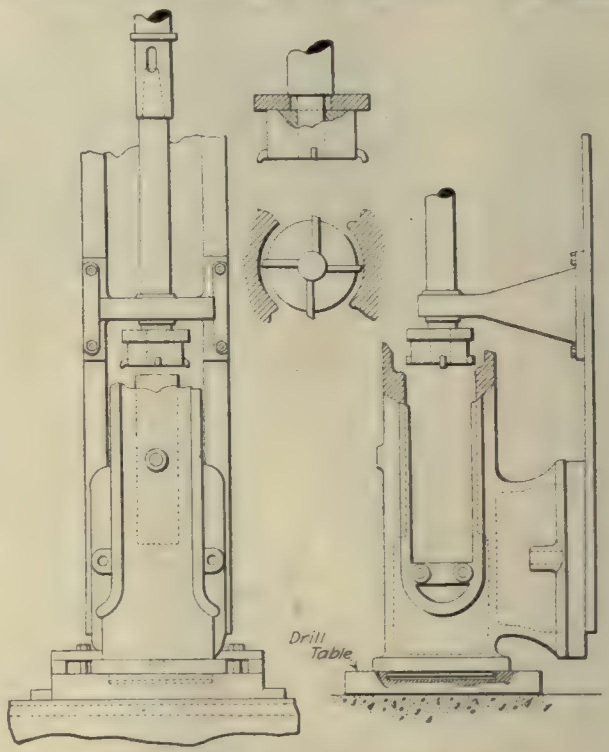
A PATTERN PROTECTOR

This method adds considerably to the life of the patterns without adding the weight usual with iron patterns. It saves the molder a good deal of making up, which is necessary with a wood pattern when it has been used a few times. This foreman made no claims in this direction but he said: "It only protects my patterns, and if they want iron patterns later on they can have them."

Boring Engine Guides

By William A. F. Millinger

The accompanying drawing shows how a small machine shop tackled the problem of boring the guides of a small engine. The only machine available for the job was an upright drilling machine. There was no possibility of supporting the bar at both ends, as the hole next to the table was too small. A guide was rigged up as shown, clamped to the sides of the drilling machine and the engine casting located on parallels.



BORING ENGINE GUIDES

A boring head with the roughing tools in advance of the finishing tools, and a roller steady immediately behind them, made a good speedy job.

Roller Bearings in Machine-Tool Design

By Robert Porter

Realizing that different types of anti-friction bearings have their own spheres of application, this article will treat with those bearing points in machine-tool design which not only lend themselves to improvement but where bearings of the hollow, helical roller type seems the most logical.

Let us consider first the application of roller bearings to an accessory which is common to 90 per cent. of the machine tools manufactured; namely, the countershaft. Here is an appliance which manufacturers seem to overlook. The countershaft is considered a necessary evil—it has to be furnished so the tool may be operated. Some manufacturers make their own countershafts, others buy them complete, still other manufacturers shop around for the various parts, and merely assemble them.

What has this to do with roller bearings? A great deal.

The fact that the countershaft is considered an accessory not only by the manufacturer but also by the user, accounts for the manufacturer's oft-repeated words, "We don't have any trouble from our countershafts." The writer has followed up several remarks like this by calls on the users. They admitted they had frequent trouble with these same countershafts, but had not troubled the manufacturer. The counter-

shaft has not in all cases been considered by the user as a part of the machine tool. In many cases, a local transmission house has supplied a new countershaft, while in other cases the user has insured against further trouble by equipping the boxes, clutches and loose pulleys of his countershafts with roller bearings.

Many advantages have been found in the use of this type of bearing, particularly in the use of the hollow helical roller. Rolling action is substituted for sliding friction, a saving in frictional load from 50 to 75 per cent. This results in a power saving which makes possible the use of the increased available power at the spindle of the machine tool, itself. In other words, increased production may be realized.

While power saving is an economical factor, it is not as important a one as the advantages in lubrication. With the hollow, helical roller there is lubricant capacity within the rollers themselves. Then the rollers distribute the oil back and forth across the bearing surfaces, maintaining an oil film. The oil used for lubrication is conserved, it does not leak from the housing when the housing is properly designed, and yet the bearing is thoroughly lubricated at all times. It has been found that replenishment of lubrication is not required oftener than three or four times a year.

Where this type of roller bearing has been adopted, the periods for inspection of the countershafts have been cut down from once or twice a week for plain bearings designs, to once in three or four months. The resultant saving in time, labor and lubricant is at once apparent.

These advantages cannot be realized however, without an additional first cost for the countershaft equipped with the hollow helical roller. But this first cost may be regarded from two angles: If it were not justified by the advantages already discussed, it would be by the additional advantage of insurance.

Inefficient lubrication has been the cause of many failures of the plain bearing countershaft. By making possible a more efficient and more reliable system of lubrication, certainty of operation is insured.

With bearings in the countershafts which eliminate the possibility of a sticking clutch or loose pulley, and which give positive lubrication to all bearing surfaces, let us consider the added advantage of insurance. The reports of those who are using the hollow, helical type of roller bearing concur in this: The added cost of using this type of bearing is an investment on insurance which is worth while.

While a countershaft may be the most obvious point for using this type of roller bearing, the machine tool itself as we shall see, offers some interesting applications.

Let us stop for a moment and review briefly the essentials of machine design; namely: (1) Rigid construction in reference to particular function of machine. (2) Use of metals based on the granular structure of the metal in hard and soft state. (3) Lubrication. (4) Symmetry and simplicity of design. (5) Permanency of alignment. (6) Accessibility with regard to cleaning, lubrication and renewal of parts subject to wear.

Bearing friction in some classes of machines, is an important factor in determining the power cost of operation. The use of plain bearings necessitates provision for taking care of wear, either by providing for adjustment or by bushing, always with the idea of maintaining alignment.

It is a fact that the factors which determine the life of a machine tool are the bearings. The roller bearing of the hollow helical type will increase the first life of a machine tool. By first life we mean the period of useful life before the machine must be torn down for repairs or renewals. The reasons for this will be discussed further on.

It has been found in many cases that the manufacturing cost of a machine may be materially decreased by simplifying the design. In many cases the helical roller bearing has replaced the plain bearing, and a simpler design resulted. Fewer machining operations are necessary to accommodate the roller bearing. One of the reasons for this is the fact that no means need be provided for taking up wear.

When renewals must be made they can be taken care of quickly and simply. In most types of machine tools the designer faces the problem of vibration. So far as the writer is aware, the only satisfactory method of absorbing the vibration on machine tool spindles is by a large mass of metal surrounding the spindle. However, certain vibrations applicable to gear shafts, driving shafts, etc., are absorbed by the hollow helical roller, which possesses the quality of resiliency and absorbs shocks and vibrations without transmitting them to other portions of the machine tool.

On gear shafts the helical roller bearing has been found highly satisfactory. Permanency of alignment, a most desirable feature of the gearshafts, is assured. This results in quiet running gears. Let us now review the points which the writer has endeavored to bring out briefly: From the foregoing, we see that the hollow helical roller bearings are commanding attention from the designer and manufacturer, as well as from the user, for several important reasons. (1) They make available additional power for use in production. (2) They assure absolute lubrication and require little attention. (3) They insure against shutdown. (4) They make possible a simpler, more symmetrical and often a less expensive design. (5) They assure permanency of alignment. (6) They absorb vibration and are quiet in operation. (7) They eliminate rubbing friction.

They command attention from superintendent and production engineer for the following additional reasons: They eliminate the problem of securing experienced help to scrape in and fit close-fitting babbitt or bronze bushings; they also make possible a greater production without additional investment.

Press Tools for Knife Parts

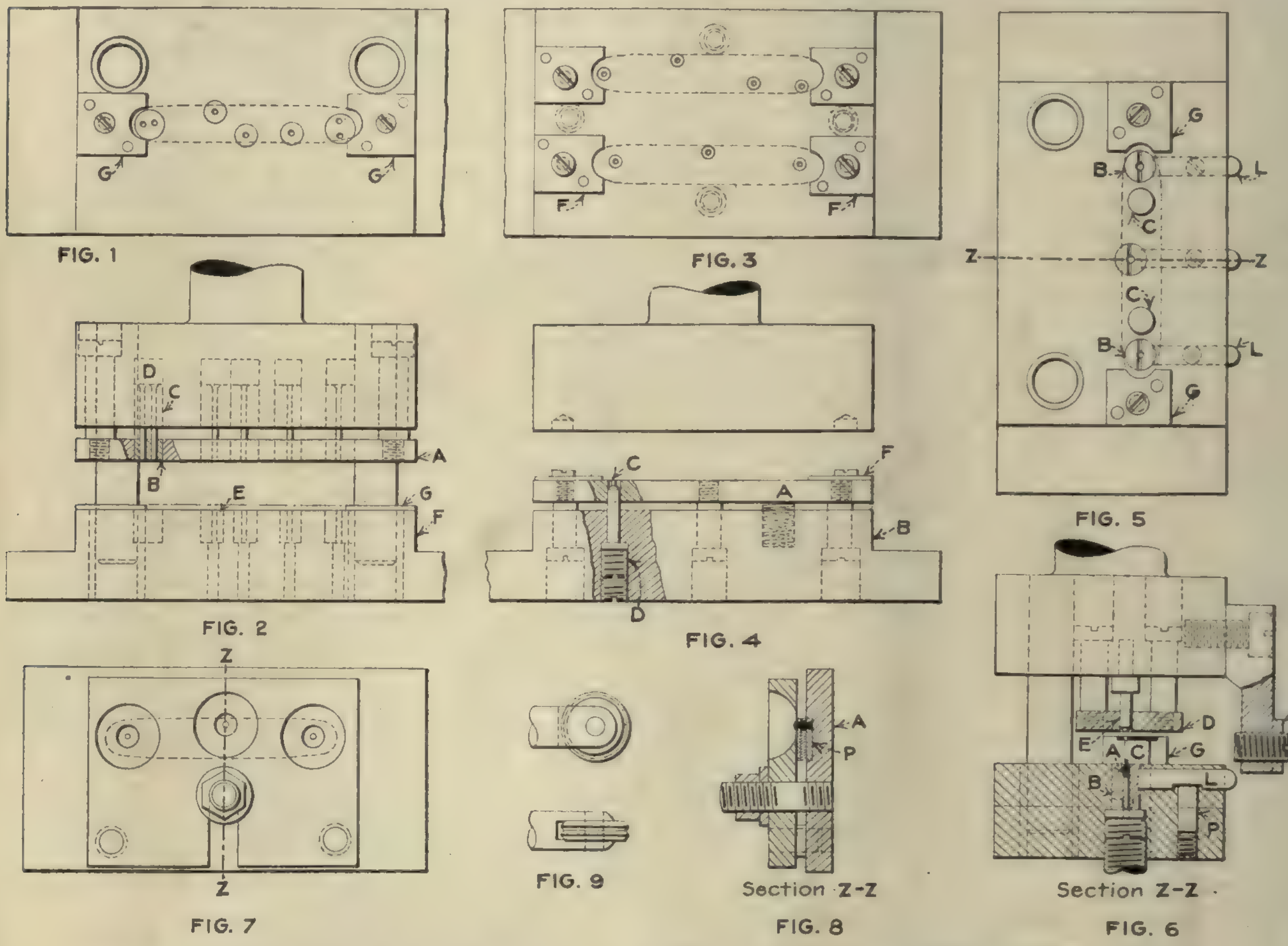
By A. C. Lindholm

I had occasion to substitute a number of modern ideas for antiquated methods in making and assembling the parts of a pocket knife. The knife part was attached to the back of a mechanical novelty, and the parts here mentioned consisted only of the assembled top scale, spring, blades and center scale. These parts were stamped out in the usual manner, but instead of proceeding with press tools for rivet holes a drill jig was

used, and the rivets were put in by hand, then the whole assembled.

Evidently the piercing of the holes in the center scale was thought to be impracticable, owing to the size being smaller in diameter than the thickness of the stock used, the size of the hole being 0.060 in. and the thickness of the stock 0.062 in. After drilling the holes they were countersunk in the drilling machine for the rivets, which were inserted and headed over by upsetting the end with a hammer. Figs. 1 and 2 show the piercing die used in place of drilling jig. In order to properly support the small punches the stripper *A* was placed on the punch-holder, tool-steel bushings *B* guide the punches. The punches were inserted in tool-steel holders *C*, complete blank was finished at one stroke of the press, all holes being countersunk on the proper ends. The punchholder was made of cast iron, no machining being necessary except the turning of the shank and face.

Figs. 5 and 6 illustrate the riveting die. Its function was to place the shouldered rivets in the scale and securely fasten them. In operating the die, rivets *A* were placed in the split bushings *B*, and the scale (shown in outline) placed in the gages *G*, resting on the pins *C*. As the punch descended the spring pad *D* came in contact with the blank, carrying it downward and forcing the shank end of the rivets into the holes. Here the spring pad rested and the riveting punches *E*, upset the end of the rivet in the countersunk hole. On the re-



FIGS. 1 TO 9. PRESS TOOLS FOR MAKING PARTS FOR A POCKET KNIFE

the ends being headed over and resting on the hardened inserts *D*. The dies *E* were of the bushing type, and were inserted in the cast-iron bolster *F*. The piece to be punched is shown in outline on Fig. 1, gaged by the pieces *G*. The guide pins insured alignment and the bushings in the stripper insured stability and thus prevented breakage. The part called the center scale, required some countersunk holes on both sides. This operation was done in the die in Figs. 3 and 4. These show the top and bottom outline of scale placed in gaging position. In this case the stripper *A* was attached to the bolster *B*, and actuated by springs shown. The countersinking punch *C* was placed in the bolster with a setscrew underneath and a binding screw back of it to prevent the screw *D* from becoming loose. In this operation one side was countersunk and then the blank was reversed and placed between the gages *F* so that a turn stroke, the pins *C* actuated by a spring plate under the die (not shown) lifted the assembled piece from the bushings *B*.

In staking over the rivets there was a tendency to upset the body and the other end. To prevent this occurrence, the bushing was split and a plunger *L* actuated by an adjusting screw *M*, locked the rivet. This locking occurred before the scale was forced over the shank end of the rivet. The adjusting screw had a locknut *N*. The plunger *L* was kept in place by a pin *P* and sustained by a setscrew underneath. The split bushings were held in place as shown in the illustration, and a thin piece of metal was inserted in the saw-slot to prevent any undue strain which might occur when operating the die without a rivet in place.

In assembling the respective parts into one unit, it was necessary to have one side nicely finished as this

side was nickel-plated. The riveting operation was performed by the roller-spinner method, using a well-known make of machine for this purpose.

The fixture shown in Figs. 7 and 8 proved to be all that was required. The pieces to be riveted are shown at *P*, Fig. 8, located in the nest of the baseplate *A*. A top plate having a countersunk recess, spherical in form, located the spinning rollers, Fig. 9. These holes corresponded with the rivets to be spun and insured the proper height of the rivet. All necessary parts were hardened, especially the top plate.

Drilling Jig for Rocker-Arm of Airplane Motor

By J. J. Woffington

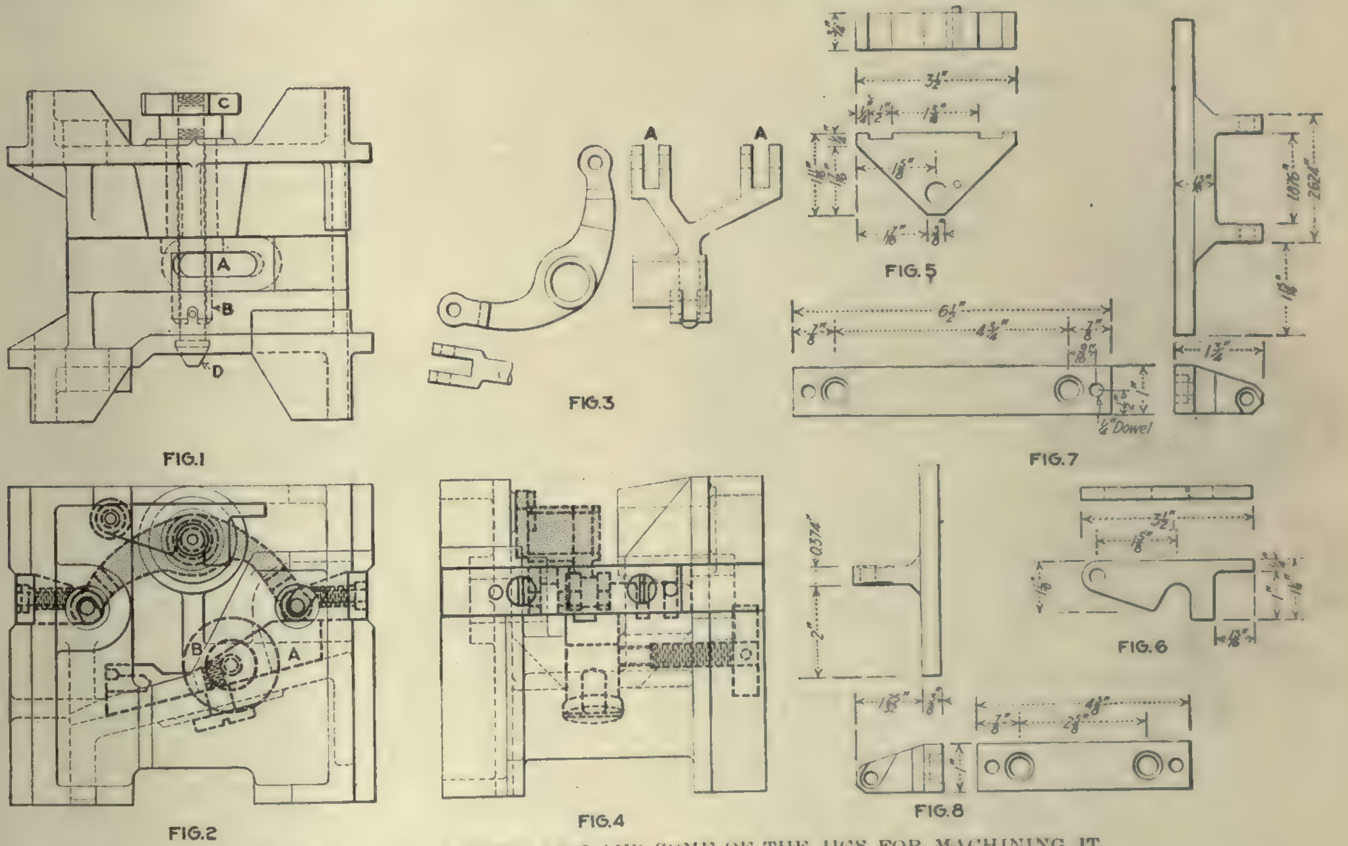
The rocker-arm to be machined is shown in Fig. 3. The shaded portions in Figs. 2 and 4 show it in position in the jig. Fig. 1 shows the jig body with most of the parts removed in order to make its construction plainer to the readers.

The large hub on the rocker arm has a 0.8125-in. reamed hole through it, and both ends are accurately finished to size. The forks are also accurately finished holes, these openings must be as nearly as possible central with the outside of the stock after securing the center-to-center distances from the main hub.

This is accomplished by the equalizing device shown at *A*, Fig. 2, which slides up and down a slot in the jig body, as this wedge is pushed up the inclined groove in the jig body the second equalizing device, details of which are shown in Fig. 5, adjusts the two forks *AA*, Fig. 3, in relation to each other, and in connection with the sliding wedge (*A*, Fig. 2) adjusts all three forks in such a way that any inequalities are divided equally among the three, and spaces them with relation to the 0.8125-in. hole in the main hub.

As the sliding wedge is moved by hand and locked with the hand screw (*B*, Fig. 2) there is very little tendency to bring too much pressure on the forks and distort the rocker-arm. A hollow stud in Fig. 1 locates the large hub of the rocker-arm. The hand nut *C* draws the cone-headed bolt *D* down against a clamp and holds the work in place. The form of this clamp is shown in Fig. 6, and it swings out of position to permit loading and unloading the jig in the course of regular operations.

The support bars shown in Figs. 7 and 8 fit into the rocker-arm forks and after having been correctly lo-



FIGS. 1 TO 8. THE ROCKER ARM AND SOME OF THE JIGS FOR MACHINING IT

to size and in relation to the faces of the large hub, and each fork on the rocker arm has a $\frac{5}{16}$-in. reamed hole. It was for drilling and reaming these $\frac{5}{16}$-in. holes that the jig shown in the illustrations was designed. The rocker arms are very light in design, and as considerable accuracy is required, any tendency of the piece to spring during the drilling and reaming must as nearly as possible be eliminated. And since there is but a small amount of metal left around the $\frac{5}{16}$-in. cated in the jig are dowelled in place. These bars support the forks against the thrust of the drill and also support the reamer, besides making it impossible to place the work incorrectly in the jig.

The expense involved in making the jig has been more than paid for by the time saved in turning out the work. In addition the pieces are much more uniform than they would be unless considerable care were used in machining.

EDITORIALS

Go the Limit—NOW

THE TIME for halfway measures is past; the hour has come for us to go the limit in centralizing our war-making preparations.

The reorganization of the Ordnance Department, recently announced, is a long step in the right direction; and to go further: the sooner we secure complete centralized control, the sooner we can prepare for victory and peace. Federal control is the only logical step, and it is inevitable. Why not take it now?

The one great weakness which is apparent to every one who knows conditions in Washington is lack of coordination. Not only are the three great divisions of our fighting forces—army, navy and aircraft—independent, but each has separate divisions in great number. Instead of working as parts of one huge organization, each is competing with the other for machine tools, gages and products of all kinds. Each division acts independently of the other in nearly all matters.

No business could survive such lack of coordination, and this is, or should be, the largest business enterprise in the world at the present time!

The new plan calls for the division of the Ordnance Department into four heads: Procurement, Production, Inspection and Supply. This is good as far as it goes; but now is the time to make the reorganization complete. These four divisions should cover army, navy and aircraft under the one head and one organization. Unless this is done, the work is only one-third done. The volume of work which must be covered by the three branches is almost beyond comprehension. It will strain our resources and our organizing capacity to the utmost. But there will be less lost motion and costly delays with one central head which can coordinate all these branches than if we have divisions working along independent lines.

The action just taken marks the beginning of great possibilities. It opens opportunities for utilizing the best engineering and business talent of the country. The men for the work will be forthcoming when they are called; but they must not be handicapped by red tape, military or otherwise. They must be given power and then be held responsible for results just as they have been in their private-personal business.

With the making of all munitions organized under one head, we can utilize all the good men now engaged in this work, both regulars and reserves, and many more. There is much to be done in taking proper care of specifications, inspection, gaging and other important details. Delays in delivery must be prevented by keeping in close touch with manufacture from the time it starts or before; by diagnosing the case before, instead of holding an autopsy after delay has occurred.

The three great branches of our service need careful attention. They are now competing in dozens of ways and they will continue to compete unless they are all put under one head. This lack of coordination affects and delays them all. It extends to nearly all lines of their activity and is inefficient in every way. This can be remedied by cooperation and the engineering profession can be relied on to do its full share when the opportunity offers.

The recent conference in Paris emphasized the absolute necessity for cooperation and coordination between all the Allies. But without complete coordination in supplying our own army and navy with arms and other munitions of war, we cannot hope to do our part. And unless we do, the war will not be won! Can we neglect the warning of the Paris conference in this vital matter?

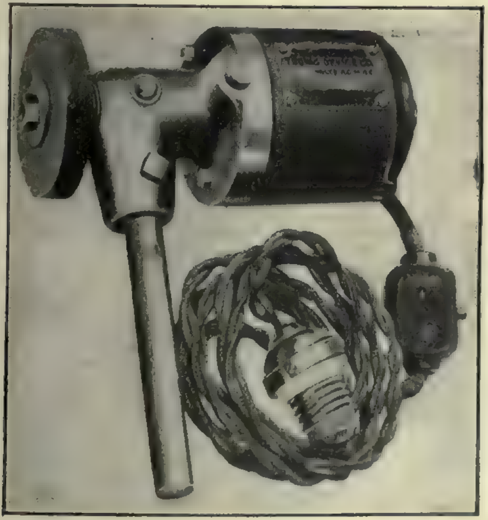
There is no time like the present. The necessity for complete reorganization has been shown by the change already made. The time is ripe to carry reorganization to its logical conclusion. In that way only can we hope to do our full share in this great struggle for democracy. The world expects much of us, and rightly. Can we afford to stop short of the ultimate goal: complete coordination?

Let us go the limit—NOW.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

"Precision Truing Device" for Grinding Wheels

The illustration shows a device that has recently been placed on the market by the Precision Truing Device Co., 519 Main St., Cincinnati, Ohio, for truing grinding wheels. It is a self-contained electrically driven mechanism designed either to be placed in a holder the same as an ordinary diamond tool, or to be clamped in any position on the machine that is convenient to the operator. The small wheel is of hard abradant, and runs at an approximate peripheral speed of 8000 ft. per minute in the opposite direction to that of the wheel to be trued. It is moved across the face of the wheel to be trued the same as an ordinary diamond. The motor is series-wound for either direct or alternating current, and may be operated from the ordinary lamp socket. The spindle is of high-carbon, chrome steel, hardened and ground;

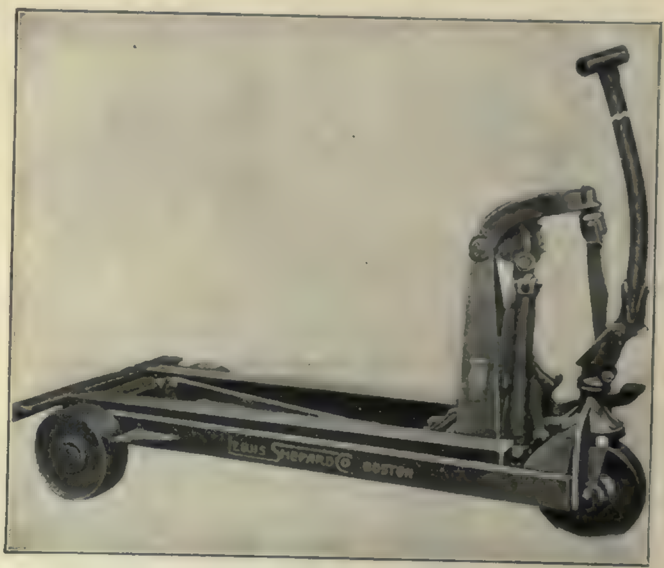


EMERY WHEEL TRUING DEVICE

and is bushed with removable and adjustable phosphor-bronze bushings. The shank is furnished either $\frac{1}{2}$ or $\frac{5}{8}$ in. in diameter as desired. Attachments can also be supplied to hold the device in any required position. It is claimed that this mechanism not only trues abrasive wheels at a much smaller cost than is possible where a diamond is used, but that the wheels sharpened with it will hold their cutting edge longer. It is also claimed that the device adds to the life of the grinding wheels.

Lewis-Shepard Elevating Truck

The illustration shows the latest type of elevating truck that has been placed on the market by the Lewis-Shepard Co., 48 Binford St., Boston, Mass. It is known as the "Type K, Jacklift Master Truck." The capacity of the truck is 8000 lb., and the features claimed are

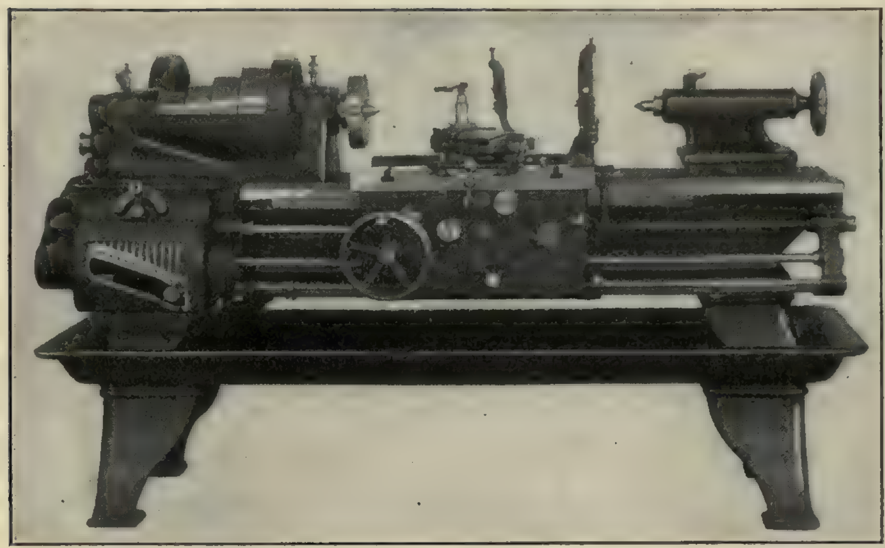


LEWIS-SHEPARD FOUR-TON ELEVATING TRUCK

higher, easier, vertical lift and free lifting handle. The maximum lift is 3 in. and the lifting ratio is such that one man can elevate the maximum load. Crucible steel is used largely in the construction. Ten models are made, five having 7-in. wheels, while the remainder are equipped with 10-in. wheels.

Sundstrand 16-In. Toolroom Lathe

This lathe is of heavy construction and all levers are arranged for convenience of operation. The material and workmanship are high grade and each machine is rigidly inspected under its own power. The bed is heavily braced and heavy ribs have been placed between the bearing pedestals in the headstock. The bearings are phosphor bronze of generous proportions, and are provided with sight-feed self-oilers. The end thrust on rear bearings is taken by ball bearings. Special crucible steel is used for the spindle which is accurately



SUNDSTRAND 16-IN. TOOLROOM LATHE

Swing over bed, 16$\frac{3}{4}$ in.; swing over carriage, 9$\frac{7}{8}$ in.; distance between centers, 6-ft. bed, tailstock flush with end of bed, 32 in.; front bearing on spindle, 2$\frac{7}{8}$ x 5$\frac{1}{4}$ in.; rear bearing on spindle, 2$\frac{1}{8}$ x 3$\frac{7}{8}$ in.; nose of spindle, 6 threads; 2$\frac{3}{8}$ in.; hole through spindle, 1$\frac{3}{8}$ in.; center bushed to Morse taper No. 4; center bushing for headstock spindle No. 7 Morse taper; diameter of tail spindle, 2$\frac{1}{4}$ in.; cuts thread per in., 1$\frac{1}{2}$ to 80, including 11$\frac{1}{2}$; feeds from 6 to 320 per in.; lead screw, 1$\frac{3}{16}$ in., 6-thread Acme; diameters of cone, 4$\frac{1}{2}$ in., 6$\frac{1}{2}$ in., 8$\frac{1}{2}$ in., 10$\frac{1}{2}$ in.; width of belt, 2$\frac{3}{4}$ in.; ratio of back gears, 10$\frac{3}{4}$ to 1; length of bed, 6 ft. 3$\frac{1}{2}$ in.; width of bed, 15 in.; toolpost takes $\frac{5}{8}$ x 1$\frac{1}{4}$-in. tool; length of carriage on bed, 24 in.; countershaft speeds, 150-205 r.p.m.; weight, net, 6-ft. bed, approximately, 2800 lb.; domestic shipping weight, approximately, 3100 lb.; export shipping weight, approximately, 3300 lb.

ground and has a hole through its entire length to accommodate draw-in attachments and collets up to $\frac{7}{8}$-in. capacity.

The tailstock has a long bearing on the shears and is of the cutaway type, permitting the use of the compound-slide at right angles to the cross-slide. The carriage is of liberal length for a lathe of this size and is securely gibbed. The top is provided with T-slots to permit clamping of work. Wipers fitted with felt pads for the removal of chips and dirt from the shears are attached to the carriage. The cross-thread gage stop has micrometer adjustment. A graduated chasing dial is set into the carriage saddle, making it possible to chase all threads without stopping the lathe. The compound-rest has a large bearing and can be swiveled full 360 degrees. The top and bottom slides are fitted with taper gibs. Both the cross-feed screw and compound-rest screw collars are graduated in thousandths.

The apron is of double construction, all gears and studs being supported at each end, removing any chances of cramping the bearings. Both the longitudinal and power feeds are engaged by means of frictions. Automatic stops have been provided which will stop the carriage in either direction for feeding or screw cutting. A lever located at right side of apron controls the carriage-reverse mechanism. The lead screw is accurately made, and is used for thread-cutting only. There is no spline on the lead screw which adds to its long-lived accuracy.

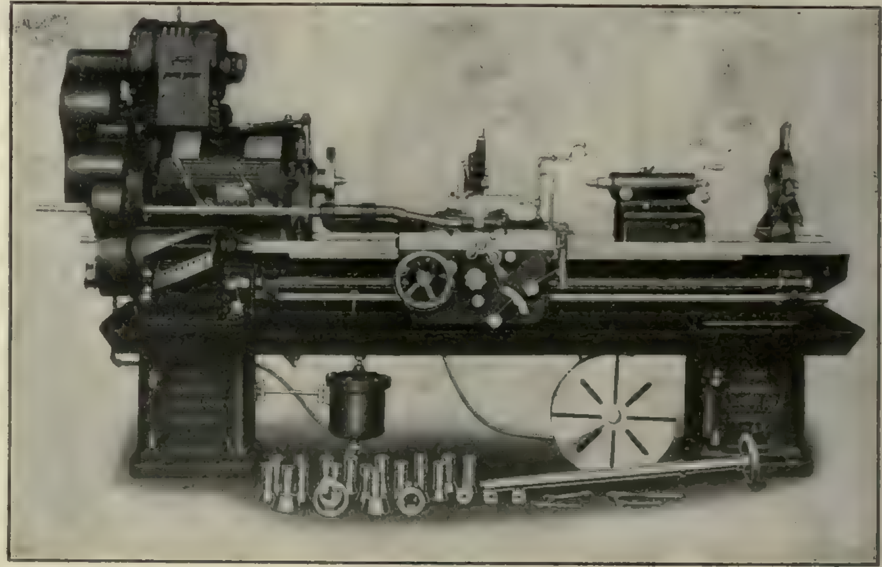
The quick-change gear box is a self-contained unit, mounted on the front of the bed. The driving mechanism consists of a cone of 12 gears, giving 12 different speeds to the shaft or screw. In this cone are meshed three different gears giving a range of 36 speeds and feeds. Only two levers are used to obtain all changes. The shafts in the gear box are mounted in SKF high-duty ball bearings. All gears are made from steel drop forgings.

In the equipment is included a special gear for cutting 11$\frac{1}{2}$ threads, large and small faceplates, followrest, steadyrest, double-friction countershaft, oil pan and necessary wrenches. A taper attachment or a relieving attachment are furnished on order.

This lathe is well suited for fine toolroom work as it stands, but more so when fitted with the special taper and relieving attachments mentioned, as its accuracy and range, as well as convenience of operation, make it very desirable. The same qualities also make it a lathe that can be used for general manufacturing work to advantage. This lathe is made by the Rockford Tool Co., Rockford, Ill.

National Geared-Head Lathe

This lathe is made by the National Lathe Co., Cincinnati, Ohio, in 18- and 22-in. sizes. It is made in either motor or belt drive; any length of bed from 6 ft. advancing by 2 ft. lengths; plain or cabinet legs; metric or standard lead screw and gears. On special order, the



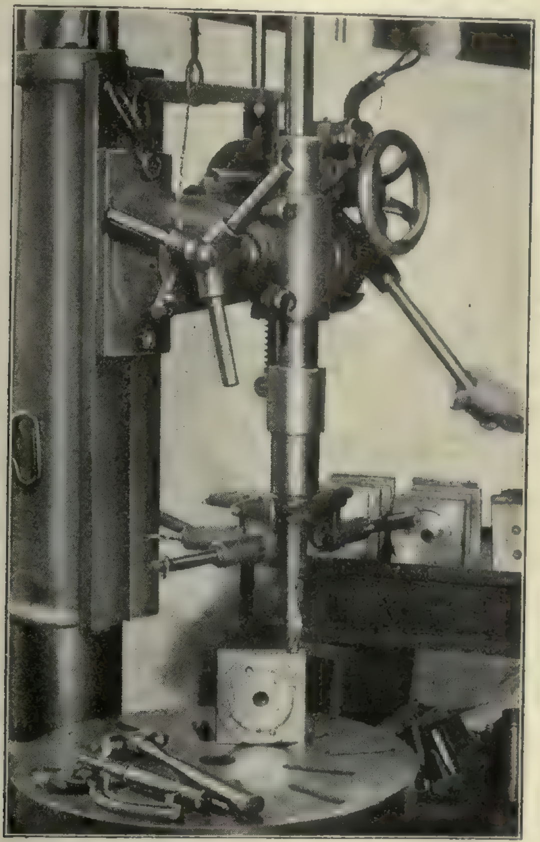
NATIONAL GEARED-HEAD LATHE

Swing over bed, 18$\frac{1}{2}$ in. and 23 in.; swing over carriage wings, 18$\frac{1}{2}$ in. and 22$\frac{1}{4}$ in.; swing over carriage slide, 12$\frac{5}{8}$ in. and 16$\frac{3}{4}$ in.; diameter of front journal, 3 in.; diameter of back journal, 2$\frac{5}{8}$ in.; length of front journal, 5 in.; diameter of tail-stock sleeve, 2 in.; diameter drive pulley, 12 in.; eight fundamental spindle speeds, 12 to 330; speed drive pulley, 330 r.p.m.; length of carriage bearing, 28 in.; width of belt, 4 in.; width of cross-slide, 8$\frac{1}{2}$ in.; greatest gear ratio, 28 to 1; hole through spindle, 1$\frac{5}{8}$ in.; distance between centers, 6-ft. bed, 38 in.; Morse taper, No. 4; diameter of nose spindle, 2$\frac{5}{8}$ in., 8 threads per in., diameter of countershaft pulley, 12 in.; speed of countershaft, 245 r.p.m.; width, top of bed, 17 in.; net weight, 6-ft. bed, motor drive, 3800 lb.; net weight, 6-ft. bed, pulley drive, 3300 lb.; weight per extra ft. of bed, 175 lb.; size of ordinary tools, $\frac{5}{8}$ x 1$\frac{1}{4}$ in.

following attachments are furnished: Taper attachment; relieving attachment; draw-in chuck attachment; indicating dial for thread cutting; heavy sheet-steel oil pan and pumping equipment.

Newman Turret Drilling Head

The Newman Manufacturing Co., 717-719 Sycamore St., Cincinnati, Ohio, is now marketing the drilling head shown in the illustration. The attachment is arranged to be clamped to the sleeve, the drive being through a

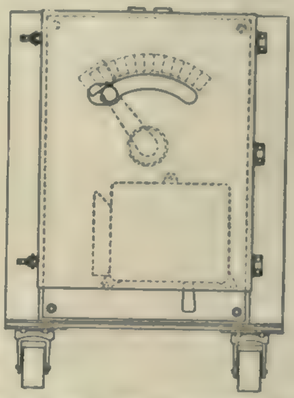


NEWMAN MULTIPLE-SPINDLE DRILLING HEAD

taper shank fitting into the end of the spindle. The device is particularly useful where a number of different operations are required on a single piece of work. One tool may be substituted for another almost instantaneously, the tool in use being the only one in motion.

Westinghouse Portable Panels for Electric Welding

The Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., has recently placed on the market two types of portable outlet panels for electric welding service. These panels are both mounted on light trucks. This feature makes for maximum convenience of service without the necessity of installing a large number of outlet panels. The panels consist of a handle-trip, railway-type, circuit-breaker with an overload release, magnetic blowout, and a 13-point faceplate connected to a resistor mounted in the rear of the panel. The face of the panel is protected by a metal cover through which the handles of the rheostat and circuit-breaker project. The resistor is made up of grids and is protected by a cage of expanded metal. Type E panel is intended for metal electrode welding only, having a capacity of from 80 to 170 amperes. Type F panel will handle metal electrode work from 80 to 160

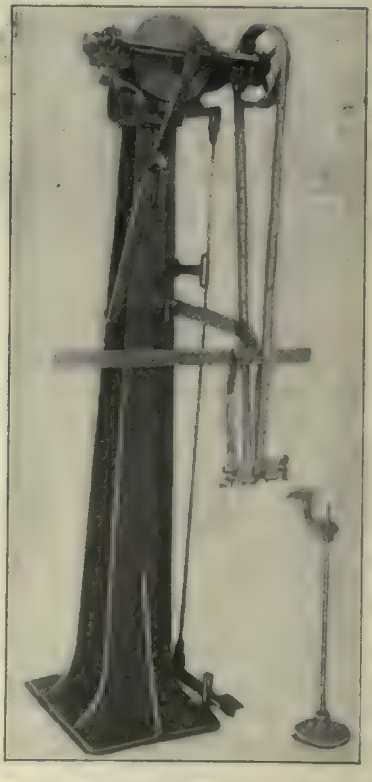


PORTABLE PANEL FOR ELECTRIC WELDING

amperes, and light graphite electrode work up to 300 amperes. Another advantage of the portable panels is that they may be placed close to the welder and thus avoid many unnecessary steps while work is being operated upon.

Fitz-Empire Dynamic Balancing Machine

The Fitz-Empire Double Pivot Last Co., Rochester, N. Y., is now marketing the dynamic balancing machine illustrated, which is designed for balancing parts weighing from 5 oz. to 75 lb. Machines of larger size will



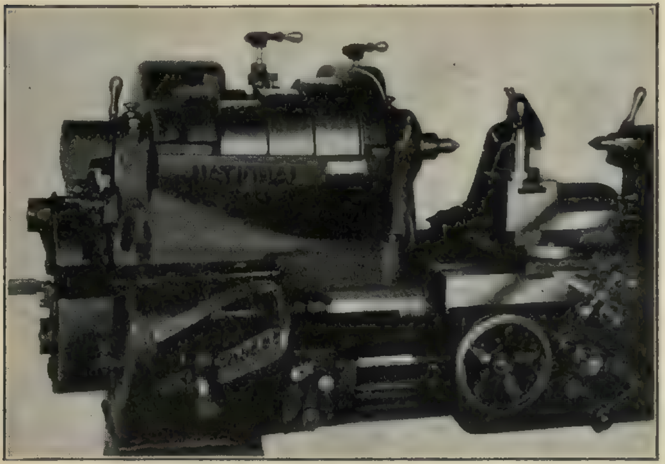
DYNAMIC BALANCING MACHINE

be made to order. The driving-head yoke is a single casting with two adjustable, self-oiling bearings. The shaft carries the cast-iron friction disk and tight and

loose pulleys, and is provided with a ball thrust-bearing held by an adjustable spring tension. By means of this spring tension the pressure between the members of the friction drive may be adjusted to suit conditions. The friction disk is provided with a foot-operated brake for stopping the machine. The sliding friction is controlled by the lever shown at the front, which is within convenient reach of the operator. The maximum distance between the spring bearings is 32 in., the shipping weight is 650 lb. and the hp. required is ½. Equipment includes one balancing arbor, two U-bearings, two floor stands, two marking rests and a suitable belt.

National Cone-Head Lathe

The National Lathe Co., Cincinnati, Ohio, makes this type of lever-controlled, cone-head lathe in 18- and 22-in. sizes. It has extra large cone- and back-gear ratios. The headstock casting has the outside walls brought up to the center of the cone. The three-step, double back-gear cone for 3½-in. belt, has back-gear ratio 3 to 1 and 9 to 1, using 8- and 6-pitch gears as follows: Forward 15, 22, 33½, 46½, 67, 98, 140, 205 and 300 r.p.m. The double-friction countershaft gives 9 more speeds forward or reverse as follows: 18, 26½, 38, 56, 81, 118,



NATIONAL CONE-HEAD LATHE

Swing over bed, 18¾ in. and 23 in.; swing over wings of carriage, 18½ in. and 22¼ in.; swing over carriage slide, 12⅜ in. and 16⅜ in.; diameter of front journal, 3 in.; diameter of back journal, 2⅜ in.; length of front journal, 5 in.; diameter of tailstock sleeve, 2 in.; double back gear diameter cone, 6.3-8.2-10.1 and 12 in.; single back gear diameter cone, 8.2-10.1 and 12 in.; back gear ratio, single back gear, 5½ to 1; back gear ratio, double back gear, 3 to 1 and 9 to 1; 16-spindle speed on single back gear lathe, 15 to 370; 18-spindle speed on double back gear lathe, 15 to 360; length of carriage bearing, 28 in.; width of belt, double back gear, 3½ in.; width of belt, single back gear, 3 in.; hole through spindle, 1⅜ in.; distance between centers, 6-ft. bed, 38 in.; Morse taper, No. 4; diameter of nose spindle, 6 threads per inch, 2⅝ in.; diameter of countershaft pulley, 12 in.; speed of countershaft, double back gear, 205 and 246 r.p.m.; speed of countershaft, single back gear, 158 and 195 r.p.m.; width, top of bed, 17 in.; net weight, 6-ft. bed, pulley drive, 3300 lb.; weight per extra ft. of bed, 125 lb.; size of ordinary tool, ⅝ x 1¼ in.

169, 247 and 360 r.p.m.; countershaft pulleys 12-in. diameter for 4-in. belt running at 205 and 246 r.p.m.; total spindle speeds, 9 forward, 9 reverse, or 18 forward.

The 4-step, single, back-gear cone has 6.3-in., 8.2-in. 10.1-in. and 12-in. diameter pulleys for 3½-in. belt. Back-gear ratio 5½ to 1, using 8- and 6-pitch gears. The 8 spindle speeds are as follows: Forward 15, 23, 35, 54, 83, 128, 195 and 300 r.p.m.; and forward or reverse 18½, 28½, 43½, 67, 102, 158, 240 and 370 r.p.m.; total spindle speeds, 8 forward, 8 reverse, or 16 forward.

The quick spindle-speed change device enables the operator with a short movement of a single lever quickly to change from open-belt speeds to back-gear speeds. It is a special feature that the change can be made instantaneously without throwing out the back gears, as these gears can be in mesh while running on open-belt speed. This applies to both double or single back-geared heads.

Bids Wanted on Presses and Other Machinery

The following letter requesting bids on a number of machines was received by the Warner & Swasey Co., Cleveland, Ohio, and as they do not manufacture all the apparatus wanted they are passing the request along to anyone to whom it may be of value.

Ricardo Mateos Garcia,
Fuencarral, 92,
Madrid, Spain.

The Warner & Swasey Co.,
Cleveland, Ohio.

Gentlemen:

I beg you please to send me an offer on the following machine tools:

First: A machine group for making brass screws with a maximum length of 30 mm., and maximum thickness of 4 mm. The group must be automatic and made up of: (1) A machine for making a head plain form or heavy round. (2) One for splitting the head of the screws, that is to say, making the screw driver catch.

Second group: A machine for stamping pieces of a maximum diameter of 35 to 40 mm., which also must be automatic. For your information, will say that the plates of the articles manufactured are very thin, for example: 0.2 to 0.3 of a mm. thickness.

Third group: Machine for stamping pieces of brass with a diameter not greater than 100 mm.

Fourth group: Machine for pressing by hand and stamping small pieces. This small machine will be suitable for stamping pieces, using the clippings coming from the stamping of large pieces so we can use up most of the brass plate.

Fifth group: Am also interested in a complete plan, although I do not know if you can furnish it, for polishing and nickel-plating the above mentioned pieces. In case you can make me an offer of this, please also tell me the capacity of each machine, the weight, and dimensions, necessary hp. for each, and time of delivery.

If possible, please quote prices C. I. F. a Spanish port, Cadiz or Barcelona, since it is easier for you to find out freight rate charges via steamship company, insurance, etc., from New York to a Spanish port.

As already stated above, and to give you an idea of the machines I need, I will say that I intend to make more or less of the articles I have mentioned and, therefore, the plan will be similar to the one belonging to the firm of Hart & Hegeman Mfg. Co., of Hartford, Conn.

I found your address in *Exportador Americano* (*American Exporter*).

Awaiting reply, I am,

Yours very truly,
RICARDO MATEOS GARCIA.

P. S.—Correspondence in Spanish, French or German.

Inspection of Screw Gages for Munitions of War—Erratum

On page 1066, Vol. 47, the last paragraph should read: "A projection machine, Fig. 1, etc." A subhead "Ring Screw Gages" should have been placed above the last paragraph, left hand column, page 1072, Vol. 47.

Heald Magnetic Chuck—Erratum

In the article on the Heald Magnetic Chuck on page 1105, Vol. 47, part of the third line of the paragraph of specifications under the cut reads, "number of holes in top of plate." This should read "number of poles in top plate."

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Jan. 5, 1918—The taking over of railroads of the country by the President on Dec. 28 is probably the most revolutionary act which we have so far witnessed in the conduct of the war. Few will dispute either its necessity or its wisdom as in this way only can complete coöperation be secured between the numerous lines throughout the country and it is only by complete coöperation that their capacity can be best utilized for the good of the nation. Naturally there are wide differences of opinion regarding the terms of remuneration, but on their face at least they seem to be about as fair from every point of view as could be expected. The stock market reaction should not be taken too seriously, as some seem to be doing, as showing conclusively that the public interests are not being well served by the new arrangement.

It is undoubtedly true that almost all of the roads are in a more or less dilapidated condition and will require liberal doses of tonic in the shape of new locomotives, new cars, and in many cases, new equipment. These adjustments, however, are absolutely necessary to the conduct of the war as well as the carrying on of any normal business and, even if there is no reimbursement for the expenditure which this makes necessary, these expenditures will play a direct part in our war coöperation and are by no means wasted.

The guaranteeing of the same rate of dividend as the average for the past three years, is probably as fair a method of return as could be desired. The main thing, however, is that we are to secure better transportation service which is of prime importance at this time.

There is, however, an entirely different angle to this whole situation which will not be overlooked by builders of machine tools and railway appliances. Many orders for new machinery for the railway shops, for locomotives, cars and their accessories, as well as other railway equipment must be placed in the near future, and, while this adds tremendously to the volume of business which must be done, it also adds seriously to the complications of our machine output. It will probably be relieved to some extent by utilizing shops which specialize upon railway equipment, and which have not as yet gone into other lines. In the case of standard machine tools, however, it simply means the issuance of more priority certificates, which have become so common as to mean comparatively little to the average manufacturer. That, however, is an entirely different story about which there will be something to say in the near future.

The public investigations into the equipment of army camps, reflects in greater or less degree a condition in many other branches of the army service. These delinquencies are from all appearances due largely to the state of mind of those in charge, and to a lack of appreciation of the problem of manufacturing uniform and other material in extremely large quantities. There seems to be a disposition to consider the work done when the orders are placed; and when deliveries fail to materialize at the dates specified, great consternation results. With the quantities previously ordered in peace times it is quite probable that no such difficulty presented itself, but anyone familiar with doing business on a large scale recognizes at once that orders must not only be placed but must be followed up, particularly when those to whom the orders are given are not entirely familiar with the work or such large contracts.

It is very much easier to criticize than to do things right yourself. But it is impossible to make a soldier who has contracted pneumonia on account of not having a complete uniform, believe that every possible effort had been made to clothe him when he knew that some of the largest clothing firms in the country had not been given contracts to anywhere near their capacity. These delays are not all confined to the Quartermaster's Department by any means. One of the difficulties seems to be that after a contract is placed it is not followed up with sufficient persistence to make sure that it is being properly fulfilled; and in cases where work is delayed, unavoidably or otherwise, there seems to be hesitation in placing supplementary contracts with other firms.

There is a noticeable difference in the manner in which much of the work is being handled by men in charge of aircraft, and the methods of men in many of the other branches of the war work. There is a certain snap and go to the work which reminds one of the automobile field, and the reason is apparent when we learn that many of the men, reserve officers and engineers, are from the automobile industry. Many of the formalities are lacking, but the work goes on and results are being obtained in various ways.

Some of our English aëronautical friends rather decry the usefulness of the automobile engineers and the automobile factories in aircraft work, and state that they did not prove nearly so helpful in England as they anticipated. But we must remember that our automobile industry was, and is, developed to a much greater degree than in any other country, that it represents the most modern practice of securing quantity production on a commercially interchangeable scale, and we have no fears of being disappointed as to their assistance in creating our huge airfleet in the shortest possible time.

The Work of the Council of National Defense

Transmitted to Congress by the President

A REPORT of the Council of National Defense covers the history of the Council from its inception to the close of the fiscal year ending June 30, 1917. Permanent organization of the Council was not effected until Mar. 3, 1917.

In a broad sense, Director W. S. Gifford says in introduction, the Council and Commission have sought to make available to the United States the best thought and effort of American industrial and professional life for the successful prosecution of the war. It has become a truism that no past war has been so essentially a war of the mechanic and the machine, and the realization of this truth has been the inspiration of the policy pursued by the Council, the Commission, and their subordinate bodies.

The direction of the machinery of American industry for the national defense necessarily involves the creation of an organization of great flexibility. The swift changes in strategy and rapid improvement in war machinery, attended by the equal speed with which implements of warfare are scrapped and replaced at the front, has been reflected by corresponding rapid transformation and stimulation of the industrial organization within the nations at war. These ever-changing developments have necessitated almost unprecedented flexibility in Government organizations to which the history of the first three months of the war in the United States has proven no exception. Constantly recurring demands for increases in personnel and for new efforts in unexpected directions, have had to be met. It has been the effort of the organization of the Council of National Defense to hold itself in constant readiness to meet such demands and to shift its ground and expand its facilities in the interest of the national service. It has been in no sense a fixed institution. Its organization has been and must continue to be in process of evolution rapid enough to keep abreast with the swiftly changing current of the times, and yet conservative enough to prevent confusion or lack of proper coördination and control. It has been called upon to be ready to fill the gaps and assist the regular Government departments in their efforts to carry the new and huge burdens thrust upon them. Flexibility must remain the essence of the spirit with which the Council carries on its work.

The several fields covered by the Council's work are enumerated as follows:

1. Supervising coördination of purchases for the executive departments of the Government, including the development of new sources of supply for both raw materials and finished products.
2. The standardization of specifications for tools and implements used in the manufacture of munitions.
3. The coöperative organization of transportation and electric communication for war service.
4. The inauguration in conjunction with the Government departments, of an aircraft program; also one to make this program an industrial possibility.
5. The organization of the medical profession for war.
6. The conduct of a campaign to assist commercial business in meeting the demands made upon it by the war; and to aid establishments organized to render men, supplies and equipment available for the needs of the Government without impairing the essential service of trade, and without unnecessary hardship to the people at large.
7. The development and stimulation of motor transportation facilities for Government use.
8. The organization for common counsel of the leaders of the American labor movement, joined with representative employers and persons prominent in civic and industrial life; and for the effective enlistment of the labor forces of the country for the conduct of the war.
9. The bringing together and concentration on war work of the engineering and educational professions, including the promotion of scientific research for the benefit of the national defense.
10. Effective centralization and direction of the efforts of American women for assistance in the conduct of the war.
11. The organization of the coal industry for more effective production and distribution of fuel.
12. The centralized direction of the activities of the several states in their efforts to aid in war.

The work of the Aircraft Board resolved itself into two main divisions: Equipment for training purposes in this country, and equipment for combat work in France. It was in the development of the program for combat, reconnoisance and bombing planes, that the major difficulties were encountered. In all these forms of planes, the lack of previous American experience made it seem necessary to depend to a large extent on designs developed in the allied countries, or else adaptations of their designs. In the production of motors there appeared to be an insuperable obstacle to the production of foreign motors, and in adapting them to the methods of American shop practice.

It was the consideration of these difficulties that led the Aircraft Production Board to develop the composite international design known as the Liberty motor, so constructed and with its parts so standardized that it lends itself easily to quantity production with American shop methods. The general policy has been to rely mainly on a few highly organized and capable establishments, rather than to scatter orders for planes and separate parts among a large number of small shops.

General Munitions Board

The report of the General Munitions Board covers in detail its work of serving as a clearing house for the purchasing divisions of the army and navy by developing new sources of supplies for raw materials and munitions generally. Among the particular forms of munitions covered by the board's work, have been rifles, machine guns, ordnance of many types, ammunition, gun forgings, carriages, limbers, caissons, forge wagons, military vehicles, steel helmets, armor-piercing shells, surgical supplies, optical glass, gages, tools, and dies of many kinds. The general purpose of the board has been to eliminate competitive bidding between the War and Navy Departments and between sub-departments and committees; and it has acted as a clearing house in orders which involve materials in which a national shortage actually exists or is anticipated; and where manufacturing facilities were insufficient the board has directed its efforts to develop new facilities. It has also assisted in price problems. In the latter part of April the board was given full power to determine priority of delivery of material whenever delivery conflicted with the general policy of the Government.

Committee on Emergency Construction

The report of the sub-Committee on Emergency Construction describes the method employed in selecting contractors for the construction of the new army cantonments, a task in which the Quartermaster's Department asked the committee to assist. The selection was based on a general canvass of the country's contracting establishments, which included a detailed inventory of their capacity and reliability. The committee also assisted materially in the determination of the type of construction to be employed, the chief considerations being speed, quality of work, and economy; it further assisted the Quartermaster's Department materially in building up the organization necessary to carry through

the maintenance of cantonments, to advise on organization and to secure competent civilian experts to take commissions and assist in the actual accomplishment of the work.

The Munitions Standards Board

The work of the Munitions Standards Board, was to standardize munition specifications and to assist in so modifying various specifications and designs as to permit greater quantity of production. One of its most notable services was to aid the Government in finding ways and means of adapting peace-time standards to war-time conditions, in order to make them more practicable as manufacturing projects.

Committee on Coal Production

It was the function of the Committee on Coal Production to make every effort to increase the output of coal at the mines, and accelerate the movement of coal to points where the need was greatest. Among the methods employed by the committee to relieve congestion and speed up distribution, was the pooling of coal of similar characteristics through the Great Lakes ports and through the tide-water region.

During the week ending Jan. 6, 1917, the report states the average daily production of bituminous coal was 1,840,000 net tons; of anthracite coal, 228,490 gross tons. During the week ending Apr. 21, 1917—the time of the creation of the Committee on Coal Production—the average daily production of bituminous coal had decreased to 1,682,000 net tons; of the anthracite, 223,680 gross tons. From the latter date, production progressively increased, until early in July bituminous coal was being produced at the rate of 1,902,864 net tons per day, and anthracite at the rate of 281,960 gross tons per day, which was the greatest output of both bituminous and anthracite coal in the entire history of the coal industry; an output if maintained, sufficient to supply not only the entire coal requirements of this country, but also to have created a large surplus to relieve the coal shortage of the allied nations.

Commercial Economy Board

The work of the Commercial Economy Board was to study and advise how commercial business might best meet the demands to be made on it by the war. The problem was to find what activities within the various lines of business were nonessential; and to reduce them, or at least be prepared to reduce them. It was equally important from the outset to conserve essential materials, in order to prevent shortage or to keep existing shortages from growing worse. This work was outlined in the recent report of the Editorial Conference.

Section on Coöperation with States

The purpose of this section was to act as a clearing house between the state councils of defense; to secure uniformity where uniformity was desirable, and to make the services of the organization of the several states available to the various branches of the Federal Government. It was to transmit to the state councils for their information and assistance, the requests and recommendations of the Council of National Defense and the different departments and new official war organizations in Washington; and through recommendations, to assist the state councils in accomplishing the ends sought.

Woman's Committee

Although the first work of the Woman's Committee was the organization of the Washington committee and developing a system of subsidiary state committees, its work embraced National registration to the end of ascertaining the woman-power of the country; coöperation in special campaigns with such branches of the Government as the Department of Agriculture, the Food Administration, the Department of Labor and the Committee on Labor of the Council, in the problem of women in industry; coöperation with the Children's Bureau, the Liberty-Loan Bureau and the Commission on Training-Camp Activities, and the development of educational propaganda for the better understanding of the war on the part of women and school children.

National Research Council

The National Research Council has served as a department of science and research of the Council of National Defense, and in that capacity has been charged with the organization of scientific investigation bearing on the national defense and on industries affected by the war. It has coöperated extensively with scientific missions to this country from the allies, and has been represented abroad in joint work for the promotion of reasearch service of particular value in the conduct of the war, including the submarine problem and various physical and chemical problems.

Committee on Transportation and Communication

The report of the Committee on Transportation outlines the history of the organization built up by the Railway War Board, upon the special invitation of the Council of National Defense. As a result of the railroad agreement to vest in the executive committee, power to move cars and engines from one part of the country to another, the report states that between May 1 and June 30, orders were executed which resulted in moving in the public interest fully 110,000 empty freight cars from sections of the country where they were not needed, to other sections where they were needed. To economize in traffic facilities, passenger trains making over 24,000,000 miles per year in the aggregate were discontinued on the recommendation of the executive committee. This, the report estimates, will result in the saving of 1,500,000 tons of coal per year, and has released for other and more important service 3000 men, including a considerable number of engineers.

Wire Communication

The report of the Committee on Telegraphs and Telephones includes mention of the following activities of the telephone and telegraph companies in organizing for war service: General preferential consideration given to Government business throughout all the main wire systems; the organization of fourteen or more battalions of officers and men for the Signal Corps; increase of efficiency at all strategic centers of the country in spite of a greatly increased pressure of ordinary civilian business; assistance in training telegraphers and telephone operators for Government work in the field or in Government offices, and research in investigation on special communication problems by telephone engineers, in coöperation with the War and Navy Departments.

Committee on Supplies

By securing options, by "pegging" prices of various articles, by the allotment of large requirements throughout the industries, by the elimination of middle men.

and the curbing of competition between Government departments, the committee has enabled the Government to make substantial savings in its purchases. Its work has principally been concerned with commodities, the securing of which involved unusual difficulties, either because of the large quantity required or the shortage of materials needed in their manufacture; or in some cases, because of an unusual competitive demand for similar articles for civilian use.

Under an order of the Secretary of War, based on the emergency power vested in him, it was determined that contracts should be made without resort to advertising for bids. The committee has assisted the purchasing officers in dealing directly with the prime producers of the commodities required. In many instances the committee has succeeded in maintaining purchase prices which existed at the date of our entrance into the war, or even in securing lower prices. The committee has also secured to the Government four to six month options on large supplies of materials at prices which were in effect when the war began.

The committee has coöperated with the proper departments in drafting new specifications which designate the best available substitutes for those articles now difficult or impossible to obtain in the quantities required. The committee has further brought to the service of the Government many mills and factories which had never before produced Government goods. A section of the committee has also assisted the Army and Navy in making subsistence and forage purchases.

Committee on Raw Materials, Minerals, and Metals

Without authority to fix prices, this committee has succeeded in obtaining raw materials at a substantial price-reduction without trade disturbance of consequence. Without legal power to determine priority, it has been largely instrumental in many cases in diverting output in such manner as to secure the greatest general benefit. Without power, save that of persuasion, it has brought specialized private business efficiency into immediate and effective coöperation with a well-ordered federal system.

The report describes in detail the work of the Committee on Lumber, as exemplifying the operation of the whole system. This committee consists of six executive members, practically on continuous duty in Washington, and six field members in different parts of the country. Its work has covered the furnishing of material for the wooden-fleet program, for cantonment construction, and for all the other building projects which the Government has undertaken. The report states that probably $10,000,000 has been saved by the Lumber Committee's mobilization of producers.

Committee on Engineering and Education

It has been the function of the Committee on Engineering and Education to make available to the Government in the most effective possible form, the services of the engineering and education professions. The Engineering Committee has been appointed by different engineering groups to assist in the solution of problems of engineering policies. In a similar way through a meeting of the heads of 187 colleges, universities and technical schools, held in Washington on May 5, the work of carrying on the relation between the colleges and the nation was turned over to the educational section. Progress has been made in organizing both of these groups for national service.

The report of the Committee on Labor tells in detail of the committee's work in mobilizing the resources of labor for the national defense, and in caring for problems involved in the conservation and welfare of workers; and it reviews the work of the special committees on Wages and Hours, Mediation and Conciliation, Welfare Work, Women in Industry, Information and Statistics, Press Publicity and Cost of Living. Other committees have been doing pioneer work in their particular fields by investigating to find out where they could be of most assistance, and in organizing for carrying out their duties.

General Medical Board and Medical Section

The General Medical Board created an executive committee; committees on state activities and examinations; hygiene and sanitation; research; dentistry; medical schools; publicity and hospitals. The work of the members of these committees has from the first been supplemented by volunteers, not officially members of the General Medical Board, but serving as full-time advisors and in residence at Washington. At the General Medical Board meeting which was held at first every week, and later at longer intervals, matters of general medical policy were discussed; committee reports received, discussed and analyzed, and nonmembers encouraged to present ideas bearing on medical problems of war. Such reports were further studied and analyzed in the smaller and necessarily more effective excutive committee, where a decision was reached and reported by the chairman to the Advisory Commission of the Council of National Defense of which he is a member. Through the agency of the States Activities' Committee of the General Medical Board, the status of practically every medical practitioner of the United States is at hand.

Automotive Transport Committee

Many sessions have been held with representatives of the Quartermaster's Department with regard to specifications of the War Department for Class B and Class A motor trucks. The purpose in view was to secure greater clarification of the then-existing specifications for these trucks, making it possible to comply with them in a more thoroughly commercial way. The committee has all along kept in close touch with the aëronautic program of the Government, and held regular communication with members of the aëronautic division of the Standards Committee of the Society of Automotive Engineers, which has been coöperating with the War and Navy Departments; with the Aircraft Production Board; with the National Advisory Committee for Aëronautics; and with the Bureau of Standards.

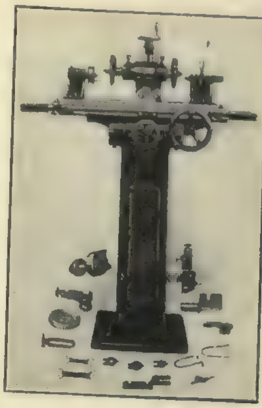
Special mention is also made of the Coöperation Committee of the United States Chamber of Commerce, the Inter-department Advisory Committee and the Committee on Shipping. On June 30, the report states, there were 408 persons engaged with continuous work for the Council. Of this number 168 were receiving compensation, and most of these were clerks and stenographers. This summary does not take into account the large number of additional volunteers who were devoting part of their time to the Council's work.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Machine, Universal

Draper & Hall Co., Middletown, Conn.



"American Machinist," Dec. 13, 1917

For grinding cutters, reamers, counterbores, taps, end mills, gages, etc. Spindle is of 60-point carbon steel, 1$\frac{7}{16}$ in. in diameter and runs in taper white bronze bearings. Swing, 8 in.; longitudinal feed, 18 in.; distance between centers, 17 in.; cross-feed, 7 in.; vertical adjustment, 7 in.; top of platen, 26 x 4 in.; grinds cutters on combination, 12 in. in diameter; diameter of wheels, 6 in.; weight complete with attachments and countershaft, 700 lb.

Cutters, Form Milling

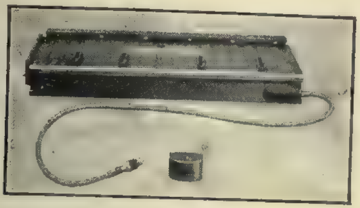
Bilton Machine Tool Co, Bridgeport, Conn.

"American Machinist," Dec. 27, 1917

This company is now marketing a line of milling cutters, these being made in both the plain and formed types. The illustration shows regular spiral mills, bayonet grooving cutters, cutters for milling teeth in pliers, thread-milling cutters for shells, cutters for small pinions, concave cutters and a number of formed cutters for munition work

Chuck Magnetic Type 1436

Heald Machine Co., Worcester, Mass.

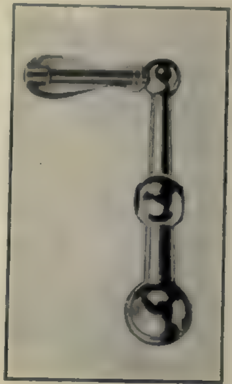


"American Machinist," Dec. 20, 1917

Is waterproof and may be adapted to either 110 to 220 volts in a few moments. Working surface, 15$\frac{3}{8}$x 40$\frac{1}{2}$ in.; dimensions of base, 14$\frac{1}{2}$ x 40$\frac{9}{16}$ in.; height, 5$\frac{7}{8}$ in.; magnetic surface, 12 x 35 in.; watts used, 300; number of coils, 32; number of poles in top plate, 16; strength, 200 lb. sq.in.; weight, 625 lb.

Cranks, Quick Action Ball

Cincinnati Ball Crank Co., Oakley, Cincinnati, Ohio

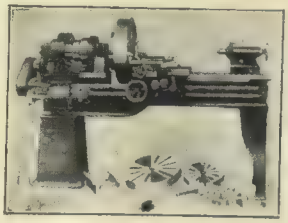


"American Machinist," Dec. 27, 1917

This company has placed on the market a line of quick-action ball cranks. As shown by this phantom view, the spool or swivel type of handle is used. These cranks are built in various sizes, the largest having an over-all length of 13 in. If desired the handles can be furnished separately for installation on cranks or wheels of machines already built and in everyday use

Lathe, Gap, "Filsmith"

Philip Smith Manufacturing Co., Sidney, Ohio

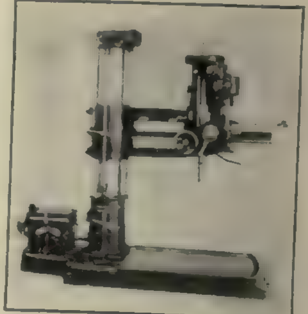


"American Machinist," Dec. 20, 1917

Swing with gap piece in place, 14 in., with gap piece removed, 22 in.; maximum face of work with gap removed, 6$\frac{1}{2}$ in.; lengths of bed, 5, 6, 8, 10 and 12 ft. Is provided with a quick-change box if desired.

Drilling Machine, Radial

Morris Machine Tool Co., Court and Harriet Sts., Cincinnati, Ohio

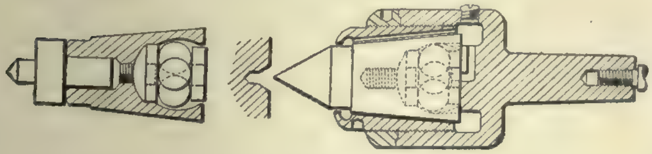


"American Machinist," Jan. 3, 1918

Drills to center of, 8 ft. 6 in.; maximum distance between spindle and base, 60 in.; maximum distance between spindle and table, 39 in.; spindle traverse, 16 in.; spindle diameter above sleeve, 1$\frac{15}{16}$ in.; spindle, Morse taper No. 5; spindle speeds, cone drive, 19 to 350 r.p.m.; spindle speeds, speed-box drive, 20 to 350 r.p.m.; working surface on base, 36 x 51 in.; working surface on table, 18 x 24 in.; ing surface on table, 18 x 24 in.; diameter of column, 11$\frac{1}{4}$ in.; height overall with arm and spindle in highest position, 120$\frac{1}{2}$ in.; motor, 5 hp.; maximum speed, 1200 r.p.m.; motor, variable speed, 4 to 1

Centers, Ball Bearing

J. A. Moller, 57 Lawton St., Box 242, New Rochelle, N. Y.



"American Machinist," Dec. 27, 1917

The revolving center is cone-shaped, being held in the body by means of a bushing. The revolving center is supported on a three-ball thrust bearing which tends to distribute the radial stresses on the stem. The stem cap or bushing is provided with oil channels and a drip retainer. It is adjustable in the housing or body and is provided with a lockring. A number of different style points are furnished. The shank and housing are in one piece and are supplied with an extension rod for knockout

Graduating Machine

Noble & Westbrook Manufacturing Co., Hartford, Conn.

"American Machinist," Jan. 3, 1918

For marking graduations and figures on cylindrical or semi-cylindrical pieces, with one operation only. The illustration shows the machine, together with two of the marking dies and some samples of the work done. The graduating die is held in a holder, keyed to the shaft which runs in bronze bearings and is provided with collar adjustment. The work is held in place in proper relation to the die by gears, and the depth of impression is regulated by a foot lever and cam. The latter is adjustable, it being possible to regulate the cutting depth to a hundredth of an inch

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Jan. 4, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	$23.00
No. 2 Southern Foundry, Chicago	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia	33.75	33.75	30.00
*No. 2, Valley	33.00	33.00	31.00
No. 2, Southern Cincinnati	35.90	35.00	25.90
Basic, Eastern Pennsylvania	33.95	30.00	30.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Jan. 4, 1918	One Month Ago	One Year Ago	Jan. 4, 1918	One Year Ago	Jan. 4, 1918	One Year Ago
Structural shapes	$4.20	$3.95	$3.75	$4–4.04	$3.85	$4.20	$3.75
Soft steel bars	4.10	3.85	3.75	4–4.04	3.85	4.10	3.85
Soft steel bar shapes	4.10	3.85	3.75	4.14	3.85	4.10	3.75
Plates, ¼ to 1 in. thick	4.45	4.75	4.75	4.39	4.50	4.20	4.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Jan. 4, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York	4.25	3.75
Warehouse, Cleveland	3.98½	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Jan. 4, 1918	One Month Ago	One Year Ago	Jan. 4, 1918	One Year Ago	Jan. 4, 1918	One Year Ago
*No. 28 black	5.00	6.445	6.445	5.50	6.45	5.50	6.445	5.00
*No. 26 black	4.90	6.345	6.345	5.40	6.35	5.40	6.345	4.90
*Nos. 22 and 24 black	4.85	6.295	6.295	5.35	6.30	5.35	6.295	4.85
Nos. 18 and 20 black	4.80	6.245	6.245	5.30	6.25	5.30	6.245	4.80
No. 16 blue annealed	4.45	5.645	5.645	4.85	5.65	4.95	5.645	4.70
No. 14 blue annealed	4.35	5.545	5.545	4.75	5.55	4.85	5.545	4.60
No. 12 blue annealed	4.30	5.495	5.495	4.70	5.50	4.80	5.495	4.55
No. 10 blue annealed	4.25	5.445	5.445	4.65	5.45	4.75	5.445	4.50
*No. 28 galvanized	6.25	7.695	7.695	7.50	7.70	7.00	7.695	7.25
*No. 26 galvanized	5.95	7.395	7.395	7.20	7.40	6.70	7.395	6.95
No. 24 galvanized	5.80	7.245	7.245	7.05	7.25	6.55	7.245	6.80

*For painted corrugated sheets add 25c. per 100 lb.; for galvanized corrugated add 5c.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Jan. 4, 1918	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Jan. 4, 1918	One Year Ago
New York	$15.00	$8.00
Cleveland	15.30	7.50
Chicago	15.00	6.00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

* Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Jan. 4, 1918	Cleveland Jan. 4, 1918	Chicago Jan. 4, 1918
Tire	5.00	5.00	4.04
Toe calk	5.70	5.50	4.35
Openhearth spring steel	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	8.00	11.25	12.00
Coppered bessemer rods	7.00	....	....
Hoop steel	4.04½	....	....
Cold-rolled strip steel	9.00	....	....
Floor plates	6.19½	....	....

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Jan. 4, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	30.00
Tin, in 5-ton lots	86.00	74.00	42.88
Lead	6.50	7.25	7.50
Spelter	8.00	7.88	9.50

*Government price.

ST. LOUIS

Lead	6.35	7.13	7.33
Spelter	7.75	7.63	9.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Jan. 4, 1918	One Month Ago	One Year Ago	Jan. 4, 1918	One Year Ago	Jan. 4, 1918	One Year Ago
Copper sheets, base	31.00–33.50	35–37	41.00	32.50	44.00	35–36	42.00
Copper wire (carload lots)	32.00	36.00	36.00	28.50	44.00	34.00	36.50
Brass pipe, base	36.50	38.50	47.50	40.00	52.00	41.00	46.50
Brass sheets	30.75	35.75	45.50	33.00	47.00	35.00	44.00
Solder ½ and ½ (case lots)	48.00	40.50	27.50	43.25	28.25	41.50	28.25

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Jan. 4, 1918	One Year Ago
Mill	$25.00	$42.00
New York	30.00	45.50
Cleveland	34.00	42.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Jan. 4, 1918	One Year Ago	Jan. 4, 1918	One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Jan. 4, 1918	One Year Ago
New York	15.50	15.00
Cleveland	17.75	16.75
Chicago	16.00	15.75

Cannon Making in Past Centuries

By H. H. MANCHESTER

CANNON manufacture between 1550 and 1800 was marked by a gradual displacement of guns constructed of wrought-iron bars and hoops, the continued use of cast bronze, and the growth in favor of cast-iron cannon. The long, small-caliber guns built up of iron bars were particularly suited to the so-called serpentine powder, which was something mixed on the spot, and was always slow burning and comparatively weak. When the use of the more rapidly-burning, corned powder was extended to large guns in the sixteenth century, it was found that so great a length for the guns was of no benefit. This negated one of the chief advantages in the use of wrought-iron bars in gun construction, and such cannon were in time superseded.

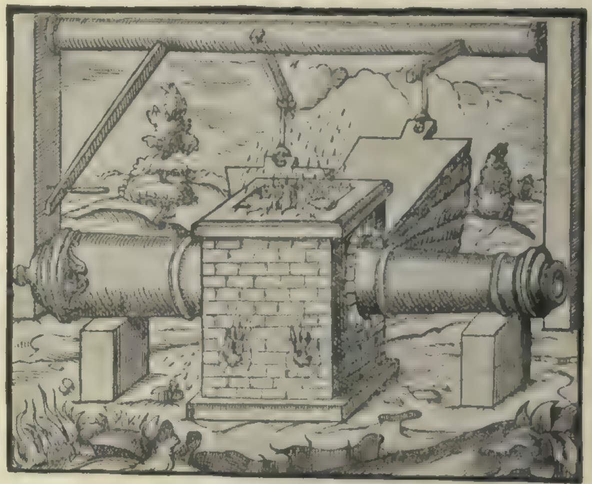


FIG. 1. A FIELD FURNACE FOR DESTROYING OR REPAIRING A CANNON, 1641

While bronze cannon were cast as early as the fourteenth century, their great popularity dated from the sixteenth. In England they seem to have been cast for the first time in 1521. In 1545 the ship "Mary Rose" had on board both breech-loading, wrought-iron guns and muzzle-loading bronze guns.

For several centuries the bronze gun continued in favor, especially for the smaller field pieces. The bronze guns were tough enough to fire a cast-iron shot, and it was discovered that such shot even though smaller would do more destruction than a shot of stone. This led to a multiplication of smaller bronze field pieces instead of almost immovable bombards.

Bronze could be not only cast but wrought, which occasionally enabled a gun to be repaired. Collado, for example, in 1641, gives a picture of a field furnace, Fig. 1, to be used for such guns. This fulfilled a double purpose as it was employed to ruin guns on the eve of a retreat, and also to heat a gun which showed a slight crack in an unimportant place so that it could be welded together —which suggests that even at that date there may have been attempts to construct guns by forging them in one piece. This thought is corroborated by a device of M. Villons', which was approved by the French Academy in 1716. It was a method of forging separately, different sections of the barrel of a cannon, and then welding them together. It is important as a first step toward the modern forging of cannon.

In the illustration, Fig. 2, the three parts of the cannon were strung along the rod. The sections of the cannon rested on the block *C*, which could be raised or lowered and swung into the furnace. When brought to a white heat the sections were driven together by the swinging ram. While this arrangement does not appear free from objections, it was stated that it was in use in two places in France. For large guns, however, the chief reliance of the seventeenth and eighteenth centuries was on cast-iron cannon. Cast iron for guns had been experimented with very early. Cannon which were partly wrought and partly cast, using stone balls, seem to have been employed in Germany at the siege of Karlstein in 1422. Several other cast-iron cannon of this same period are to be found in museums, and others date from the time of Maximillian I of Austria, or about 1500 A. D. But it was not until the development of the stack or high blast furnace, which was first introduced about 1444 and became more widely known a century later, that the melting of iron became easy enough to make large guns of cast iron economical.

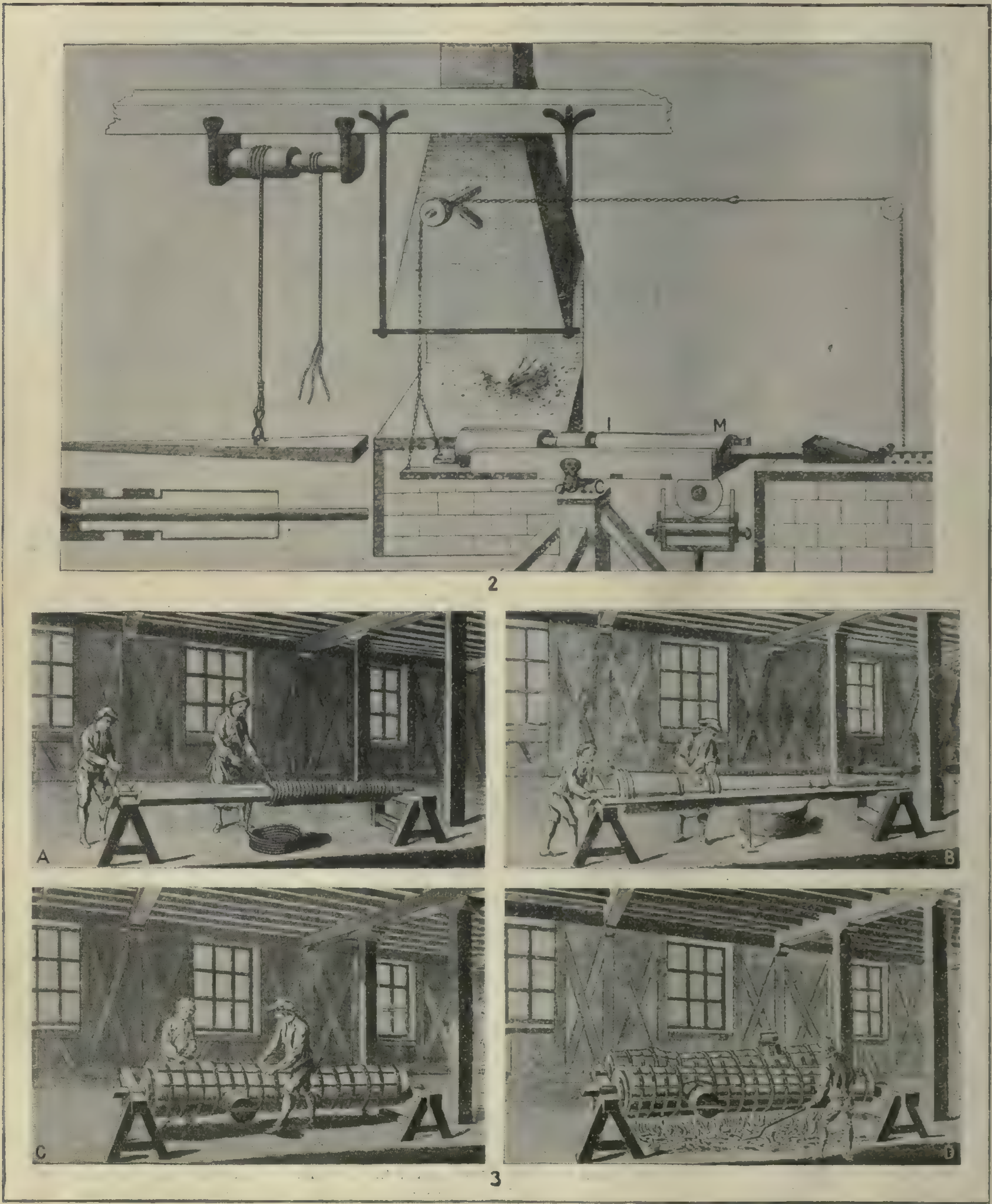
It is recorded that in England the first cast-iron cannon were made in 1540 with the assistance of founders from abroad. In 1544 there was in Dover Castle a cast-iron cannon which had been made in Utrecht, and presented by Charles V to Henry VIII. It was 24 ft. 6 in. long, and had a caliber of only 4¾ in. As a general statement, there were no great improvements in the casting of cannon in the seventeenth century. Molding in sand as a commercial method began about 1708, but it was used for small articles and not for cannon. Up to the first of the eighteenth century cannon had regularly been cast hollow, but experiments on the solid casting of cannon were made in 1720 by Kassler in Germany, and adopted in 1739 by Maritz in France. From that date casting solid seems to have been generally preferred.

Some very interesting illustrations on the manufacture of cannon were published in the different French encyclopedias, and by Monge toward the end of the eighteenth century. One of the engravings of casting cannon, *A*, Fig. 3, illustrates two men winding a straw rope around a wooden spindle, which was the first step in forming the mold. One man turned the spindle by means of a winch, while the other held the rope and guided it with a stick. Another cut, *B*, Fig. 3, shows two workmen forming the clay mold over the straw rope. Again one workman turned the spindle, while the other laid on the clay. This clay mold was made the exact form of the outside of the cannon.

In another cut, *C*, Fig. 3, two men are shown binding the second clay form with bands of iron. Still another picture, *D*, Fig. 3, illustrates a workman baking this clay until it becomes hard enough for the spindle

to be knocked out, and the straw rope and the inner clay form removed. This left the inside of the outer mold the shape of the outside of the cannon, and ready for the casting. Four such cannon were often cast at a time. They were set up vertically a few feet apart, at the corners of a square, and well packed around with clay. The molten metal was admitted to the molds at the bottom.

The casting of cannon was something of a ceremony, as is suggested by the illustration, Fig. 4, which we reproduce from that period. When all was ready, at the word of command an opening was made in the furnace, and the operation carried through with military regularity. The molten iron was allowed to fill the molds somewhat above the top of the cannon. This head of



FIGS. 2 AND 3. FORGING AND MOLDING OPERATIONS ON CANNON
Fig. 2—An arrangement for forging a cannon in separate sections and welding them together, 1716. Fig. 3—Making the mold for a cannon, 1765

FIG. 4. CASTING AN IRON CANNON, 1765

FIGS. 5 TO 7. A NUMBER OF BORING METHODS USED ABOUT 1783

Fig. 5—Boring a cast-iron cannon, 1783. The vertical method. Fig. 6—The horizontal method of boring a cast-iron cannon, 1783. Fig. 7—Using a bow drill for drilling the touch hole of a cannon, 1783

metal was important because in it was gathered much of the imperfections and scoria of the casting.

The boring of the cannon, which, as already mentioned, were by that time cast solid, was done by both vertical and horizontal machines. In the illustration, Fig. 5, of the vertical method which we reproduce, the cannon was raised by windlasses, and allowed to rest much of its weight on the drill. The drill consisted of an iron bar in the end of which were set hardened-steel cutters. The only power used was that of oxen or horses. Considerable heat was developed, and it will be remembered that Count Rumford used the boring of cannon to prove the theory of latent heat, and of the production of heat by friction.

In horizontal boring, Fig. 6, sometimes the drill was turned, and sometimes the cannon itself was turned against the drill. In the latter case the gun was usually fastened to the axis of a water wheel. In order to press the cutter against the gun, a weight was employed which sometimes acted through a rack and pinion, and in other cases through levers. The levers were said to have avoided the jerky movements of the rack and pinion. Sometimes the gun was bored twice, the first boring being somewhat smaller than the intended size. The advantage of the horizontal method of boring seems to have been that in this position it was somewhat easier to handle the guns, and to bore more than one gun at a time. Monge gave a plan for the boring of four guns at once by the horizontal method.

While the gun was being bored, especially if it were revolved against the drill, the outside was turned at the same time. The touchhole was drilled either by hand or by the use of horsepower. A machine for this purpose was devised by M. Villons, and approved by the French Academy in 1716. A more interesting arrangement, Fig. 7, however, is pictured in the *Encyclopédie Méthodique* in 1783. It proves that the bow drill was used for the purpose—which is very surprising in consideration of the fact that the bow drill was invented at the dawn of history.

The interior of the gun was examined for defects by means of wax tapers, or by throwing the sunlight into it with the aid of a mirror. The gun was proved by setting off a large charge of powder, or sometimes by stopping the touchhole and forcing in water.

These methods of cannon manufacture remained in vogue with few improvements until after the introduction of steel guns well along in the nineteenth century.

Manufacturing a Steel Chair

By G. F. Wetzel

Production Engineer, Frank S. Betz Co., Hammond, Ind.

Recently a number of steel ward chairs for use in Government hospitals were manufactured, the allotment herein described numbering twelve hundred. The making of these chairs involved some methods which might be applied in the manufacture of other articles, and furnishes a good example of the benefit of both the acetylene and electric welding processes in the manufacture of steel furniture.

An idea of the construction may be obtained from the illustration, Fig. 1. The chair consists of the tube *A*, ⅞ in., outside diameter, one continuous piece forming the back and back legs; two back strips *B*, each 1½ x ⅛ in.; seat ring *C* of tubing, ⅞ in., outside diameter; brace ring *D* of tubing, ⅝ in., outside diameter; two front legs *E* of tubing, ⅞ in., outside diameter; and the seat *F* of 18-gage sheet iron. The specifications called for a 19-in. diameter seat, which is larger than the usual size for this type of chair, but is satisfactory for hospital use.

Making the Back

After cutting the tube to the correct length, the ends were reamed to remove the burr formed in cutting, so that wood floor-tips could be inserted. From Fig. 1 it will be seen that there are four distinct bends in each half of the back tube. The bends *G* were made

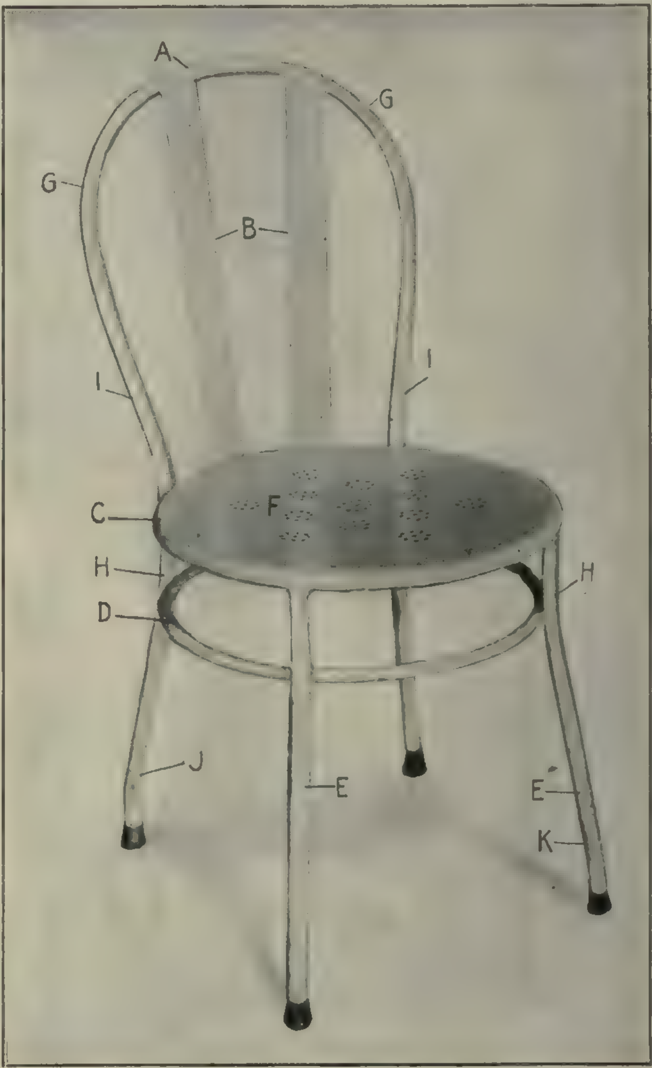


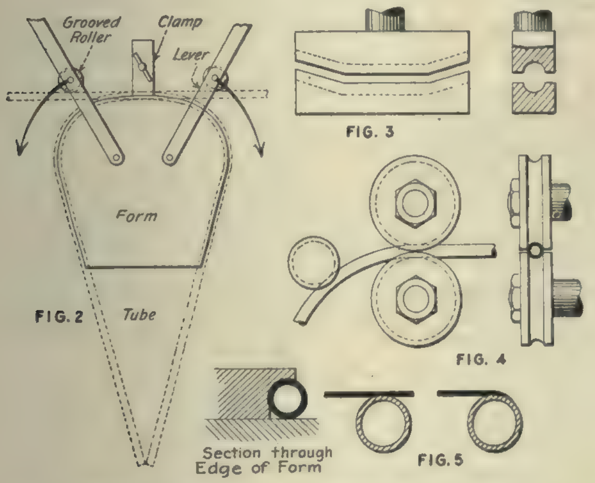
FIG. 1. COMPLETED CHAIR

by means of the fixture shown in Fig. 2. The tube after being located by means of a stop was clamped at the middle and bent around the cast-iron form by two laborers, one at each lever. The form was bolted to a heavy iron plate about 42 in. square, supported on a pipe frame screwed to the floor. The section of the form was such that there was no flattening of the tube in bending (see section through edge of form). In making the form, a paper templet was made of the desired form for the back, and then trimmed down to allow for the spring of the tube. This will vary with the form of the bend, the thickness of the tube wall, the iron used, and the angle. It is best to be

conservative in allowing for springing; trim down the form casting if necessary.

The bends at H and I, Fig. 1, were made by a cast-iron forming die in a punch press. The die, shown in Fig. 3, was made to bend larger angles than desired, and then adjusted in the press, as the distance between die and punch when in contact had no effect except on the angle of bending. A wooden frame nailed to the floor served as a jig to locate and hold the work properly. The bend at J, Fig. 1, was made in like manner with another die of cast iron.

The tubes for the legs E, Fig. 1, were cut to length, and one end only, reamed, as the upper end comes against the set ring and the burr is not objectionable. The two bends, at H and K were made in one operation with a cast-iron die. As with the back tube, allowance had to be made for adjustment to admit the springing of the tube. Cast-iron forming dies for use on pipe or tubing work are used in many products in the shop.



FIGS. 2 TO 5. TOOLS FOR CHAIR WORK

Fig. 2—Frame for bending back. Fig. 3—Die for forming bends in back legs. Fig. 4—Machine for rolling coils. Fig. 5—Method of attaching seat

They stand up remarkably well, and if properly designed will not flatten the tube. This was done in the three following operations: (1) Cut to length, (2) ream one end, (3) bend in press.

The seat and brace rings C, D were made by taking full lengths of $\frac{7}{8}$-in. and $\frac{5}{8}$-in. tubing, respectively, and rolling them into coils of the correct diameter. These coils were then cut through on one side by means of the acetylene flame and welded into rings. The rings were straightened and trued on a cast-iron cone and the welded joints ground off smooth, after which they were ready for assembling. The rolling was done on a machine having two driven rollers and one idler roller, the arrangement and form of which are shown in Fig. 4. The rollers were made of cast iron, about 7 in. in diameter, and after rolling twelve hundred pieces of each size, showed no appreciable wear. The operations for making the seat and brace ring are as follows: (1) Rolling tube into coil, (2) cutting with acetylene flame, (3) welding joint, (4) grinding joint smooth, (5) straightening.

The seat F, Fig. 1, of 18-gage iron was cut into squares on the power shear, and then cut into circles on a power-driven circle shear. The perforations consisted of groups eight $\frac{3}{16}$-in. holes in a circle $1\frac{1}{2}$ in. in diameter with an equal-size center hole, the groups arranged to form a six-pointed star. Each group took one stroke of the punch press; the center one being stamped out first, and the sheet rotated on a pin to get each of the circles of perforations. In making the seat it required three operations: (1) Cut into squares from sheet, (2) cut into circular form, (3) perforate.

The back straps B required no other work to prepare them for the assembly than cutting to length, and straightening a few pieces.

All the joints in the chair were made by the acetylene-welding process except that between seat ring and sheet, there being twelve acetylene welds. To enable the welders to set the work up rapidly a jig was made, which held the legs, back, brace ring, and seat ring in their proper relative positions. One welder would tack (or weld just enough to hold) each joint, remove the work from the jig, and pass it on to another man to finish the weld. In this way only one jig was necessary for the desired output, and one man doing all the setting up enabled him to become very proficient. The next step was to spot-weld the seat in place. The most efficient way would have been to spot-weld the seat sheet to the ring as the first step in the assembly, but the heat from the following acetylene welds would have caused the sheet iron to buckle.

The seat was attached as shown in Fig. 5, with a spot-weld about every $1\frac{1}{2}$ in. around the circumference. The four following operations were necessary: (1) Set up in jig, (2) tack all joints except on seat sheet, (3) finish weld, (4) spot-weld seat.

Finishing

Since even the best acetylene welder can not make a weld smooth enough to enamel over without being finished, there was considerable filing to be done. A heavy fillet of iron was placed at each joint between the various tubing members in making the welds, and these had to be filed so that they were smooth to the touch. Any holes had to be finished out, unless they were too deep in which case the painter puttied them up. The files used were $\frac{1}{2}$ in. rat-tail.

In finishing the seats, the sheet projecting past the center of the seat ring was hammered over to fit the ring, and then ground and filed so as to give a section as shown in Fig. 5. Finishing required three operations: (1) File acetylene-welded joints, (2) hammer over edge of seat, (3) grind and file smooth.

The final step in the process was the enameling. Practically all steel furniture used in hospitals is finished in white, so these chairs as specified, called for the same. The finish consisted of four coats, two under coats, and two of finishing enamel. All four were sprayed on under pressure, and oven baked, giving a durable, elastic covering. As the chairs came from the ovens and cooled, the wood-floor tips were inserted. These were held in place by driving fits, the tips having a shank about $1\frac{1}{4}$ in. long and a shoulder to come against the end of the tube. The shank was slightly tapered, the small and large ends being $\frac{1}{64}$ in. under and over the inside diameter of the tubing, respectively.

A chair made in the way described is practically indestructible under ordinary conditions of use, as it is nearly as strong as if made of an unbroken piece of material. Naturally the enamel will wear in time, but it can be refinished at small expense, when the chair will be as good as new.

Use of Diamond Tools in the Shop—II

BY F. A. STANLEY

Showing how counterbores, boring and reaming tools, hollow mills and other tools with diamond cutting points are made and applied on various classes of materials; also operations on large heavy work are shown, along with the handling of small- and medium-size parts.

REFERENCE has already been made to the reaming of work with diamond tools, and Fig. 19 represents a gray-iron casting having two long, small holes finished in this manner. These 3/8-in. holes are made and finished in perfect alignment; the final operation being accomplished with the long reamer, Fig. 20, which carries a single diamond blade as shown. Before the application of the diamond reamer the holes are brought nearly to size by the customary process, so that a very small amount of metal is removed by the reamer, Fig. 20. The action of this tool is to take a very minute scraping cut through the bore, that the long rod or body of the reamer, guides itself in the holes when the casting is slipped over it. The diamond is set in a narrow blade of steel which fits snugly in a groove, formed by means of a small milling cutter. This arrangement allows the diamond carrier to be adjusted slightly for setting to exact size of cut by a light blow at the end, thus rocking the blade in its seat. The reamer is driven by the spindle of a bench lathe and the work is slid over the tool by hand.

APPLICATIONS TO SPECIAL MATERIALS

In Fig. 21 is a bearing disk of special composition-metal and graphite, which is machined with the diamond tool, Fig. 22. This material turns off in minute grains or powder, and presumably would be very difficult to machine with steel tools. The diamond tool made for the purpose carries a square point set into the end of its holder at an angle of 7 deg. so that a sharp, square corner is presented to the surface of the work. Here again the work is run at high speed and light, fine cuts taken with the tool.

In Fig. 23 is a white metal and graphite rod with a 3/8-in. hole bored in the end to a depth of 2 in. The hole is put in with a drill 0.006 or 0.008 in. under size, and the two-lipped diamond tool, Fig. 24, is then used to size the hole accurately. The diamonds in this holder are set with their outer edges perfectly parallel with the axis of the bar so that in removing the 0.003 or 0.004 in. on a side they take a fine scraping cut in the bore. This particular piece of work is rotated at about 1000 revolutions per minute.

In Fig. 25 is a job which is finished with a diamond counterbore, Fig. 26. The work is a special switchboard built up of mica composition, and the first operation in connection with the series of holes is to put through a 3/8-in. drill at the various center distances required. Following this, the holes are enlarged to 3/4 in. diameter by the diamond counterbore. This tool as shown in Fig. 26 carries a pointed diamond which is set at an angle in the lower end of a steel holder, 1/4 in. square, fitted into the body of the counterbore and held by a pair of screws. The tool is pivoted in the usual manner. It will be noticed that the diamond point operates at the outside of the circle to be cut, instead of facing clear across the surface of the material. Owing to the method of building up the plate in laminations the action of the tool is to cut the material out in a series of thin rings.

The piece illustrated by Fig. 27 is manufactured in great quantities from hard rubber. The diamond turning tool Fig. 28, is for finishing the outside surface, and the diamond boring tool Fig. 29, for the interior. The former tool is shown on a large scale to bring out clearly the method of mounting the diamond point in its carrier and the latter in the boring bar. The special machine developed for this work was designed to utilize four diamond tools; one for turning the taper and cone, one for turning the large end, one for facing the end, and one for boring out the interior. The two tools shown in the detailed sketches referred to give an adequate idea of the salient features of the set of four.

If one computes the area of the surface of the piece in Fig. 27 he will find that there will be something over 16 sq.in., considering now the exterior turned surface alone. Yet one diamond tool has been known to have turned at least 75,000 such pieces, representing an area of over 8000 sq.ft., before its cutting point required touching up.

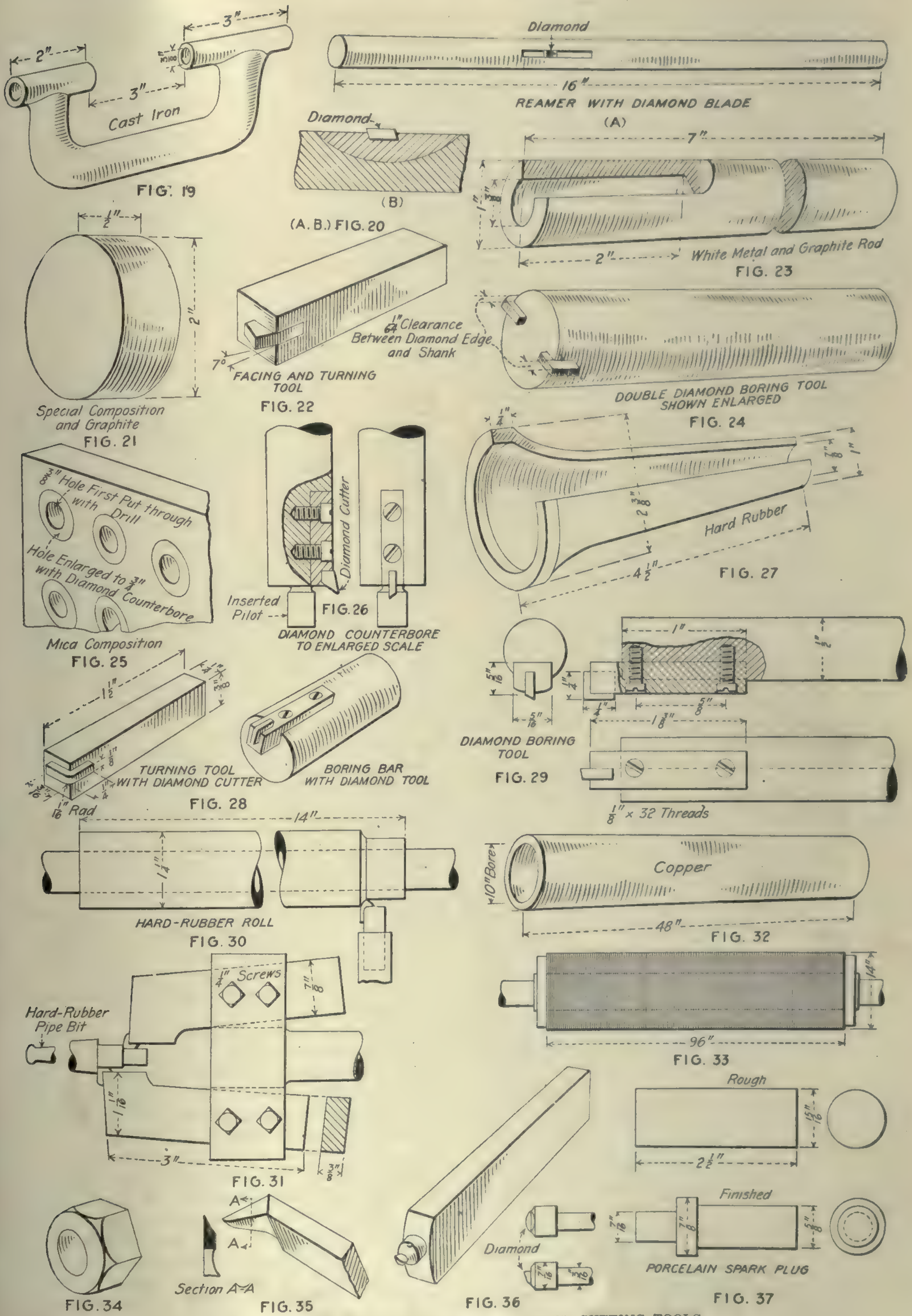
In Fig. 30 is a hard rubber roll 14 in. long by 1 1/4 in. in diameter pressed on to a spindle 18 in. in length and then turned down at certain points along its length with the diamond seen at the right. In this instance a depth of cut of nearly 1/8 in. is taken with a diamond which is rounded along the sides as indicated.

In Fig. 31 is illustrated the application of a pair of diamonds to the finishing of rubber pipe bits, the two tools being carried in a holder which allows them to be readily adjusted for diameter and distance between shoulders. The pipe stems are chucked in a quick acting fixture and the toolholder fits the tail spindle of the machine. On this kind of work a single diamond has been operated without reshaping on over 100,000 gross of stems, which in round numbers are 14,000,000 pieces.

HEAVY WORK

While the majority of illustrations so far presented has been confined to light and fairly small work, the usefulness of diamonds as cutting tools is by no means restricted to work of such size. For example, in Fig. 32 is a heavy copper cylinder several feet in length with 10-in. bore which is finished inside with a diamond boring tool with a view to securing the most accurate results obtainable. In this boring operation the work was rotated at 95 r.p.m., and the diamond was fed at the rate of 0.0025 in. per revolution, the depth of cut in finishing being 0.002 in.

Diamonds have been used to a considerable extent particularly in repair shops for redressing paper-mill calender rolls whether of chilled iron, paper or other material. One of the most interesting applications is in finishing calender rolls made up of a great number of



FIGS. 19 TO 37. VARIOUS USES OF DIAMOND CUTTING TOOLS

paper disks compressed in place on a shaft, and then finished externally in the same way that a metal cylinder would be handled. In Fig. 33 is shown such a roll. The paper disks of which it is composed are commonly blanked out as in Fig. 34 with a many-sided die, the interior being punched out to permit the disks to be slipped over their permanent arbor or spindle. They are then built up on the shaft as in Fig. 33, and squeezed together under high pressure while their retaining collar or flange is screwed or shrunk on to the end as shown. In turning off the edges of the paper disks to bring the whole affair down to a plain cylinder, an off-set, keen-edged side tool, Fig. 35, is used; which starting at the end of the roll, feeds through the paper from the side and turns the roll down to cylindrical form.

In Fig. 36 is shown the type of diamond and holder which has been developed for finishing such rolls. The diamond itself has a rounded nose, and is set into a $\frac{7}{16}$-in. head which is turned down to form a shank, $\frac{3}{16}$ in. diameter, by 1 in. long, to fit the hole bored in the front end of the holder.

A similar tool is used for turning off the surfaces of chilled-iron calender rolls.

Another important application of diamond tools in connection with repair work is found in the truing up of commutators on their own journals. The surfaces of copper and insulating material are none too easily trued up with ordinary steel tools; while the diamond has decided advantages in cutting the materials referred to, and enables repair undertakings of this kind to be handled with facility. Some firms who make a business of repairing electrical apparatus all around the country, now send the repair man out with a single diamond tool and know that he will take care of it and bring it back safely; where formerly he would start out with a half dozen or possibly a dozen steel tools and through oversight or carelessness leave a good share of them in different plants with the result that there was quite a heavy loss of money in unreturned tools. The diamond itself is of sufficient value to cause any mechanic to handle it with the best of care and to bring it home safely when his work is finished.

About the Diamonds Themselves

While from one point of view the first cost of diamond tools is rather great, the amount of work which they will turn out and the quality of work which they produce make them in most cases very economical appliances in the long run. This fact has already been brought out at numerous points in this article, where figures have been quoted covering rates of production and total amounts of work finished before the reshaping of the diamond became necessary.

Naturally the value of a diamond for a given piece of work depends greatly upon what kind of a stone is selected for the purpose, and here the skill of the makers of such tools is displayed; for the art of selecting stones for industrial uses requires as much knowledge and experience as the classifying and grading of diamonds to be used as jewels.

We all know that diamonds are exceedingly hard, but ordinarily do not realize that some are considerably harder than others, and that the factors of hardness and form of crystalization must be kept in mind in the selecting of stones for shop use. The bortz diamond which is almost as hard as carbon and which is unsatisfactory for jewels because of imperfect crystalization, is employed to a great extent in tools for cutting metals and other materials; and when crushed the powder or dust is used for lapping and polishing a number of articles in every day use.

A diamond chip will cut a long shaving from a glass plate as a knife blade will shave a piece of wood. It is obvious that the diamond will turn porcelain and similar substances; and Fig. 37 illustrates work of this character, that is, the machining of porcelain spark plugs which are turned all over. The sketch referred to gives the dimensions of both rough and finished plugs.

(*The end*)

Clean Shop Windows

By Robert C. Heinmiller

Your shop and office windows: what are they, assets or liabilities? It is interesting to note how manufacturers care for the windows of their plants. They can usually be placed in three groups, (1) those who clean all the windows every two weeks or oftener; (2) those who keep the office windows clean but neglect the shop windows; (3) those who neglect all the windows until conditions demand cleaning.

Those of the first group rightly consider clean office and shop windows as assets. It costs to keep them clean, especially with the advent of metal sash and increased glass area, but the investment pays dividends in contented workmen, decreased lighting costs, better product and pleasing appearance.

Those of the second group display poor business judgment. They do not seem to realize that the man in the shop makes the product they sell, and that dirty shop windows have a bad effect on the man inside. Why make him work by artificial light when an occasional soap and water bath for the windows would give him more daylight? While clean office windows may impress a customer to some extent the impression will be negative if he sees dirty shop windows.

Those of the third group display very poor business judgment. They lack vision in several ways. The windows of their plants are liabilities. They cause an increase in the cost of artificial light, inefficiency on the part of the workmen, and bad impressions on the part of the visitor and customer. Dirty windows will cut your profits in more ways than one, just as clean windows will increase them.

Some manufacturers have gone so far as to place potted plants about the shop. A picture was recently published of a Pacific Coast machine shop showing brackets for holding plants on the columns. Geraniums in a shop improve working conditions, but geraniums need daylight through clean windows. This likewise applies to employees. Clean windows in a shop cause other improvements. With plenty of daylight, white ceilings and walls in the shop will necessarily follow. Dirty floors and rubbish-piled corners stand glaringly forth but the pride of even a careless workman begins to exercise itself under proper lighting conditions. One improvement leads to another and each is a forward step in the development of contented workmen and a better product.

Uses of an Economic Department in a Machine-Tool Plant

BY LUDWIG W. SCHMIDT

A manufacturing plant making machine tools, and dependent for its output on the regular demand for those machines, will find it of great advantage to estimate beforehand the character of the market with which it will have to deal in the near future. Upon the correctness of such an estimate will depend the manufacturing policy of the enterprise.

PUBLIC institutions, governments and very large industrial enterprises have already recognized the wisdom of collecting all information valuable for the conduct of their affairs, and the great demand for the statistical brochures published by the U. S. Government is the best proof of the increasing interest taken by practical men in the application of scientific methods to the everyday affairs of business.

In this country it is generally realized that the great progress made by German industry in foreign markets has been gained by the exact knowledge which German manufacturers have collected by their own exertions or by that of their governmental agents, of the needs of foreign markets, and by accommodating themselves to the demands of their prospective customers. The U. S. Government reports are recognized to be the best individual trade reports supplied by any commerce department in the world. Supported by such help, American machine-tool manufacturers should not find it difficult to give more attention to the economic side of their business by adding to their technical, commercial and executive departments a department for economic research, both as a control for present technical and commercial activity and as a lead for future development.

In this article the organization, management and uses of such a department will be described. The writer's experiences, as well as that of others, have been combined for explanatory purposes, and it may be said beforehand, that of course the conditions in each factory will have largely to govern the fitting-out as well as the working and the uses of such a department.

ORGANIZATION

The first step is to find a head for the department who will combine economic knowledge, with commercial ability and sufficient elasticity of mind—qualities which are absolutely necessary for such a position. The demand will, no doubt, bring a supply of men qualified for this work. Already many firms employ in their commercial departments, men with a university course of economics to their credit. In selecting a man for the special work of instituting and managing a literary and economic department for a machine-tool plant, a person is required who has more than a superficial knowledge of the industries concerned with the demand for machine tools. A commodity of enormous uses like the machine tool will necessarily require a closer understanding of the many influences governing its sales than would be required in the case of machines finding a less varied market. Ought the specializing departmental man to have a practical training? He may have been an engineer with a liking for economics, a class of man now found increasingly frequent, or a salesman, an advertising manager, or a journalist, or an economist pure and simple. His work is not that of a technical adviser and nobody, therefore, will demand a wide technical knowledge from him. Men for such a position are, as a rule, found in all kinds of situations.

Men who possess great ability for managing an economic department are very valuable to a firm, as they will help largely in the building up of the business. To save expenses it will frequently be possible to add to the economic duties of the manager those of responsibility for the literary output of the plant, the making up and editing of catalogs, price lists, and possibly advertisements. The head of the firm may be satisfied that by combining those three duties, the chief of the economic and literary department will be kept pretty busy. If he requires help it will be very easy to find a girl secretary with a library or an economic training who will be able to do most of the work, unless the department is a fairly large one, when a second assistant will have to be added. An office boy for all the minor work will complete the staff.

The equipment of the office is fairly simple. It requires the necessary office appliances, including a typewriter, in the selection of which care should be taken that it cuts good stencils. A duplicating apparatus is a very useful addition to the office machinery and will save a good deal of expense. The main expenditure will consist in the institution of filing cabinets, which ought to be of steel as their contents are part of the good will of the firm and their loss by fire may be irreparable. It will be advisable to have some of the filing cabinets for the ordinary index cards, while another section ought to be large enough to take book files of the ordinary letter size.

INFORMATION

Most likely the official in charge of the work will have only a slight connection with the plant. His initial work, therefore, will consist in making himself acquainted as thoroughly as possible with the output of the firm, the manufacturing methods, the markets to which the machines have been sold, and the uses to which they are put. If he has gained that knowledge, a course of action for the further development of his work will soon suggest itself. In the beginning this must necessarily be the collection of all information which he considers useful for the accomplishment of his task. This information will come to him: (1) Through the agents of the firm and other officials in the employ of the firm; (2) through reading newspapers and trade journals; (3) through his own investigations.

Some of the leading German houses which have built

up very large literary and economic departments, add to the duty of their outside representatives that of reporting from time to time not only on matters of direct interest to the firm, but as well on matters concerning the trade in general. It has been found a good plan to pay for such reports or to hold out to the writer special distinction by publishing them in a sort of house journal. Such reports, if written in the right form, will be of enormous value to the department. This will be the case especially when several agents begin to report, and comparisons can be made between the reports from several markets. It is difficult to advise just what those reports should contain. As a guidance it may be said that all personal matter, meaning changes in addresses, the foundation of new industries in the district, and so on, should be reported.

Business Conditions and Trade Journals

Notice ought to be taken of business conditions in general.

Sales opportunities and likely changes in the condition of the market should be brought to the notice of the economic department. It will help the work when the department prepares special inquiry sheets which will remind the writer of the facts desired. This latter system, by the way, will assist largely in the filing and classifying of the material thus obtained. Agents can do a lot by reading newspapers and sending clippings to the department. This is very easy work but will help, therefore is important.

The department will add to personal information that of a less confidential character, such as information contained in the leading dailies and the trade journals. The selection of these journals and daily papers is a matter of judgment and depends very much on the field of activity of the firm. A plant having only the home market to deal with necessarily will confine itself more to home papers and trade journals; nevertheless, a few foreign journals should always be read, which will add to the required accomplishments of the manager of the department that of being able to read at least two other languages.

As far as America is concerned, the names of a number of leading journals and papers dealing with the business and technical side of the market for machine tools will readily suggest themselves to the reader. In foreign markets some discrimination must be used. As a rule one or the other of the great dailies should be read; further, the leading foreign journals dealing with the competing industry and with the best buying industries.

A great part of the information needed can be got from governmental publications. For this country, the Commerce Reports may be mentioned; while for England, the Board of Trade Journal, and for Germany the *Mitteilungen für Handel und Industrie* will frequently contain interesting information. Attention is also drawn to the Agents' Series, published by the U. S. Department of Foreign Commerce

The main and leading part of the work, however, will fall to the personal initiative of the chief of the department himself.

The arrangement of the material deserves special care. An experience of some years has shown me that it is by far the best system to separate the work into two sections: the index and the material. The agent's reports which may come in with the agent's ordinary letters shall best be given on separate sheets, so as to be separated easily from the letter. If this is not done, or the information is very short or contained in some letter (of perhaps a customer), it should be copied for the special use of the department. The best plan would be to instruct the other departments automatically to do this and to send copies to the economic department, or to inform the manager of that department and allow him to deal with the fact as he thinks fit.

That written information which may come from agents in the form of special reports or other written information of any sort, is best collected in one set of material. It is filed into the folders of a vertical filing system, either each letter separately, or a number together; separate letter filing is preferable but takes more space. Each report receives a current number and runs in the filing index as A, and number. The second section of the material filed consists of printed material, newspaper clippings, etc. These are treated in the same way, and the most useful manner of handling them seems to be to paste the clippings on a sheet of paper of suitable size containing a typewritten, short survey of the contents of the clipping. Ten of these sheets can be filed conveniently in one envelope. In this case the envelope system will allow the filing together of related matter. The envelopes are numbered and the sheets inside are numbered again, as for instance B.101-3—this section being called B. The third section is formed by the collection of material which for some reason cannot be cut; as, for instance, valuable trade journals containing a large amount of interesting information, books, etc. These have to be treated like the books in a library, and form Series C. It may become necessary to institute a special section containing secret reports which must be kept separately and are not accessible to everybody.

A considerable part of the work will consist in watching the development of competing firms and of such firms which either are likely customers or are closely connected with the well being of the industry at home. This can be done to some extent by the collection of the competitors' and other advertisements. The possession of a large advertising library consisting of clippings of all kinds is if used properly, a valuable possession in itself, and deserves close attention.

Indexing

The indexing is done independently from the collection and filing of the material. The shortest way of preparing the index will be to underline in the documents filed, both written and printed, certain passages of special interest, and to use those passages as index words. These index words are used again on the index cards, which in their turn refer to the number of the document in the usual way. In doing the index work it is necessary to follow a certain well devised plan, so as to make the cards useful for any sort of research which may become necessary. It is this part of the work which demands the attention of the organizer of the department, as it will facilitate considerably the various uses the department may be put to. One thing must be kept in mind: the index must be easily understood so that it can be operated without difficulty by everybody. It is not necessary to enlarge too much on

this side of the work which is really technical, and every system expert will be able to advise about it. It will grow as the work progresses.

The selection of the material to be collected may offer some difficulty to the novice. This, however, is really a very simple matter. It stands to reason for instance, that a manufacturer of machine tools having a large sale in England will be especially interested to know everything that may affect his business in England. Consequently it will be necessary to follow all the influences which may affect sales in that country. The demand for machine tools depends largely on the prosperity of those industries which need machine tools, they being machine shops, the ship-building industries and many others. It must be of very great interest to the manufacturer to know beforehand of a favorable development in the demand for motor cars, or an increase in the shipbuilding activity. Both can be learned from statistics and news, published in the press. A good harvest in such countries as Argentine, Canada or the U. S. A., will as a rule bring about an increase in transportation demand, and means a corresponding increase in shipbuilding activity. As an example: During the present war an enormous amount of tonnage has been destroyed. As yet only a small part of it has been replaced. On the other hand, foreign markets have been starved of goods which they need urgently for the pursuance of their trade. It is obvious that the destroyed tonnage will have to be rebuilt as quickly as possible. The shipbuilding industry therefore, will become one of the best customers for machine tools. It is not difficult for a machine-tool maker to supply himself with all the news about the laying down of new tonnage, and the names of the yards which secured the orders. It may be of further interest to know who secured the orders for subsidiary machinery, and so on. All this will direct the trading policy of the firm. Another example: Several years ago machine-tool makers made a fortune by the abnormally large demand that suddenly came from the motor car industry. The coming of that boom had been predicted early, by a good many authorities, but it seems that the fact itself came rather as a surprise to the American machine-tool makers.

Preparing for the Future

These examples help to show that the department of economics, by carefully following newspaper hints and reports coming from the special agents and other sources, can study the development of the market; and by so doing, enable the firm to prepare itself for a future emergency. This throws a good deal of speculative work on the head of the department. He will have to be able to scent opportunities when they arise, and by following up the news as it comes, make sure about them. Not everybody has this peculiar ability and it is said that men having it are the greatest merchants of today. On the other hand there is no reason why the careful collection of the material by a man with average ability should not assist the head of the firm, who most likely has had experience from which to draw conclusions and direct the work of the department.

To be effective, the economic department should work not only mechanically, but will have to take up research work in the interest of its firm, on its own initiative. Most firms have a technical department busy with the improvement of machines and conducting the technical progress of the firm; while nearly all chemical firms have special departments for chemical research. The high value of such departments has only recently been proved to the business men of this country, by the shortage of dye stuffs and the lack of a sufficient number of experienced chemists and institutions able to conduct researches in this direction on a large scale. The earlier superiority of the German dye industry however, rests not only with the inventive genius of her chemists but in addition with the intimate knowledge of the economic side of dye distribution as well; in fact, it has been said that such knowledge enables this industry to regulate its distribution so perfectly that only by that regulation has the present use of by-products on so large a scale, been made possible; and hand in hand with the chemical research has gone the economic study.

Our initiative, therefore, in the extension of economic research in the interest of the firm, may be laid to the manager of the economic department. Again an example is presented: There are springing up continually, new industries. This has been the case especially during the last years, when in this country hundreds of new plants have been opened to manufacture one article or another made till recently in Europe. Thus, for instance, the demand for cheap brushes has led to the extension of some of the leading brush manufacturing plants in this country. These brushes had to be cheap, and cheapness could be produced only by the employment of new manufacturing methods. In some cases machines of different types were newly devised, or copied from foreign models. It is obvious that a manufacturer having foreseen that development, and it could very well be foreseen in the circumstances, might have profited by his knowledge. It is therefore, the duty of the manager of the economic department to follow all news hinting at new industries, and if possible to trace it to its facts.

Special researches on questions of importance to the policy of the plant, are best conducted separately from the general work of the department; it is also advisable to start a special index for that purpose, which may refer frequently to material already indexed in the regular index system. All material however, added in this way should be filed in the regular filing system and indexed as well in the main index, for the research index applies only to one special purpose.

Special Markets

It seems well to point out a few advantages of the possession of such especially selected economic material. Every firm receives here and there an order from a place about which little is known. The writer is able to give a great number of cases where large orders could have been secured but where the opportunity slipped away owing to the fact that there was nobody in the whole plant who knew anything about the market in question or how to handle the transaction, or how to find the required information.

Suppose an inquiry comes from Buenos Aires and looks like business. The head of the firm feels that more could be done, but is not sure of his ground. His economic department can furnish him with a full report on the market, its possibilities, sales of other firms, likely customers; in short, everything that can be learned about the market, short of having sent someone

to study it. All this information can be gained by carefully collecting it. The presentation of all these facts would be impossible at a moment's notice, and their acquisition would cost a good deal of money. By preserving knowledge in the course of the routine work of the economic department it has been paid for out of the ordinary income of the firm.

The head of the firm, while possibly able to follow the movements of the market by reading a few important papers, will never have sufficient time continually to watch a great number of journals. Part of the reading work, or in fact the responsibility for all, is therefore delegated to the manager of the literary and economic department whose duty it is to prepare, weekly, a short report; making a note of the most interesting points from the press for the president and the directors, that they may be continually informed about everything of importance. These regular reports will have to be supplemented if necessary, by emergency reports containing information which may need the immediate attention of the Board.

Cost Not Excessive

The cost of an economic department is not excessive, and considering the many uses to which it can be put, the outlay seems well worth while. Such a department may have been considered a luxury till recently. However, that stage has been passed, and it has become more and more a necessity. An economic department conducted in a proper manner and by an able man, will prevent uneconomical buying and overproduction. Its value will lie not only in the opening of new opportunities but in the prevention of mistakes as well.

Safeguarding Sales

By Geo. W. Shaw

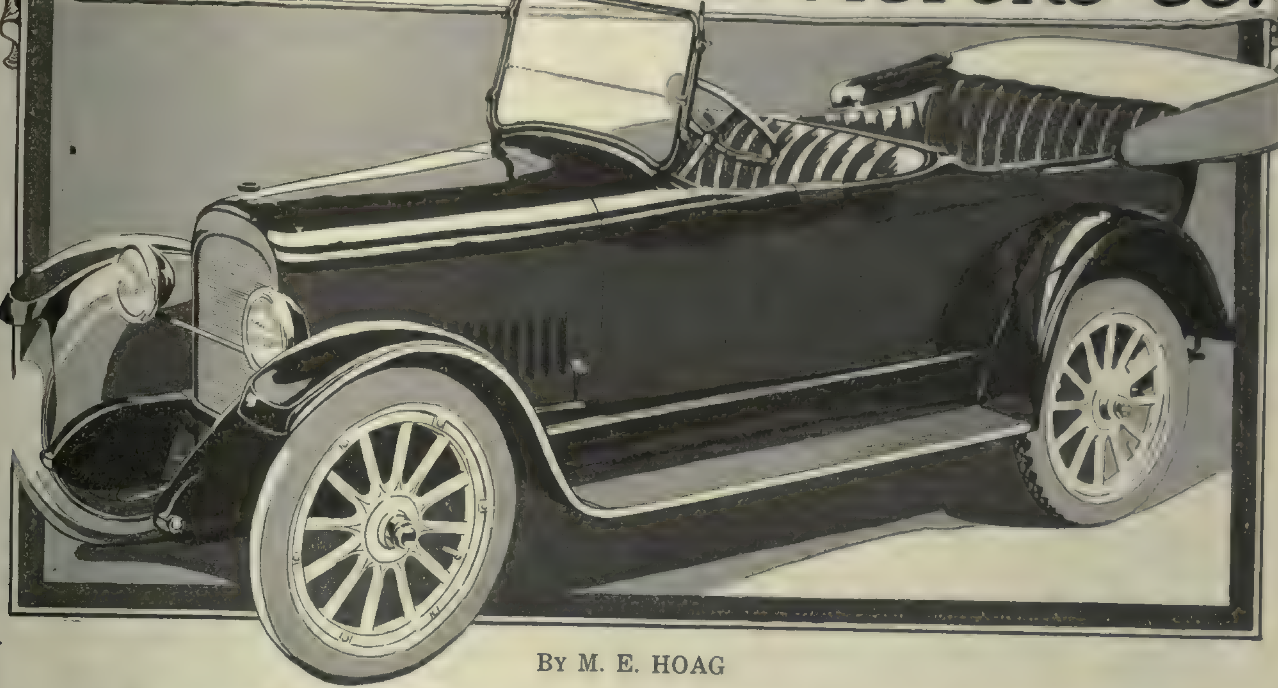
Four years in college and three years in a law school had produced a bone dry condition of my finances. To relieve this condition I secured a position as traveling salesman. Never shall I forget the advice the president of the company gave me when I started. It was this: "Sell lots of goods to good people at a good price" and then he added: "Any one can sell to a dead beat at a poor price." Business men will agree that this was good advice. Little did I appreciate at this time how difficult it would be for me to follow it, but I was soon to learn. My second order was large and closed at a good price but my customer was worthless; in other words, he had no financial or credit standing with my firm. Of course, the sale was lost, with the net result that I had wasted time which belonged to the company for which I was working. I was temporarily somewhat discouraged and thought that I had made a blunder. Later it occurred to me that employers should tell their salesmen about the worthless buyers. After 15 years' service in the legal profession, and as president of one company and secretary of another one, both of which are doing a fair volume of business, this question has occurred to me: Why are the worthless customers allowed to exist? To answer this question I realize is almost an impossibility. It may, in truth, be said that the debtor with no financial or credit standing we shall have always with us. Notwithstanding this fact experience has proved to me that a great many of these worthless customers could be eliminated.

The credit man of any business knows that it is not safe to sell to a corporation no matter how large, unless he first finds out how it is organized. Just this morning a report reached me from a receiver that the entire assets of a million-dollar company did not sell for enough to pay the bonds, and there was nothing left for unsecured creditors. How often we hear the report, "nothing left for unsecured creditors." I venture to say every business man has heard it too often. This should not be the case. The creditor who has furnished raw material and supplies to keep a business going, should not be left to hold the bag while the Shylocks of business—to wit, the promoters and bondholders—are allowed to walk away with the swag. No group of men should be permitted to incorporate and do business unless at least 50% of their capital is subject to the payment of unsecured claims. Claims for raw material and supplies should be preferred claims the same as labor claims, as raw material and supplies are the life-blood of any business. It is robbing Peter to pay Paul to allow the bondholders, preferred stockholders and other secured creditors to profit at the expense of the creditor who has furnished raw material or supplies. The law should not permit companies to organize in such a way as to cover their assets and then by a big showing and pretentiousness get credit for their raw material and supplies. What is true of corporations is true of other business concerns, such as partnerships and joint stock companies. They should not be allowed to secure creditors for an amount greater than 50 per cent. of the actual value of their assets, and to do so should be made a criminal offense. If such were the law there would be a minimum of worthless business customers, with the result that business would be more stable, time and expense saved in the credit and sales departments of all manufacturing concerns, and the yearly audit would show fewer suspense accounts and a smaller item for doubtful ones.

Experience has taught me that the anxiety to boost sales often overcomes good business judgment. This helps keep the worthless customer in existence. We continue to sell to a concern when we know others in our line have been unable to collect their accounts. Such business methods defeat their own ends. It permits a worthless customer to sell cheaper than a good customer who pays for your products. This is not fair to the good customer and in the end hurts the manufacturer. It unsettles the market, causes trouble and in many cases loss of customer and trade. It is poor business to keep a worthless customer in business in competition with your own good customers.

In conclusion I wish to say that the item of accounts receivable in the annual statement of all manufacturers is too large and important an item to admit of much doubt as to its actual value. True, credit departments and rating concerns have done well in view of the fact that the business world is full of worthless customers bidding for manufacturer's products, but their work would be much easier if the law required every concern that entered the business world to comply with a fixed financial and credit standard, the same as our Uncle Sam requires every soldier to comply with a fixed physical standard.

METHODS of the NASH MOTORS CO.



By M. E. HOAG

II—Sheet Metal Work

All of the drawn- and pressed-metal parts used in Nash cars are made in the Nash shops. Some of this work is unusual in that it is done with fewer operations than is usually the practice in most shops.

THE oil pan shown in Fig. 19 is a difficult piece to draw on account of its size and depth; the thickness of the metal being 16 gage. This piece is drawn and formed in two operations with one annealing, the work being handled in double-acting presses, as is the general practice in these shops.

After the final drawing operation, the pans are trimmed and the bolt holes punched in the flange with

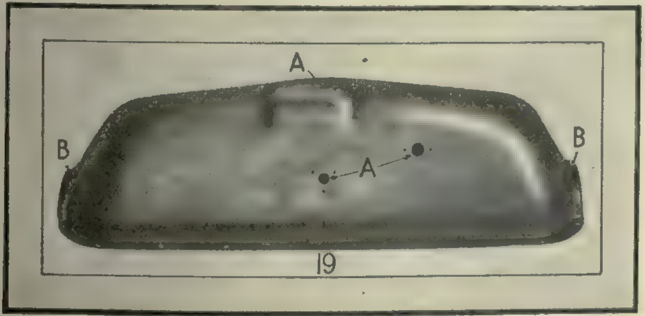
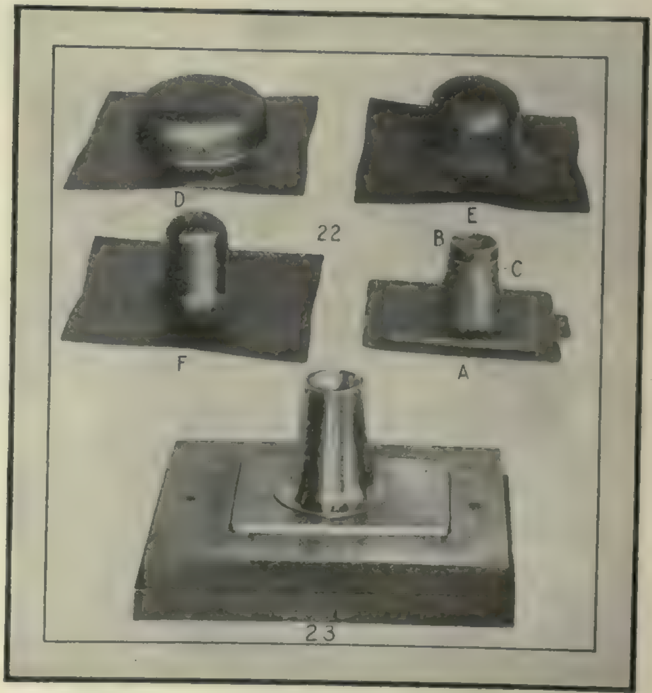


FIG. 19. OIL PAN COMPLETED

the dies shown at *A*, Fig. 20. The work is then passed to a second operator who places it on the wedge-operated dies at *B*, where the holes shown at *A* and *A*, Fig. 19, are punched and at the same time the semicircular webs are punched out at each end at *B* and *B*.

The dies for these operations with work removed, are shown in Fig. 21. The block *A* carries the trimming punch and the punches for the bolt holes in the flange. The piece is located by the several blocks seen on the bed of the die. The base *B*, Fig. 21, carries the dies for the holes *A*, Fig. 19, the top hole being made by the punch *D*, Fig. 21. The holes in the side of the pan are



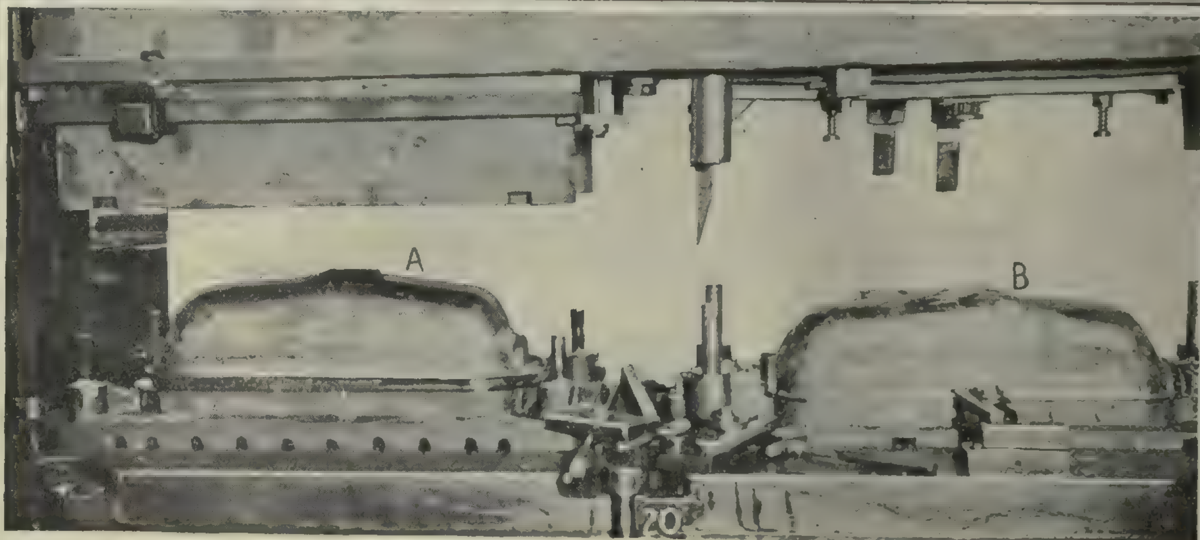
FIGS. 22 AND 23. TRANSMISSION-CASE COVER AND FINAL DRAWING PUNCH

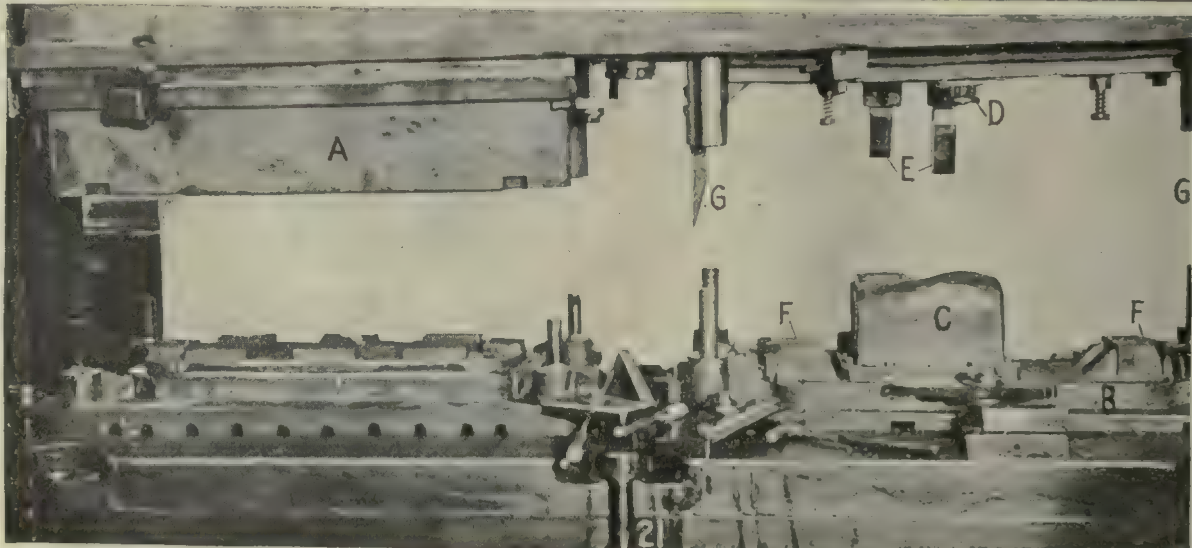
Fig. 22—Cover in process. Fig. 23—Punch for final drawing of transmission case cover

made by sliding punches on the opposite side of the block *C*. These punches are operated by the wedges *E*. The dies for the semicircular openings in the ends of the pan are carried in the blocks *F* and *F*. Sliding

punches operated by wedges G and G cut out these webs, and leave the work finished as far as the punching operations go.

Probably one of the most difficult pieces to draw and form is the transmission-case cover shown at A, Fig. 22. This piece is not only drawn up, but in the fourth operation the end is forced back to form a ball seat B for the gear-change lever. The upper end is which it is annealed, and then drawn up into the still longer and narrower form shown at F. This makes the cup slightly smaller at its base and larger at its apex than the finished piece, which gives close drawing at the base on the next operation, and furnishes sufficient surplus metal for turning in and forming the cup or ball seat B. The rectangular base is also raised in this operation as shown in the illustration. The final oper-





FIGS. 20 AND 21. OPERATIONS ON OIL PANS
Fig. 20—Oil pans in position on trimming and punching dies. Fig. 21—Trimming and punching dies for oil pan

afterward threaded at C to receive a cap which holds the lever in place. By unscrewing this cap and removing the lever, the car is out of commission as far as thieves are concerned unless they have a cap and lever made up to fit.

This gear-case cover is drawn up in four operations with two annealings. The first operation works up a large amount of stock into a shallow cup as shown at D, Fig. 22. The second drawing reduces the diameter of this cup but increases its depth as shown at E, after ation trims the flange and punches the bolt holes. The punch for the last drawing is shown in Fig. 23.

In making the mud guards the stock is cut and partly formed in dies which turn up the flanges and give the piece its general form, but they do not form the belly or raised part, which in the past was hammered by hand.

For this raising operation, the machine shown in Fig. 24 is used. The square turned finages are supported on the outside by the deep flanges A and A on the roll B, and on the inside by the ends of the roll C.

The rolls are driven by gears and by chain and sprockets on the countershaft and the gear shaft. The roll *C* is raised by the springs *D*, to permit inserting the work, and is closed down by the levers *E* and *E*. A foot lever is used to bring the right amount of pressure on the work which is gradually brought to shape by passing

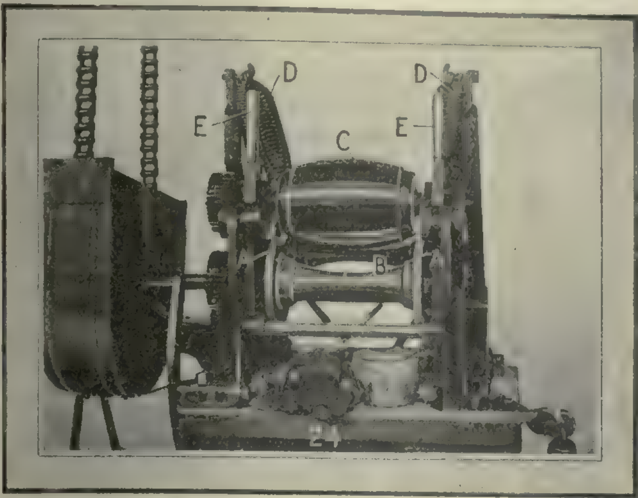


FIG. 24. MACHINE FOR ROLLING MUDGUARDS

through the rolls several times and gradually increasing the pressure. The levers *E* and *E* permit quick release of the rolls when the work has passed in the required distance, otherwise it would be drawn through the rolls, and the flange on the end broken down thus spoiling the piece.

(*To be continued*)

Specifications for Ordnance Gages

SPECIAL CORRESPONDENCE

The Ordnance Department has issued full and complete specifications for the guidance of manufacturers who desire to bid on furnishing gages for use on ordnance work comprising cannon, artillery ammunition and trench warfare material.

We present herewith a brief *résumé* of the information contained in these specifications, and print in full the tables of tolerances allowed for the various types of gages. These specifications convey information grouped under the following heads: Gage Classification: Explicit definition of the difference between inspection gages and master inspection gages.

Design and Construction: Plug gages, ring gages, snap gages, plunger or flush pin gages, profile gages, miscellaneous gages, plug-thread gages, ring thread gages, gages for core and full diameters of threads, etc., with complete information as to material to be used, method of hardening, how to be marked and the kind and size of cases to be provided for them.

Tolerances: Information explanatory of the tables on this subject together with full instructions for the application of tolerances to each type of gage; explicit instructions regarding the measurement of thread gages by the three-wire method, and a list of the best sizes of wire for the different pitches together with the formula to be used for computing effective diameter.

Any manufacturer who is directly interested in this subject can obtain a copy of these specifications by making application to the Design Section, Gun Division Office of the Chief of Ordnance, U. S. A., Washington, D. C.

TABLE I. TOTAL MANUFACTURING TOLERANCE ON PLAIN GAGES

Mfg. Tol. Allowed On Work	Allowable Tolerances for Master Inspection Gages: Go Male Gages and Not Go Female Gages	Allowable Tolerances for Master Inspection Gages: Not Go Male Gages and Go Female Gages	Allowable Tolerances On Inspection Gages: Go Male Gages and Not Go Female Gages	Allowable Tolerances On Inspection Gages: Not Go Male Gages and Go Female Gages	Suggested Tolerances for Working Gages: Go Male Gages and Not Go Female Gages	Suggested Tolerances for Working Gages: Not Go Male Gages and Go Female Gages
0.000 to	+0.0000	—0.0000	+0.0001	0.0001	+0.0003	—0.0003
0.002	+0.0001	—0.0001	+0.0003	—0.0003	+0.0005	—0.0005
0.002 to	+0.0000	—0.0000	+0.0002	—0.0002	+0.0004	—0.0004
0.004	+0.0002	—0.0002	+0.0004	—0.0004	+0.0007	—0.0007
0.004 to	+0.0000	—0.0000	+0.0003	0.0003	+0.0006	—0.0006
0.006	+0.0003	—0.0003	+0.0006	0.0006	+0.0010	—0.0010
0.006 to	+0.0000	—0.0000	+0.0004	—0.0004	+0.0009	—0.0009
0.010	+0.0004	—0.0004	+0.0009	—0.0009	+0.0015	—0.0015
0.010 to	+0.0000	—0.0000	+0.0006	—0.0006	+0.0014	—0.0014
0.020	+0.0006	—0.0006	+0.0014	0.0014	+0.0025	—0.0025
0.020 to	+0.0000	—0.0000	+0.0008	0.0008	+0.0020	—0.0020
0.050	+0.0008	—0.0008	+0.0020	0.0020	+0.0035	0.0035
0.050	+0.0000	—0.0000	+0.0010	0.0010	+0.0025	—0.0025
Up	+0.0010	—0.0010	+0.0025	—0.0025	+0.0050	—0.0050

TABLE II. TOLERANCES ON MASTER INSPECTION THREAD GAGES

No. of Threads per Inch	Allowable Variation in Lead in Effective Length of Part to be Gaged	Allowable Variation in One-half Included Angle of Thread	Allowable Tolerance On Diameters of Go Male Thread Gages and Not Go Female Thread Gages	Allowable Tolerance On Not Go Male Thread Gages and Go Female Thread Gages
4-6	±0.0005″	±0°-5′	+0.0000 +0.0006	—0.0000 —0.0006
7-10	±0.0004″	±0°-5′	+0.0000 +0.0004	—0.0000 —0.0004
11-18	±0.0003″	±0°-10′	+0.0000 +0.0004	0.0000 —0.0004
20-28	±0.0002″	±0°-15′	+0.0000 +0.0003	0.0000 —0.0003
30-40	±0.0002″	±0°-20′	+0.0000 +0.0002	—0.0000 —0.0002
44-56	±0.0002″	±0°-30′	+0.0000 +0.0002	—0.0000 —0.0002
64-80	±0.0002″	±0°-30′	+0.0000 +0.0002	—0.0000 —0.0002

TABLE III. TOLERANCES ON INS TION THREAD GAGES

No. of Threads per Inch	Allowable Variation in Lead in Effective Length of Part to be Gaged	Allowable Variation in One-half Included Angle of Thread	Allowable Tolerance on Diameters of Go Male Thread Gages and Not Go Female Thread Gages	Allowable Tolerance on Diameters of Not Go Male Thread Gages and Go Female Thread Gages
4-6	±0.0006″	±0°-5′	+0.0006 +0.0015	—0.0006 —0.0015
7-10	±0.0005″	±0°-10′	+0.0004 +0.0010	—0.0004 —0.0010
11-18	±0.0004′	±0°-15′	+0.0004 +0.0008	—0.0004 —0.0008
20-28	±0.0003″	±0°-20′	+0.0003 +0.0006	—0.0003 —0.0006
30-40	±0.0002″	±0°-30′	+0.0002 +0.0005	—0.0002 —0.0005
44-56	±0.0002″	±0°-45′	+0.0002 +0.0004	—0.0002 —0.0004
64-80	±0.0002″	±0°-45′	+0.0002 +0.0004	—0.0002 —0.0004

TABLE IV. SUGGESTED TOLERANCES FOR WORKING THREAD GAGES

No. of Threads per Inch	Allowable Variation in Lead in Effective Length of Part to be Gaged	Allowable Variation in One-half Included Angle of Thread	Allowable Tolerance on Diameters of Go Male Thread Gages and Not Go Female Thread Gages	Allowable Tolerance on Diameters of Not Go Male Thread Gages and Go Female Thread Gages
4-6	±0.0006″	±0°-5′	+0.0015 +0.0025	—0.0015 —0.0025
7-10	±0.0005″	±0°-10′	+0.0010 +0.0020	—0.0010 —0.0020
11-18	±0.0004″	±0°-15′	+0.0008 +0.0015	—0.0008 —0.0015
20-28	±0.0003″	±0°-20′	+0.0006 +0.0012	—0.0006 —0.0012
30-40	±0.0002″	±0°-30′	+0.0005 +0.0010	—0.0005 —0.0010
44-56	±0.0002″	±0°-45′	+0.0004 +0.0006	—0.0004 —0.0006
64-80	±0.0002″	±0°-45′	+0.0004 +0.0006	—0.0004 —0.0006

Making Peace with a Bully

By John R. Godfrey

ONE OF my friends wandered by the other day and dropped in to settle the war, as we've both been doing fairly regular for the past three years. He was getting sick of seeing nothing but war headlines he said and longed for the time when a good lively divorce suit would once more hold the center of the front page.

He was rather inclined to think we might as well call it a bad job and quit, forget Belgium and Louvain, the *Lusitania*, Edith Cavell and Captain Frye, poison gas and air raids on hospitals, and shake hands with old Bill Hohenzollern and his near-soldier son, and tell him he wasn't so bad after all—and go back to white bread and sugar for a change.

I didn't know just how much that sort of thing riled me till then, but I just blew out the cork and talked to him somewhat thusly:

* * *

I'm a peaceful sort of cuss under ordinary circumstances, one of the sort who'd rather go around the block than run into a scrap of any kind. Not the "turn-the-other-cheek" sort exactly, because I'd do my durndest to keep the first cheek from getting hit.

But if I was running a little shop and my next door neighbor broke in, took away all my machinery, smashed things up generally, killed the workmen, lugged off the stenographer and burned the building, I'd be pretty apt to get peeved. And if after doing all that, he came around and wanted to shake hands and be friends again, I'd be apt to view him with suspicion, to put it mildly, especially if he insisted that I shouldn't call the police, or say anything about it to anyone.

* * *

There's a limit to my peaceful proclivities and that would be about it. It would make me about as fighting mad as though I hadn't thought I was a pacifist before it happened.

It would sort of seem to me that the least he could do would be to restore my property as he found it, provide for the families of the men and the stenographer, make some substantial remuneration for damage to my business and feelings and give some sort of an iron-clad bond to assure me that he woudn't get that kind of a spell very often.

Until he would agree to that I shouldn't feel like having much truck with him, and I'd be pretty apt to keep on heaving bricks in his direction and 'phoning the police, until he either came to terms or put me where I couldn't fight. If anyone wants to make up and be friends with that sort of a chap, he's welcome; but I don't fancy that kind of friendship.

Then when he told how he had to do it because he wanted a bigger slice of trade (when he was underselling me already in most things), and that he is God's senior partner in the business of running this old world of ours, I'd reach for another brick. I presume its my lack of kultur, but as long as you don't realize what you are missing, it isn't so bad, and I'll try and stand it a few days longer.

* * *

I'm not a bit anxious to keep up the fight. It gets sort of tiresome dodging bricks as well as heaving them. But I might as well get swatted now and have it over with, as to let him get away with all he has stolen and to live in fear that he'll try it again as soon as he gets his second wind and I've got the old shop rebuilt and running.

I believe he's got to have a taste of his own medicine before he can realize just what it means to the other fellow. And though this doesn't sound very pacific—I'm just bound to keep on heaving a brick whenever he shows his head; for I don't relish his using all my machines in his own business—and I did like that stenographer, too.

Series for Executives

Inspectors and Inspection

BY W. B. SEIGLE

A previous article discussed the inspection force, its duties and relations. This article takes up the work of actual inspection.

THE force of inspectors, from chief to the last sub, being complete the matter of methods and results is next to be considered. Naturally the casting or forging, as the case may be, comes first, the pattern having been checked and O.K.'d before being sent to the foundry, and it is always better to lay out in detail with as fine lines as possible, any piece before beginning to manufacture, to find out if proper allowances have been made for finish, shrinkage, etc., and $\frac{1}{8}$ in. for cast iron, $\frac{1}{16}$ in. for brass or white metal, and $\frac{3}{16}$ in. to $\frac{1}{4}$ in. for cast steel are found most desirable where the blueprints show finish. If rough finish is required, the patternmaker should allow $\frac{1}{32}$ in. on cast iron, brass or white metal, and very little more on steel.

Frequently, castings that can be saved by engine lathe machining need a little more allowance, and closer relation of the various dimensions, when they are to be done in the automatics, so that any slight variation will not affect the parts that function.

AFTER this comes operation inspection in or after machining. On large heavy castings, or where the pieces are not symmetrical and it would be difficult to reset them on the machine, it is better to have all inspection of the operations done in that particular machine, while the apparatus is still clamped down or chucked and stamped as O.K. It is frequently found where this is not done, that the next operator who has the second operation, will go on and do his work. And where the piecework system is in vogue and only good work is paid for, if the error is not discovered in the first operation inspection, and the second completed correctly, both men are paid for work that is useless, and the added expense of the labor plus the time lost that might be used on work that was right is expensive.

On automatic machines, after the set-up is made, and the first two pieces inspected, 100 per cent. inspection is not necessary, but every 10th, 20th, or 25th piece, should be inspected according to the nature of the work and the limits required. Should the 20th piece be found to differ much from the first one, it would then be necessary to go over the other 19 so that no poor work be allowed to go to any other department.

It frequently happens that variations in excess of those shown on the drawings may be allowed, but it is not best to let the operators know of such allowances, as continuous attempts to produce work to close limits soon becomes a habit, and much better results follow, than where the operator knows that he can be careless and produce varying sizes. On shafts, linings or bearings, drive fits, shrinkages, etc., it is an actual fact that where these fits are finished on a grinding machine, limits as close as 0.00025 in. plus or minus are so easily maintained that rejections rarely exceed 1 per cent.

WHERE large numbers of similar parts are produced, such operations as drilling, milling, etc., are rarely if ever inspected, as the jigs are in themselves a guarantee of correctness. In any manufacturing concern where inspection is rigid and standards are correct, when the finished parts of any apparatus from the different departments are brought to the assembling bench absolutely no fitting is nor should be required and the assemblers should not be allowed to make any changes to the pieces that come to them, as they are already interchangeable. Screw machine parts should have from 10 per cent. to 100 per cent. inspection, the amount differing according to requirements of the parts used. When all the parts are assembled, the finished unit should then be gone over more carefully to see if it corresponds to specifications, outline, etc., and, of course, if all the parts of any machine are right the finished machine must be so. So many, and complex parts enter into most of our modern apparatus, and so many kinds of metal, that if one small part is not O.K., it may cause the whole thing to fail of its purpose.

INNUMERABLE jigs and fixtures require the most complete and methodical inspection, and the fits of the bushings in the jig itself may determine its accuracy, for unless well seated and fitted the wear soon makes it useless. Not over 0.002 in. should ever be allowed on a new jig for any work, and in many cases even this would be too much. Round and flat plug gages, ring gages, etc., should be within 0.0001 in. when new, and all thread gages, male and female, practically the same. All jigs, fixtures, templets and gages that are in constant use should be inspected at least every two weeks, and necessary corrections made.

In one factory where rejections were high, a notice was posted that read as follows: "From date, each foreman when assigning work to an operator, shall see

that an up-to-date blueprint shall be given with the work, and that all pin and snap gages to be used on the job are to be sent to the inspection room to be verified before any operations are begun. If plug or ring gages or thread gages, whether male or female, are needed, these too will be checked, and any operator who may at any time have doubts as to the accuracy of the gages or jigs he is using has the privilege of asking the inspection system to try them for him. Our inspection system is to help the operator and protect the company. Use it." Needless to say the rejections fell off, and many of the operators, who looked on inspection as a hindrance, realized that it was very helpful.

IT IS best where conditions and production warrant that all gages should be made in duplicate, or better still in triplicate, so that while one is being repaired, there need be no delay, and inspectors should never use operators' gages. For proof of this, the following is an actual occurrence: An operator in a Government factory made an error in the length from the face to a shoulder in the bore of a breech block of 0.10 in. by reading his scale wrong. A steel pin gage of ½-in. steel was used, and he very quickly made another 0.10 in. short, but otherwise as near like the right one as possible. When the inspector measured the block before removing it from the lathe, the operator handed him the different gages used, the short one among them and, of course, the block was passed as O.K. The error was not discovered until some six months later, when the breech mechanism was assembled. As there were several lathe hands boring blocks, no one in particular could be blamed. (This block is in use today in one of the guns on our South Atlantic coast forts). Another actual occurrence that happened in one of our Northeastern cities is cited. A large machine was being tested before shipment, and the longer it ran, the more it vibrated in one end where a shaft had a bearing. No apparent reason could be found, but as the machine was useless, with such vibration, it was disassembled and when one of the heads was removed and the shaft bearing taken out a curious condition was found. The lining seat was not a continuous circle, but four sectors of a circle, having grooves between for oil circulation. Some operator had bored the diameter of the seat 0.047 in. too large, and had driven a plug down the grooves, raising a burr of about 0.025 in. in each edge. He had then scraped the burr just enough to allow a round plug gage to enter nicely, and when the lining was pressed in, it fitted like a glove on the burrs, but as soon as the weight of the driven part pressed against the burr it crumbled, and the lining moved all around causing the trouble noted.

These instances are cited to show that an inspector must ever be on the lookout, and thoroughness only will save him from allowing much that is wrong to get by. All operators, where the size of the work will allow it, should be compelled to stamp some identification mark on their product, and the inspectors in turn should use a similar means of marking work they pass, and if it is found to be wrong, it is easy to determine who machined and inspected it.

It has been found that in nearly every case, the personnel of any inspection force is influenced more by the attitude of the chief inspector than one would believe possible. If the chief inspector is alert and capable, and takes his duties seriously, the men under him will be the same, but if he is only an ornament, whose chief duty is to draw his salary, his force will do as little as possible and add to the company's collection of bric-a-brac. To sum up, in any factory where inspection pays for itself many times over, too much stress cannot be laid on operation inspection, that all errors may be caught as soon after being made as possible and no additional work done on that particular apparatus until it is decided whether it can be saved or not. Instead of waiting until assembly is reached and assuming that everything is right, only to find it wrong, it is much better to know that everything to be assembled is right, and no trouble found when the machine is complete.

OFTEN in this connection some of the articles on munition inspection and the trouble experienced with the inspectors of foreign governments recently published in the *American Machinist* were interesting, but very amusing and showed that those who had such troubles either never understood what was required or so failed to try to reach such requirements that their lamentations are pitiable or laughable as one looks at it. On very large orders for shells, gaines, fuses and cases, no trouble was experienced in dealing with the representatives of three foreign countries, for as soon as work was started on any of the articles mentioned, six of each were taken and finished to different standards of quality and finish, and submitted to the foreign representative for a decision, varying from better than any ordinary requirement to poorer than was expected to pass. Three of each were stamped by him as acceptable and kept in the inspection office for samples of what was good enough to meet requirements. On days when, due to special late dinners or for other reasons, eyesight and judgment were both hazy, a reminder by a look at these pieces bearing his O.K. mark soon restored both, and rejections were far below the percentage figured in, when the contracts were made. As noted before, it was the use of "horse sense" that saved trouble.

IN THE arsenals where inspection is especially rigid, good workmen are the rule, and few rejections are made, still when one considers that many parts of a gun or carriage where the shop limits are 0.001 in. or even less may be sent to the Philippines, or thousands of miles from where it is made, the reason for such quality is apparent. The writer who had over 19 years experience in the Ordnance Department of the Government, and who traveled over 30,000 miles in the service, many times had close, rigid inspection to thank for the ease with which parts sent him went together, though made 10 years after the apparatus on which they went, was sent from the arsenal.

It is well to remember that rejections by an inspector, do not always mean scrapping, for in many cases if judgment is used and the error discovered before other operations are completed, many pieces, especially large ones, can be saved. An inspector who has the company's interests at heart, does not try to see how much scrap he can throw out, but how little, and becomes an asset and factor for saving.

Giant Crane for the United States Navy

BY W. H. SHEPARD

THE largest floating crane ever constructed in the United States has recently been completed by a Cleveland firm for the United States Navy. The accompanying illustrations give a comprehensive idea of this huge machine which is now being used by the Navy Department at one of the large Atlantic Navy Yards.

The crane is mounted on a flatboat as shown in the engraving, Fig. 1, and has a lifting capacity of over 200 tons; in fact the test load required by the Navy for this machine (and which it has already successfully handled) was 403,200 lb., at a reach of 62 ft. 6 in. over the side of the boat, or at a radius of 105 ft. It was designed and built by the Wellman-Seaver-Morgan Co., Cleveland, Ohio, who have, in the past few years, successfully entered a field formerly monopolized by two or three European firms. This firm has also built three other large floating cranes for the Navy, but none so large as this. The previously built cranes have been of the bridge type, in which the whole crane with its boat is turned and manoeuvered to bring the hoisting cables to the proper positions for lifting loads. The machine just completed, however, resembles somewhat in principle the ordinary revolving derrick, in which the jib is rotated until it comes opposite the work to be lifted, and is then lowered until the hooks hang above the object to be lifted. The hooks are then lowered or raised by means of steel cables passing over sheaves built into the end of the jib.

FIG. 2. RAISING THE TUG "MASSASOIT" FROM THE BOTTOM OF THE HARBOR

To give a more concrete idea of the size and capacity of this apparatus, it may be said that its full-load capacity is equivalent to the weight of 100 of the largest touring cars. The crane would readily lift an ordinary shifting locomotive. The empty lifting hooks, themselves weigh about two tons, or the equivalent of the weight of a large touring car. When raised to its maximum height the top of the jib is over 200 ft. above the water level; a height greater than that of an 18-story building. It must also be remembered that the whole structure is

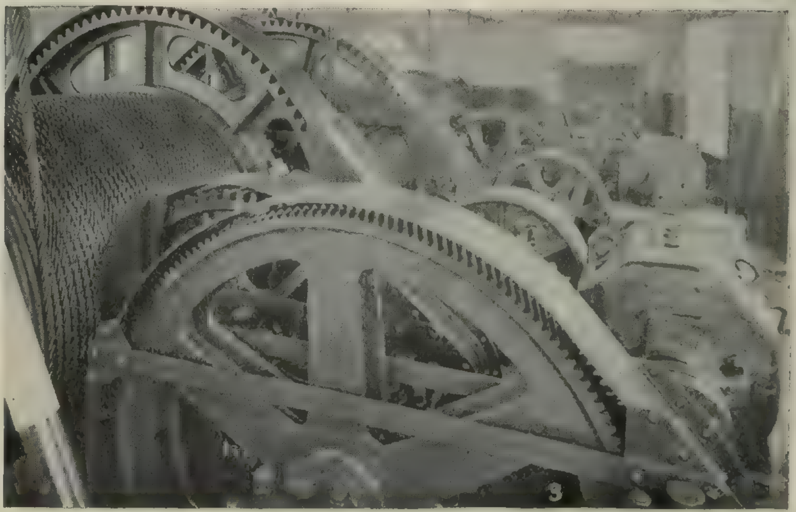
mounted on a flatboat, or floating pontoon, the stability of which must not be endangered by handling these immense loads.

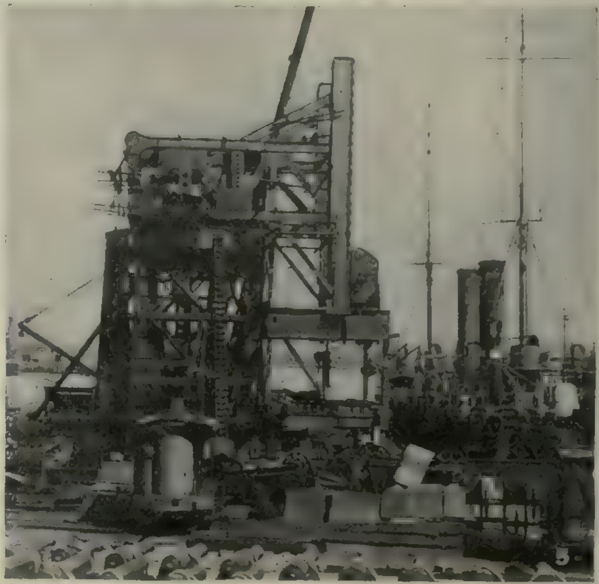
Superior engineering skill was required to proportion the parts of this crane so that as the boat is tipped sidewise and endwise under loads, it is still absolutely safe against turning over.

The boat itself, contains a complete boiler plant, and an engine-driven generator which supplies the electric current for operating the various motions of the crane which are controlled from a small house mounted high above the deck. One operator, by means of a few levers and master controllers is able to control all the functions with the utmost delicacy.

The electrical mechanism is such that when the heavy loads are lowered the motors are turned into generators in such a way that the speed can be controlled with great nicety. In case of an accidental interruption of electric current, all motions of the crane are automatically locked by means of magnetic brakes so that it is impossible to drop the load from such a cause. Great safety and accuracy of control are essential, as the crane is used to handle large guns and turrets on battleships. These must not be damaged, their value being hundreds of thousands of dollars.

The illustration, Fig. 2, shows the first work which this crane was called upon to do. The Navy tug, "Massasoit" was suddenly sunk in one of the harbors. After divers had passed cables under the tug, they were attached to the crane and the tug was readily and quickly lifted to the surface, as shown. The illustrations, Figs. 3, 4, 5 and 6, are self-explanatory. It might be interesting






FIGS. 3 TO 6. SEVERAL VIEWS OF THE CRANE

Fig. 3—The operating machinery. Fig. 4—First stage of erection. Fig. 5—The turn-table and jib support. Fig. 6—Erecting the cantilever jib

to add that the Panama Canal Commission purchased two such large cranes for heavy lifting work at Panama. These cranes were bought from a large German corporation. When the test load was applied (which was the same as was applied to the machine shown in the illustration) the first of these German-built cranes collapsed and was wrecked, owing to the faulty design of the structure. In comparison no weaknesses whatever have developed in any of the floating cranes built here in Cleveland.

The following data will enable the reader fully to appreciate the enormous size of this crane:

Size of pontoon, 140 ft. long x 85 ft. wide x 15 ft. deep; size of engine generator set, 150 kw.; the crane has a main hoist consisting of two hooks of 75 tons each, fixed on the jib; an auxiliary hoist of 25-tons capacity, movable up and down the boom; the crane rotates in a complete circle, the rotating being controlled by two 60-hp. motors; the boom luffs up and down from a practically vertical position to an angle of about 30 deg. from the horizontal, in its lowest position; the luffing is accomplished by two 10-in. screws operated by two 60-hp. motors; the two main hoists can operate separately or simultaneously, as desired; when lifting the maximum load it is operated by two 60-hp. motors; the auxiliary hoist has separate motors for hoisting and trolleying, each of which is 60 hp.; the counterbalance at the after end of the crane is fixed, and amounts to 600,000 lb.; the total weight of the pontoon crane (displacement) is 5,000,000 lb.; the capstans are electrically driven, four in number, one at each corner of pontoon; the anchor hoists are steam driven, two in number, one at each end; the main pivotal bearing, or step bearing, supports a ball or universal joint and carries a maximum load of 2,021,000 lb.; the speed of the main hoist under maximum load is about 6 ft. per minute; the speed of the auxiliary hoist is 30 ft. per minute; the speed of rotation is one revolution in four minutes; speed of luffing boom, entire range 12 minutes.

Report of the National Bureau of Standards

The annual report of the National Bureau of Standards has been released for publication and deals largely and efficiently with standardization, which is so important a matter to the manufacturing world.

Standardization has been applied to many things of the great industrial world, and the machinist's output is especially affected. This measure is doubtless to be one of the great permanent advantages derived from the war. The simple excellence of a vast economy by standardization is especially applied to the mesh of all industrial sieves, measuring instruments, master scales and electrical measurements. In the matter of standardization alone, the bureau reports 21 states that have adopted uniformity in their master scales, while the American Railway Association also has adopted a uniform scale standard.

New classifications have resulted from the bureau's work; the work on altimeters, for example, has been extended to tests and investigation of all aviation instruments. The tests applied to leather and measuring instruments are most important, as is the research made in relation to radio activities. The latter includes tests of the fog-signaling system—which had its actual development after the tragedy of the Titanic. Whatever had been done before the Titanic went to the bottom, was as naught compared with the results of the work of development accomplished with that great sea tragedy for its impulse. The fog-signal and direction-finder has come in for special investigation and development, and the bureau reports their enlarged usefulness.

Important work has been done toward perfecting the magnetic system of steel testing, to determine the quality for tool and rail making, and for ball-bearings.

A higher quality of precision in lenses will be demanded as a result of new tests, and a more precise measurement of wave-lengths of different colors used as standards of optical works, will be secured. This will permit a greater usefulness in discovering impurities in materials. Especially will optical means be applied to determine the sugar content of molasses, and there is to be a much needed standardization of camera lenses, field-glasses and range-finders.

In relation to the bureau's activities of the year, standardization especially seems to leap toward that simple organization of forces which shall tend to put things right.

The National Foreign Trade Convention

James A. Farrell, Chairman of the National Foreign Trade Council, has issued the formal call for the Fifth National Foreign Trade Convention to meet at the Gibson Hotel, Cincinnati, Ohio, Thursday, Friday and Saturday, Feb. 7, 8 and 9, 1918. The theme of the convention will be "The Part of Foreign Trade in Winning the War."

"American participation in the war against Germany," says Chairman Farrell in his call, "has laid a new obligation upon the foreign trade enterprise of the United States, and at the same time presented it a new opportunity. To consider that obligation and that opportunity, to discuss what has been done by the different elements of foreign trade, and to give serious thought to the demands and the problems of the future, delegates from every part of the United States, representing all phases of commercial and civic developement, will assemble for the three days session at Cincinnati. The war has added importance to the maintenance and development of foreign trade. It has made clear and paramount the element of national service. It is our duty as never before, to see that the flow of overseas commerce proceeds with uninterrupted regularity and in the largest possible volume, steadily bringing to us the products necessary to the life of the enterprise on which we are embarked, and steadily carrying to our allies and to our neutral sources of supply, the materials and manufactures that will enable them to maintain their efforts in the field or to continue to produce the food and raw materials so essential to our military success. More than ever the foreign trade of the nation serves a vital national purpose in maintaining the gold reserve and sustaining the huge bulk of national credit upon which the necessities of war are making such enormous demands."

All Americans engaged in, or desirous of entering overseas commerce, and especially all Chambers of Commerce, Boards of Trade, and other commercial and industrial organizations, as well as firms and individuals, are invited to take part in the convention, individually or by appointment of delgates. The discussion will be led by men who are foremost in the foreign trade experience of the United States.

Approximately one-half of the time of the convention will be given to the presentation of prepared papers and reports dealing with one or another of the numerous phases of this great convention theme. The remainder will be devoted to group sessions for the intensive discussion of single problems under the leadership of specially qualified experts.

The Program

The preliminary program is announced as follows:

Thursday, Feb. 7—Convention called to order at 10 a.m. by James A. Farrell, chairman, National Foreign Trade Council; addresses of welcome on behalf of state of Ohio and city of Cincinnati; organization of convention; election of president of convention. Topic of session, Foreign Trade Achievements Up to Date: a series of brief addresses presenting the share of the different elements of foreign trade, as shipping, railroads, finance, steel, textiles, chemicals and lumber in war preparation and work.

Afternoon session: 2:30 p.m. Topic of session, After-War Conditions of Foreign Trade: two or three papers discussing measures necessary for American Foreign Trade to meet the new situation when peace is restored, and to hold the gains it has made in recent years, organization in production and coöperation in marketing. Group Sessions at 4 p.m.: Group I. Exports Control and Imports Control. Attended by representatives of the War Trade Board. Group II. Foreign Credits. In coöperation with the National Association of Credit Men. Group III. Education for Foreign Trade. Group IV. The Smaller Manufacturer and Merchant. In coöperation with the American Manufacturers' Export Association. Group V. Getting Into the Game. Experience Session for Beginners.

Friday, Feb. 8, morning session: 10 a.m., session topic, The Merchant Marine: addresses dealing with the rehabilitation of the American merchant fleet, and means to assure its permanent retention; the American foreign trade policy of the future and the problem of the Pacific.

Friday afternoon, 2:30 p.m., group session. Friday evening, 7 p.m., banquet, Gibson Hotel.

Saturday, Feb. 9, morning session: 10 a.m. Reports of group sessions; reports of general convention committees; miscellaneous business; adjournment. Foreign Trade specials leave Cincinnati for New York and Boston, 2:30 p.m.

The secretary announces that the various departments of the Government, commissions, boards and bureaus, the activities of which concern foreign trade, are coöperating with the Council to make available to all delegates, government-trade information and advice regarding foreign markets. Several members of the specially trained Government forces will be assigned by their departments to assist in the work. The Secretary of State will assign several consuls and consuls general from Europe, Latin America and the Far East, who are expected in the United States on leave at the time of the convention. These officials, several of whom have been in the Consular Service for many years, will be accessible to delegates for the purpose of personal conversation or for informal conference with groups of delegates. In addition, the Secretary of Commerce will assign to Cincinnati, officials and experts of the Bureau of Foreign and Domestic Commerce, who will be available for individual consultation.

Among the special features will be a large collection of samples assembled by the Bureau of Foreign and Domestic Commerce from all parts of the world, vividly showing the character of products marketed by other nations. The Pan-American Union will have representatives to supply information regarding the Pan-American friendship in commerce; and a number of gentlemen, long experienced in foreign trade, either as heads of foreign selling organizations for large manufacturers or as export and import merchants, will be present to give particular advice to delegates on the details of foreign trade.

The work of organizing the convention is being conducted by O. K. Davis, Secretary of the National Foreign Trade Council, 1 Hanover Square, New York City.

The Cincinnati Executive Committee in charge of the local arrangements includes the following:

Robert S. Alter, chairman, vice president of the American Tool Works Co.; A. B. Fishwick, vice chairman and chairman Physical Arrangements Committee, 812 Commercial Tribune Bldg.; A. Clifford Shinkle, treasurer and chairman of Finance Committee, president of the Central Trust Co.; Thomas Quinlan, secretary and manager of the convention and publicity department, Cincinnati Chamber of Commerce; William Biddle, chairman of the Hotel Committee, sales manager of the American Laundry Machinery Co.; A. C. Hoefinghoff, chairman of the Publicity Committee, president and treasurer of the Cincinnati Grinder Co.; H. M. Houston, chairman of exhibits, treasurer of Houston, Stanwood & Gamble Co.; Luke W. Smith, chairman of the Entertainment Committee, president of the Charles E. Smith & Sons Co.; James I. Stephenson, chairman of Banquet Committee, president of the Cincinnati Iron and Steel Co.; E. W. Tapley, chairman of the Printing Committee, general agent of the American Express Co.

Bushing a Loose Pulley

By C. Hecker

Before accepting the criticsim of W. E. Peskett, on page 1004, Vol. 47, on an article with the above title, which appeared on page 414, *American Machinist*, I wish to call his attention to a point which he may have overlooked.

The bushing was designed to be a running fit in the pulley and on the shaft, so should be lubricated accordingly. I have used a similar bushing in places where it could be made in one piece and perforated with holes to retain and distribute the oil. Another point should not be lost sight of; this was a break-down job, and time was a very important factor. I do not see any advantage in the plan proposed by Mr. Peskett, but can see trouble from lack of lubrication after needless time spent in making.

MACHINING PARTS of a CALCULATING MACHINE

SPECIAL CORRESPONDENCE

In the manufacture of this mechanical calculating machine most of the parts are produced on punch presses from sheet metal. Accuracy in production is essential both to insure the proper functioning of the machine and to insure ease in operation. In this article are illustrated some of the test gages and press tools used.

THE Mechanical Accountant Co., Providence, R. I., is manufacturing a calculating machine which presents several interesting features.

This machine is produced in three types. The first type is for addition only; the second type adds, subtracts, multiples and divides; while the third type possesses all the features of the second type and is in addition provided with an upper row of proof dials, the purpose of which is to enable the operator to check and prove his work at any stage. Should the operator be interrupted in the middle of a column of figures, these proof dials will show just where he left off and thus avoid the necessity of going over the work again. The machines are gear-driven and as shown by the illustrations are simple in construction.

The stroke of the clearing lever for the dials is short, being only about $\frac{1}{4}$ in. With these mechanical accountants any number of keys may be depressed at the same time; or in any order desired.

Fig. 1 shows one of the eight column machines for addition only. It will be observed that the machine is made with five rows of keys, as it has been found that the operators seldom use the keys above the five rows. Figures over five are then obtained either by striking a key twice or the combination of two keys.

Fig. 2 shows one of the eight-column adding, subtracting, multiplying and dividing machines.

Fig. 3 shows two completed machines removed from the aluminum housings. The one at the right is a machine showing a top view, and the dials and key levers may be readily observed. At the left is a machine so raised that the controlling mechanism can be seen.

Fig. 4 shows one of the assembled columns ready to be placed in the holding frame. From this illustration the key action, pawls, gear and other parts which comprise the unit may be observed.

Fig. 5 shows the gage for testing the dial stop pawl. The pawl is located on a pin A and against a stop pin B, being held against the latter by the spring lever shown. The knob C which draws down the gaging points is pulled over when placing the pawl in the gage. This tool gages four points and the index fingers must register between the limit lines as shown.

Fig. 6 shows the gage used for testing the carrying disk, which is placed on the pin at A. This tool is designed to test five surfaces on the disk. It will be observed that three of the indexing levers are provided with lugs so that the operator can conveniently draw them back when placing the disk to be tested in the gage.

In front of the gage, Fig. 7, is shown a finished eccentric driving shaft. It will be observed that this part

FIG. 2. FINISHED COMPOUND MACHINE

is made with an eccentric head. The gage illustrated is used to test this eccentricity in relation to the shank. The shaft is slid from the rear of the gage into blocks which come against the eccentric surface and the circular portion of the shank. The knurled screws A-A are then tightened, which forces the locating blocks against the shaft to hold it securely.

The flattened end of the shaft fits into a similar shaped hole in the lower end of the pin B. The pin is held to the handle C by lever screw D. The handle C is pushed over or forward until the pointer registers zero on the gage, thus bringing the squared end of the shaft into correct location with the eccentric surface.

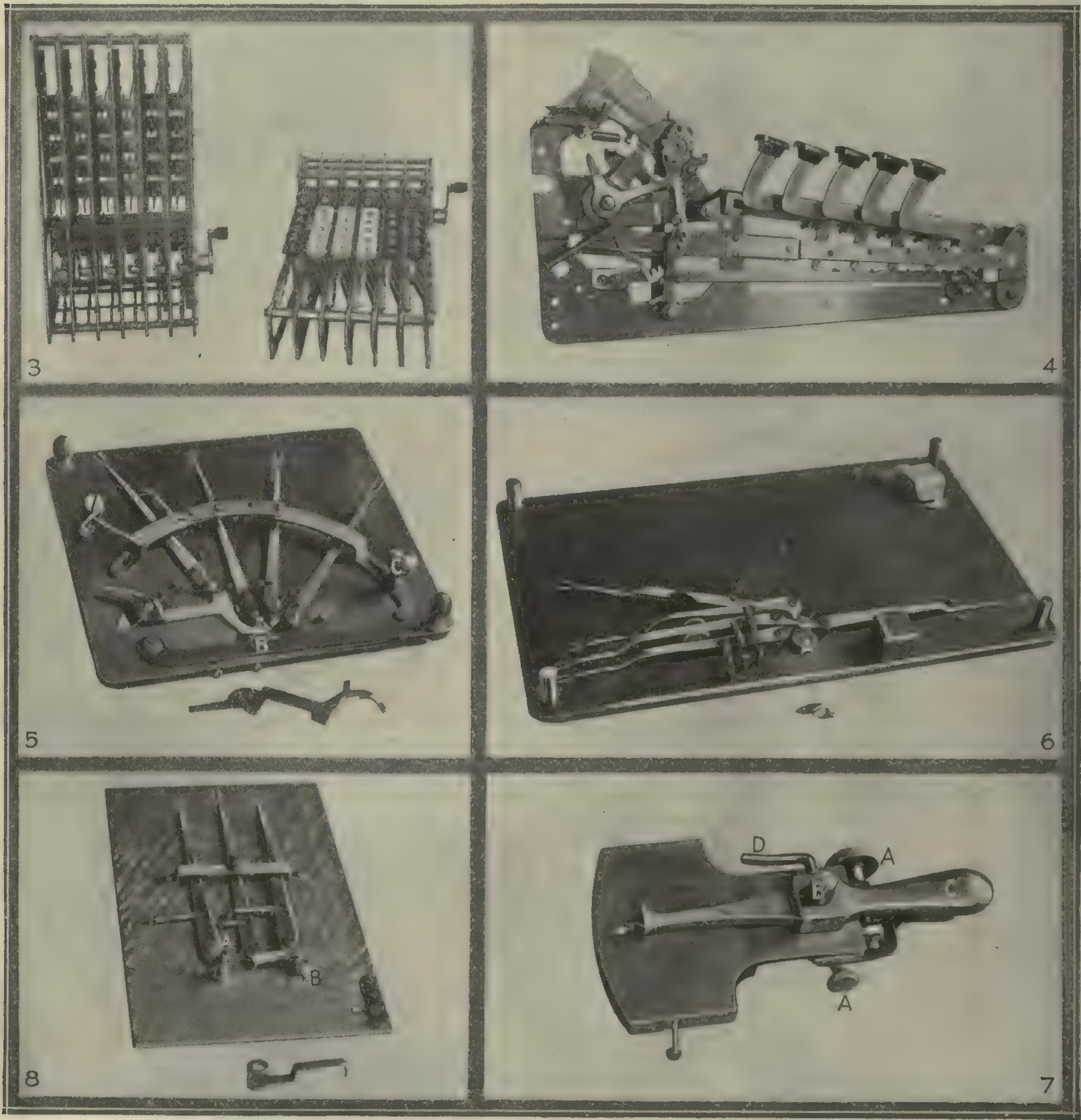
Fig. 8 shows the gage for testing the stop pawl which is located on the pin A and against the stop B.

Fig. 9 shows the gage used to test the driving ratchet. The ratchet is placed on a pin as shown, being located by the splines fitting accurately in the keyways. The end of the lever is then brought in contact with a tooth on the outside of the ratchet, and the pointer must then register between certain limits on the graduations at A.

Fig. 10 shows the gage for testing the offset on driving gear brackets. The bracket is located on the pin A. The side of the bracket is then brought against the edge of the pin B. When the testing lever is brought against the under edge of the part being tested, the pointer must register between the limits shown.

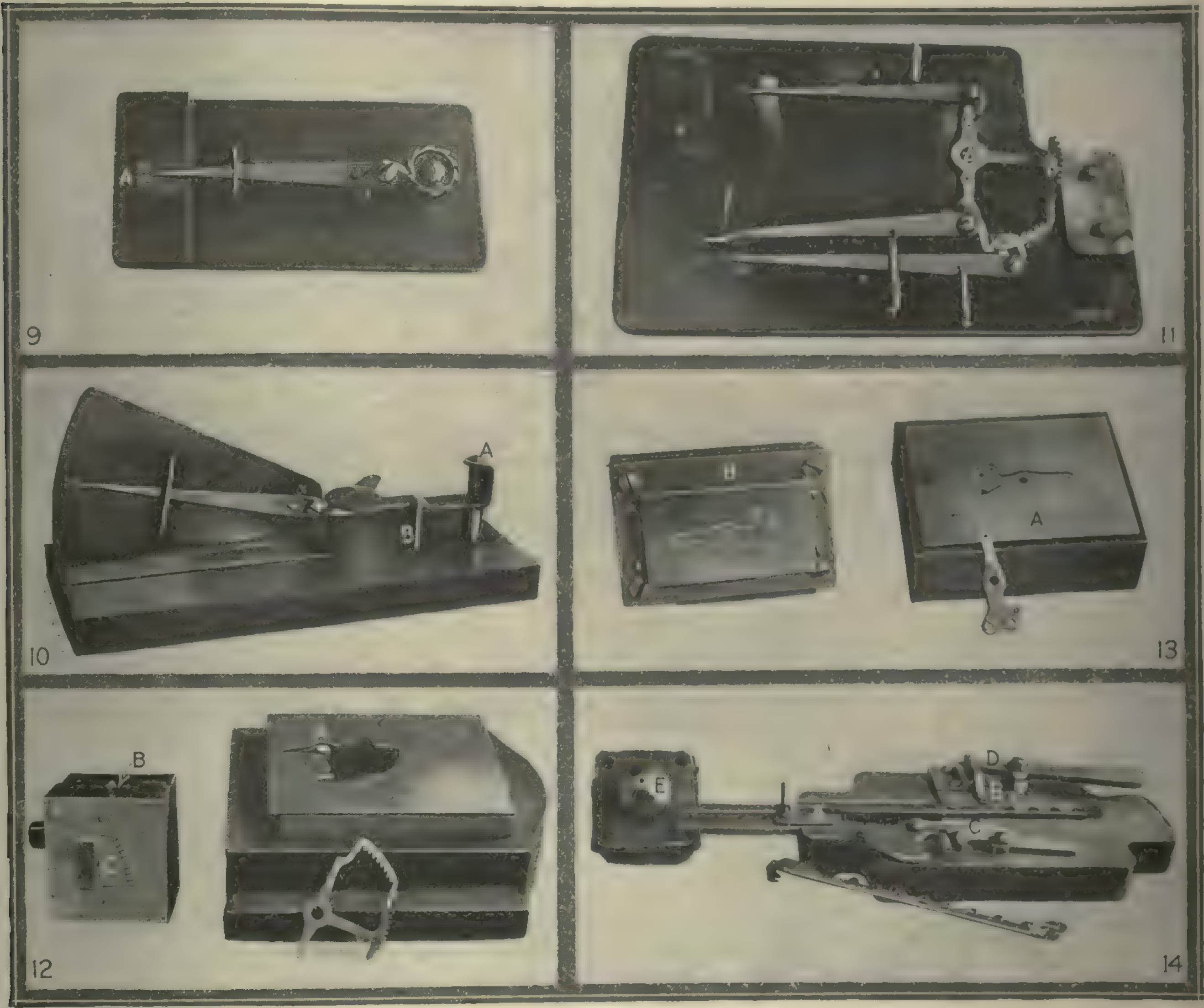
When testing the driving gear, the gage shown in Fig. 11 is used. The piece is located on the pin A, and by the teeth B, fitting into the plate as shown. Two surfaces are gaged, the end C and the first notch D. It will be seen that the gage is fitted with another locating plate not in use. It is used in testing another element of the machine.

Fig. 12 shows the punch and die used to form the



FIGS. 3 TO 8. PARTS OF THE MACHINE AND SOME GAGING OPERATIONS
Fig. 3—Machines removed from housings. Fig. 4—Assembled column unit. Fig. 5—Test gage for dial stop pawl. Fig. 6—Test gage for carrying disk. Fig. 7—Aligning the driving shaft. Fig. 8—Test gage for stop pawl

ratchet teeth in the driving gear. The gear is blanked, pierced, and the teeth on the outside punched in a previous operation. The blank is located by means of the pin at A and the contour machined in the die. It will be observed that the punch is made with a rubber pad B to actuate the stripper.



FIGS. 9 TO 14. VARIOUS TESTING AND PUNCHING OPERATIONS
Fig. 9—Testing driving ratchets. Fig. 10—Testing drive-gear brackets. Fig. 11—Testing driving gears. Fig. 12—Punching teeth in driving gear. Fig. 13—Piercing stop pawl-rocker lever. Fig. 14—Piercing the key bar

As the punch is forced down, the rubber is compressed until the punching operation has been performed with the fixed punch part C. However, as the punch is raised the rubber pad regains its normal state and forces off the part from the fixed element of the punch.

The punch and die used to pierce the stop-pawl rocker levers is illustrated in Fig. 13. This part has been blanked in a previous operation and is placed in the recess of the die A for piercing. The punch B is fitted with a rubber pad which operates the stripper in a manner similar to the one previously described. The work done with this punch and die is to pierce the five holes as shown.

The tools used to pierce the holes in the ears of the key bar are shown in Fig. 14. The die is of the progressive type and the key bar is located by the plates A and B, being pushed into position by the cam C. The lever D is used to eject the part from locating plate B after the hole has been punched. The punch E is also made with a rubber stripper.

The manner in which the tool is used is as follows: The locating plate is set up in one of the tapped holes as shown, and a number of key bars then punched. The locating block is then moved to another position determined by the next tapped hole and the operation repeated on the bars. These operations are repeated until all the holes have been punched. One of the finished key bars may be seen in front of the die.

A Letter from the Western Front

By John C. Curtiss

London Representative of the *Dry Goods Economist*

It is but a fortnight since my wonderful visit to the front, yet the scenes still haunt me, I have had time to get a true perspective. I now can realize better than I could a fortnight ago what a remarkable experience it has been; one for which most men would gladly risk their lives.

The privilege of crossing and recrossing the Channel with the grim pomp and tragedy of war-time, of visiting the great tankodromes where the uncanny tanks are in-

cubated into live monsters, and of actually riding in one of them, of seeing how Great Britain's "contemptible little army" has grown into a victorious, driving host of over six million strong: these things are worth any cost, no matter how great.

As is the case with everyone who visits the front, I am not permitted to reveal nine-tenths of what I have seen, learned or guessed; probably I would not if I could; some of it is not printable; but I may sum up my general impressions in the other tenth, which is just what I want to do.

I was one of four Americans invited as guests of the British Foreign Office to see for ourselves, then tell the public at home.

We reached the French coast at night, where we were met by a staff officer and his aids, who had come by motor to take us to our headquarters: a splendid château surrounded by a broad, deep moat and built in the thirteenth century.

Before starting off in the motors the next morning we were initiated to the use of the gas mask and steel helmet. In these, as in everything else, the British have surpassed the Hun invention. The German gas mask is simply a rubber mask, with goggles fastened to what might be taken for a lantern base, containing chemicals and perforated at the bottom for air, with a hole at the top side with a tube to put in your mouth. Often the wearer is smothered to death, being wounded and unable to remove the mask when lying in the mud.

The British mask has what appears to be a small knapsack suspended on the chest from a band around the neck; the rubber mask is put over the head, a clamp fastened on the nose, and a stiff, corrugated tube about two inches in diameter supplies the person from a mixture in the sack, the wearer holding a flat, hard-rubber mouthpiece between his teeth. They are uncomfortable, but they do the work.

Tommy's helmet is made of the toughest sort of steel, stamped out like a bowl with a 2-in. brim, and sanded on the top for less visibility; these are so tough that they seldom are punctured. Inside the helmet he wears a cap.

The pot-shaped Boche helmet is little better than sheet iron. I have one in my collection with five gaping shrapnel holes right through the crown.

The instructions over, we piled into the motor and were off for the front, traveling like the wind. I'll tell first of cur visit to the tankodrome, not because "tanks" are the most important engines of war, but because they are the newest and most picturesque.

The Tankodrome

You have had a tank sent over to you for exhibition in New York, although in England the tank was long kept a mystery, and even yet none has been put on public show.

You may realize, therefore, that we were particularly pleased when we hove up "somewhere in France" before the tank base, the place where the tanks are bred. The fully equipped machine shops and the assembling rooms where all the parts of the tanks are set together were a revelation of what this war has accomplished.

Secluded from curious eyes by a very high stockade, the tanks are enclosed in a large paddock, where they are tried out and put through all sorts of stunts. The stockade forms the outside wall of the tank shed or stall where they are kept. Here, too, is the tank school, where commanders and crews are trained. There are sub-tankodromes at different points. At these the men go on with their practical instruction and maneuvers. Some of the early battle-scarred tanks have been salvaged. They had taken a tremendous amount of punishment, but as they are repaired they become tenders for the newer tanks, to bring them supplies and ammunition.

We had the unique honor of being the first visitors to ride in a tank and sèe it put through its paces. There is more inside than one would think, when ammunition, petrol, food, water, six machine guns, engine and crew are stowed away in their proper places. It gets pretty hot, of course, and the noise is so great that communication is by signal only. Two carrier pigeons are included as part of the equipment of each tank.

Three of us were taken inside, and the sensation of traveling in a heavy moving fortress was novel. It moved over the soft ground and wheeled and maneuvered with remarkable ease. We were then told that we would be shown how the tanks go over obstructions, and all but one of us got out to see from the outside. The tank headed straight for an obstacle which had been built in, on part of the tankodrome. It mounted easily, going over the top and coming down with an awful bang as it dropped off the other side.

"The 'Appy 'Arriet"

Many of the tanks had their names painted in big white letters on the front side. Among the battle-scarred ones I hoped to find one of particular interest to me, because it had been named by its commander the "'App 'Arriet" after my youngest daughter, but I was told that it was still in "No Man's Land." The story of how "'Appy 'Arriet" got into No Man's Land is an interesting one and I will tell it as it was told me in a Red Cross hospital in France by her commander, a lovable lad and a gifted artist. His was one of the dangerously wounded cases; but the surgeons are skillful these days, so this young officer will get well.

"We were proud of the ''Appy 'Arriet,'" he said to me. "She was one of the show tanks of our colonel at the tankodrome, because her brass was always so bright.

"Just before the big push of July 31 word came that we were ordered to the concentration point behind the lines as near the front as safety would allow.

"For weeks we had been preparing for this advance. We had repainted the interior white, so that when the ports were closed we could see in the gloom. The map board with our objectives was fixed in place, many rounds of ammunition were stowed away, besides food, water and gallons of petrol.

"We moved to the concentration point behind the lines. Here we examined and tested again every part of the engine, tested every gun and even examined all the ammunition to see that it would fit properly.

"There were twenty-four tanks for the first push and twelve held in reserve. We were in the reserve.

"The push began at 3: 50 a.m. and by 5 o'clock the engineers, who had gone on in advance, had a dam built across the canal that would hold the tanks, which had crossed in single file, protected by the barrage of our guns. By noon ammunition trains were crossing that same dam, being shelled by the Boche all the time.

"During our advance our big guns kept up a barrage to hide our noise; but our presence had been discovered and they began to shell us. One of my men was watching a star shell through a machine-gun slit when a shell burst near by and we had our first casualty.

"The 'Appy 'Arriet had got well into 'No Man's Land' when she stuck fast in the slime of a crater hole; we tried to back out and forge ahead, but our caterpillars just ground deeper into mud.

"Soon all of us were wounded but one man, whom we sent back to tell the Major of our troubles. It was a horrible night. For two hours the Boche guns hammered us. I lay caked with mud in the slime of a shell hole, naked except for a pair of trousers and my boots, which were shattered with my legs. I was not picked up and sent to the dressing station till the next morning, and I'm the luckiest man alive to be here today. Fortunately we had sent back the first carrier pigeon with the news of our troubles before we were all *hors de combat.*

"The first tank in the line had better luck; it knocked out five machine guns and beat up advancing Huns who were to reinforce their front-line trenches before it got stuck in the mud, where for three days it remained, sniping the enemy and being shelled constantly in turn. Our infantry advance finally relieved it."

I learned later that the "'Appy 'Arriet" had been salvaged and returned to the tankodrome.

The War Area

As we came into the war area the evidence of the magnitude of the thing was appalling. How any mind or organization of minds can conceive and look after the details of such a prodigious task is marvelous. The throngs of moving troops who congested the roads, the hundreds of lorries and Red Cross motors hurrying back and forth, all were part of a fixed purpose; all parts of the great machine that is to guarantee the liberty of the world.

On the Somme, month after month, thousands of tons of steel were fired at the Germans. But during the past twenty-seven weeks the tonnage fired in Flanders has been more than all that fired on the Somme; and during the last week the tonnage has been double that of the average of the preceding twenty-seven weeks, and four times the tonnage of the battle of the Somme.

There is no parallel I can draw to give an idea of the battlefield. As far as the eye could see to right and left of us, was the constant flash of heavy artillery, a roar of guns such as would have made Napoleon blush for the meekness of his own. And the Boche—well, he hardly had time to answer, for the British fire, I should say, was ten to his one.

There were seven big sausage balloons (British) anchored in this section for observation purposes, one being very near to where we were. All of a sudden, out of the low-hanging clouds came a fleet of Boche planes, dropping bombs behind the British lines and trying to get their big guns and ammunition dumps. Antiaircraft guns barked away at them, shells bursting in midair. Then, from another direction, swooped down the British fleet, and we caught the rattle of machine guns as the wind brought the sound our way.

We returned to our motors, were whisked off over the congested roads to a point at the back of the lines as far as the motors could go and then on foot we picked our way through the desolation of mud, shell holes and battle *débris* toward the line of batteries. We stopped at a rest dugout to get an officer and two gun crews to demonstrate the big guns to us.

I did not get all the minute details of the size and mechanism of the guns; the place and conditions were not appropriate for concentration. They were of the same type you have seen in the cinemas, and both the guns and the ammunition beside them were covered with branches and leaves, supported by big fish nets. Shells were put in the breech of each gun, we stood off ten paces, suddenly the officer pointed to a number of Boche planes overhead. The flash of the guns would have given our location, so we waited under the nets.

When the planes had gone the officer gave the order, and both guns roared at the same instant; we listened to the whistle of the shells as they sped on behind the German lines. Other salvos were fired.

A year ago those salvos would have been answered two-fold; we waited for a reply, yet none came; the Boche hasn't the shells to spare. It is one of the signs of the decay now so noticeable.

Optimism at the Front

There are no two opinions in the trenches. Tommy regards the war as won and is only longing for the word to advance. The boys in the rest camps and in the hospitals tell the same story. If you qestion the ultimate victory you are immediately challenged for your audacity, and you can't prove much of a case with Tommy —Tommy knows.

There is no lack of anything in the British Army. The terrific barrage day and night along the whole Flanders Front is a magnificent testimonial to the co-operation between the armies at the front and the splendid armies of munition workers in England—no wonder the Boche knows the game is up, and by next spring, when the U. S. A. adds its might and its battle planes, Wilhelmstrasse will throw up its hands and cry, "Kamerade," even as the Boche does daily on the Ypres section.

The Desolation of the Somme

The complete destruction and ruin from Arras down through the Somme sector is most depressing. That the glorious cities of the middle ages with their priceless monuments and architecture should be wantonly destroyed; that vineyards, orchards and forests should be uprooted; that a once prosperous and happy countryside should be sown with millions of tons of iron, that happy homes should be destroyed, the families broken up and girls forced into the most revolting slavery at the whim of one man or set of men, was once believed impossible.

After two thousand years of Christianity, Europe had thought the Hun civilized. Now that it knows better, it is preparing once for all to teach the needed lesson that "he who lives by the sword dies by the sword." And the German people must suffer for the crimes of their leaders, whom they have kept in power and whom they have obeyed with abject meekness.

No politician or set of politicians may now with impunity suggest a truce or weak-kneed peace. The armies that have suffered and bled, the civilians who have seen their loved ones torn asunder by hellish bombs, demand

a just and speedy retribution upon the nation that brought on the world such untold misery.

That is the message I bring from the British front, and also the London front. It is the message also of the long-suffering English and French people.

We are proud of President Wilson and the manner in which he has mobilized the industries, interests and individuals of the U. S. A. He is without precedent. Let him stand as strongly at the final issue, that the wrongs of the peoples of the earth may be avenged. That is my message.

Ships Wanted

By Entropy

The nation has a large and comprehensive program for the building of a merchant marine which shall outstrip the raids of the U-boats. It has arranged for a supply of materials, for money for all the things which go to the making of ships, but it is handicapped for lack of the right men.

Shipbuilding has for many years been almost a lost art in America. There has been little or no profit in either building or owning them. In the physical surroundings which they have given their men the shipyards have not had the money with which to keep up with the other and more prosperous industries of the country; the very natural result has been that in the stress of their present mushroom growth the right kind of men have not been attracted. Any man who has worked in the other and somewhat similar industries that have modern sanitary equipment, where there is good housing, transportation, machinery and tools, finds his patriotism severely tested when he enters many of these yards.

No one can be blamed for any part of this situation except the various congresses which have had the opportunity to make shipbuilding profitable yet have passed it by. This, however, is no time for recrimination; we must have ships, and we must have the men to build them.

There are two things that the readers of the *American Machinist* can do; one is to turn every capable mechanic whom they do not need in their own business toward the shipping industry, warning him of what he may find, but appealing to his patriotism to stick on the job until the shops can be fully manned with real men; the other is to lend every aid whether of influence or of investment of money, to make the conditions in the shipyards tolerable and attractive to the men whom they send.

The shipbuilders are in a position to do almost everything that is necessary to make their places attractive except to aid the housing and transportation of their men. The program calls for the moving of anywhere from one hundred to two hundred-thousand men from the interior of the country to the seaboard. The larger part of these cannot go unless they can take their families, hence this means the migration of upward of 500,000 people to localities which have been stagnant so far as real estate is concerned, for many years. There is much danger that speculators who always prey on the evident necessities of the public will rush in and take up much of the available land. The shipbuilders certainly cannot finance this enormous housing problem out of their profits of the past years, for the enlargement of their yards has put many of them to their wit's-end to manage their finances. The only recourse is to the Government, and that is legitimate because the Government, which is simply representative of all of us, is the one who wants the ships, while it is not in a position to guarantee that the shipyards shall have work to do after this emergency is met. In fact the past action of Congress makes everyone wonder whether it will or will not support the shipping industry in the future. The Government, however, seldom acts until it is evident that the people of the country are behind a given movement. It is up to all of us to get behind a movement for Government-assistance in the proper housing of men in this case if in no other.

National Foreign Trade Convention

In Cincinnati very satisfactory progress is being made for holding the National Foreign Trade Convention from Feb. 7 to 9, inclusively. Those expecting to attend should make their hotel reservations early through the Hotel Reservation Committee: William A. Biddle, Chairman, care Chamber of Commerce, Cincinnati, Ohio. No reservations are to be made direct with the hotels.

Credit for the decision to hold the meeting in Cincinnati and for the organization for preliminary work, is largely due to Robert S. Alter, General Chairman. The members of the executive committee are: Robert S. Alter, Chairman; A. B. Fishwick, Vice Chairman; William A. Biddle, Treasurer; Thomas Quinlan, Secretary; A. C. Hoefinghoff, H. M. Houston, Luke W. Smith, James I. Stephenson, E. W. Tapley, Joseph Wolf. The members of the finance committee are: A. Clifford Shinkle, Chairman; Geo. F. Dieterle, Vice Chairman; G. P. Altenberg, L. A. Ault, J. B. Doan, E. W. Edwards, Frederick A. Geier, W. D. Henderson, Charles A. Hinsch, George H. Lewis, Theodore Luth, Orville Simpson, Leonard Smith, Luke W. Smith, O. J. Timberman, George M. Verity, Clifford B. Wright.

Demand for Engineers

The Army and Navy staff departments continue to demand men of engineering experience, especially in industrial lines. At present the outlook is that the demand will continue throughout the period of the war. In calling attention to this, the United States Public Service Reserve, Washington, D. C. (where records of men willing to serve when called, will be kept on file), points out that a man of engineering experience has a rare combination of opportunities open to him which are not open to the average, patriotic American.

These are as follows:

(1) To serve the country in his most effective capacity. (2) To keep in touch with his own profession, the result that his patriotic service will not have caused him to become rusty by the time peace returns. (3) To become a commissioned officer and receive much better pay than the average man who has wholly subordinated personal interests and now works for the national good. (4) To perform his service usually without leaving the United States.

Sidelights

EDITED BY D. BACON

Jerusalem as a vast arts-industries plant is not a Utopian idea, but a Jewish hope.

Jerusalem is in the hands of the British and the Jews feel a strong hope that from the British may come to them the opportunity for which a vast multitude has longed for nearly two thousand years: the opportunity to relate themselves once more to the land of their social and political origin. This may be the result of the world's war. If it should be, what will the Jew do with Palestine; 6000 square miles no longer arable! To make that arid land meet the great demand of usefulness to the multitudinous zionist, it must be self-supporting after some fashion. How shall 6000 square miles be made to support the racial aspiration of the Jews? What of turning that strip into a vast, incomparable home of labor-learning? What about establishing there a center where the industrial arts shall be taught to all who qualify, after some self-supporting, yet semi-benevolent plan? What of making Palestine the out-going place of a great, ever increasing army of specialized workers, gathered from every part of the world, and of which the only qualification demanded shall be a fitness for the undertaking? Transportation, apprenticeship, living and perfect equipment for a life of specialized labor! This is no Utopian idea. It is a Jewish idea and perhaps as practical as the machinery that would equip such a plant, and give unprecedented impulse to great industries.

The Fighter Who Stays at Home

In the great manufactories of this country are signs urging their men to fight for liberty by filing every possible claim to exemption which they can urge. Every scrap of clothing worn by our fighters at the front, every gun fired, every round of ammunition used by them in this fierce drive for liberty is a war contribution of the fighter who is being urged by these factory signs to do his utmost to remain at home. He is urged to remain in the very interests of the Government that calls him in the regular course of the draft operation. Every time an operator in a factory that turns out goods used at the front wastes a minute, he has put himself in a way to be responsible for the death of another fighter: of one who is fighting in the trenches!—for he delays every succeeding operation on the article he is helping to make. There is no responsibility anywhere on the front nor in the trench, greater than that which is every man's, woman's and youth's in our factories. When manufacturers appeal to their men to file their claims of exemption, the splendid fighting status of the workman is established, and never in all his life will he have again so great a chance for honor and fighting glory, for never again can he have so universal as well as personal a cause. If Congress is to create a decoration for our fighters, that decoration should belong to the industrial-brave as to the gun-brave, in recognition of his great usefulness in this fearful moment, for he has become a part of the real fighting force. It is the industrial operator's best work for humanity and his home, to stay on his job in order to do, *not* his *bit*, but his *all*. If he is properly to back his comrades in arms, he must instantly heed the signs in his factory, register his exemption claims, and do his best to put them through.

France and the Abrogation

On the first of the year France cancelled all contracts of war manufactures with the United States. There were no ships to make delivery of goods. The marine situation is not the only transportation system involved. These cancellations release a vast amount of rail service for internal use, and we never needed it so much as now; at the same time they point a second fact of importance: we need the ships! If we are to do things we must have the ships as we have the men and the money. In time of war, aphorisms may be set aside, and this is no time to make haste slowly.

The Open-Top Car Release

Priority order No. 2, withdrew open-top freight cars from the "shipping of materials and supplies, other than coal, for the construction and repair of private highways," etc., and for "construction materials for places of amusement." Now these cars are restored to this service as needed. This restoration comes directly upon the Government conduct of railroads, and either means that a new economy has equalized the transportation of freight that all ends may be kept up, or else the abrogation of certain contracts releases much rolling stock.

The importance of lifting this embargo is very great, for roads in the process of making or repair, have been held in a deplorable condition of uselessness, ever since the embargo was laid. This necessary interruption of road-making and repair, must also interrupt a motor service that is growing more and more essential in getting things done in this war-time emergency. More and more transportation is being diverted to the highroad, by motor power, thus relieving somewhat the congestion and delay by railway. If those whose contracts were held up by reason of an embargo which took them all unaware, can resume instant transportation of their materials, taking advantage of what may be but a temporary opportunity, they will be doing a patriotic service as well as putting money in their pockets and keeping faith with their customers. The good road is needed as never before. The release of means of transportation for materials to make it, may not last.

Less Machinery for the Bird Men

In the making of one type of airplane, as matters stand there are used 4326 nails; 3377 screws; 921 steel stampings; 798 forgings; 276 turnbuckles; 37 sq.ft. of veneer; 2362 ft. of wire; 11 gal. of varnish; 59 gal. of wing-dope; 65 lb. of aluminum; 34 ft. of rubber; 201 sq.ft. of linen; 244 ft. of spruce; 58 ft. of pine;

31 ft. of ash, and 1½ ft. of hickory. There are nearly 200 separate pieces to be assembled in a flying machine quite aside from the foregoing articles and an engine. This equipment is to be modified. Less machinery is to be used, and army aviation officials have assembled in the interests of such simplification. The action of the men who are working out a new plan, will not effect immediate changes however, for that would mean delayed manufacture; but changes will be made as they can, without interruption of the war plan; and the simplification will be to the advantage of the bird man, and ultimately will speed up the output of planes.

To Make the Stay-Home Fighter Stick

A schedule of wage increase and its application is now issued to the Members of the Employers' Association of Pittsburgh, and covers the year just past. Primarily this schedule was made and operated to fit the pay to the output, but its secondary is not less important than its primary purpose. The provisions of this schedule are mostly of a sort to induce or compel the fighting industrial corps to stay on the fighting line. The methods of increase are covered by the bonus, premium, straight increase, piece-work and tonnage plan, and at least three out of the five methods help to insure steady work on the part of the employee. It is, in a way, an unfortunate commentary on the soldierliness of the workman, for the exactions by way of forfeitures, and the premiums given for assiduity may be compared with the bayonet pricks used to keep the wavering man at the front, in line, when waiting for the enemy to charge. The industrial soldier is getting the conditions of wellbeing; the fighting soldier in the trench cannot have them, possibly. The industrial soldier is getting paid in full for his labor; the man in the trench is getting a soldier's pay for risking his life. The increase for clerical expense involved in this expedient-wage administration, is enormous and the workman owes something to that. He cannot give too much for what he gets today, whatever grievances may be his.

What The Railroad Take-Over Means

The present taking-over of the railroads by the Government appears a complicated act, but there are certain basic adjustments implied that may be briefly summed and even easily understood by anyone.

Under private conduct, railroads had to employ methods of competition; often this arbitrary demand interfered with economy of time as well as of money. Under Government conduct there can be no competition, which will do away with a large amount of costs: advertising for instance; while with the centralization of interests, all ticket offices save those at stations and central bureaus in great cities may be abolished; also, the man-machinery of freight and traffic solicitors, of which there were 8000 under the former system. may be dispensed with. In carrying freight from New York to San Francisco, a shift might formerly have been reckoned with at Pittsburgh, another at Chicago and another at Denver. These shifts demanded four separate billings, which alone should suggest to the mind something of the new economy as well as everything of the old extravagance. Under private ownership, certain traffic law was necessary in the interests of the public, which delayed transportation even as it insured it; in the new circumstances these hinderances will be removed. Much man-force will be transferred: Men are to be released from figuring extensions and footing way bills, for the different work of revising rates, while women will take their places in billing departments; and this transfer will introduce machines never before employed in these offices. Computing machines will be used and many other mechanical devices which women can operate.

What manufacturers and the rest of the world want, is the quick transportation of goods, and the satisfaction that will follow. The blessing of Government conduct of the railroads, in such an exigency as war, wears no camouflage.

Machinery-Drive When Man-Drive Stops

The Germans are still occupying the best of the Gallic iron-mining district; simultaneously, the French are organizing for the promotion of their iron and steel industries as never before. This anomalous situation is inspired by the absolute confidence of France and the allied world in the triumph of their cause. Before the war, France's steel and iron industries were covertly absorbed by Germany; now they belong to France, and France is organizing for a peace-time in which the metals industries are to have an unprecedented place. A separate department of the French government has been created for obtaining and coördinating information regarding foreign trade and its openings and extensions; a great financial institution has been created to take care of credit and to make enterprise safe. Great Britain has scrapped more antiquated material in the past year, than in the twenty previous years, and is preparing to acquire new machinery to an unheard of amount. Preparations for peace are being made on almost as extensive a scale as war actualities now are. Russia's industries, now dead, will be recreated according to a plan hitherto unconceived by Russia, no matter what her status immediately after the war, for no such areas as hers, will be permitted to go unworked when all the world will be crying out, her own with the rest, for food and clothing. After war comes want, unless men prepare in war-time for peace-time. That preparation is going on now and peace-pursuits are to be carried on by machinery, for there will not be enough man power to do the world's work for decades to come.

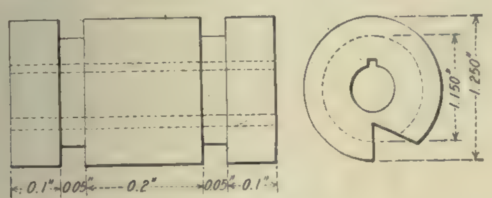
Concentric Disaster

A failure of the railroads to move coal, resulted in coal shortage in big cities. A shortage of coal resulted in a menace to the water systems, imperiling the piping in houses and business buildings. The turning on of water at innumerable taps in the state of New Jersey so reduced the supply of water in the reservoirs of that state that on the night of Dec. 29 the engines of the Erie road, could not get water to fill their boilers. This character of disaster made it impossible for the railroad to transport coal in any circumstances. Without coal in workingmen's homes, workingmen fall ill and can not work. This is one of the best possible object lessons of the complete interdependence of industrial activities which turn concentrically about the common center of economy.

Forming-Tool Information

By L. J. Griffin

Referring to the information desired by Stephen Jaross, page 648, Vol. 47, I wish to suggest that his forming tool be made up of five parts. These parts can be easily bored, turned and cut off to the proper roughing size, and then broached for a keyway. The parts



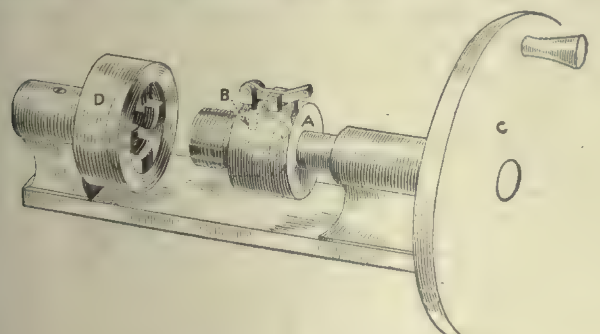
A FORMING TOOL

can be assembled on an arbor fitted with a key for the milling operation. After hardening the parts can be surface-ground to the desired width, internally ground and outside diameters finished to size. They can then be assembled on a nut arbor or toolholder, and the forming tool is completed.

Rethreading Fixture

By Leonard M. Thorn

We were manufacturing British 101 fuses and having considerable trouble with the body thread being too large after leaving the threading operation on the screw machines. We started to use a hand rethreading fixture,



RETHREADING FIXTURE

using a Whitworth button die to finish them to size. The button die was very unsatisfactory, as it would ride over the high spots in the metal, making the body thread very uneven. Moreover, it would not allow the thread gage to go over. If we adjusted the die to as near the low limit as practical, the percentage of scrap was too great. The illustration shows a fixture that overcame all our trouble and increased our production 200 per cent. with no scrap at all. It was a great saving over the old way, which never gave less than 7 per cent. scrap, and the cost for dies was cut considerably, as formerly we had to replace the button dies quite often. Now, we are using the original set of chasers, which have been in use over three months to date.

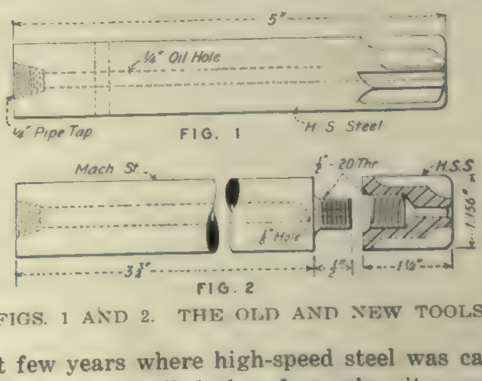
The simple operation of the die can be seen from the illustration. The fuse is placed in the cup holder *A*. The plunger pin *B* engages in the wrench hole of the fuse, holding it from turning. By means of the handwheel *C* the fuse is revolved and pushed up to the chasers which are ground to an 18-deg. angle on the end, to allow them to cut up to the last thread, as the fuse is 18 deg. also on the seat. The fuse runs up to stop *D*, which opens the die, allowing a quick return. Any style collapsible die head can be used, but we used a Modern die head. An air pipe is connected to blow the air directly into the head, to clear away the chips. Another advantage of this kind of fixture is that after it is once set, it does not need any more attention for some time, as we take off only 0.003 in.

A Finishing Tool

By A. K. Schwarz

Among the articles which we manufacture are bicycle hubs. Most of the automatics used in the production of these hubs came to us set up by the maker, ready for the job. One difficulty we had was with the finishing tools for the ball races.

In the illustration, Fig. 1 represents the finishing tool before it was changed. I have been working in shops in



FIGS. 1 AND 2. THE OLD AND NEW TOOLS

the last few years where high-speed steel was carefully and economically handled, therefore, when it came to the point where we needed new finishing tools I thought twice before using high-speed steel. The outcome of

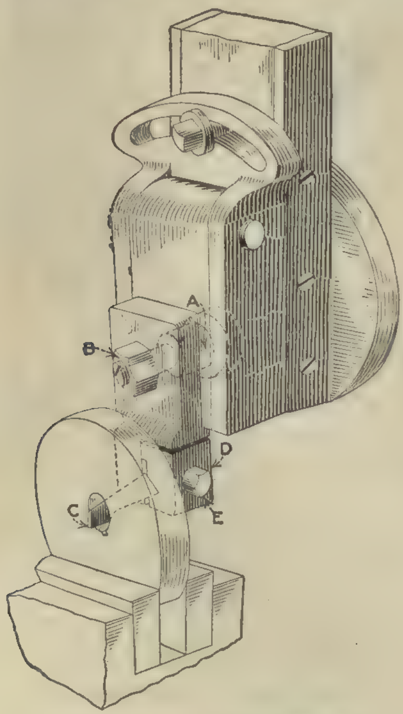
this was the improved tool, Fig. 2. It took about one hour longer to make this, but required only ¼ the amount of high-speed steel. The shank was made of machine steel. In addition to cheapness in construction another advantage of this tool is that it can be replaced in a very short time.

The first try-out these counterbores received looked very much like a failure at first glance. One of the men had a peculiar dislike for shell tools. After a two hours' run with the new tool he returned it in a broken condition. I examined the break and found that the steel was perfectly sound. I ordered a new one made and a little investigating showed me the reason for the first breakage. One of the bars of stock was just long enough to withstand the pressure of the first and second roughing tools, but the finishing tool crowded the stock out of the collet and something had to go. I am glad it was only the shell counterbore. However, we are now using this construction of tool with good results and a material saving in tool steel.

A Shaper Toolholder for Internal Work

By A. Hanschild

When an internal job has to be done in the shaping machine, such as cutting a keyway or shaping out a die, the gooseneck is not the best or cheapest tool to use as it can be rarely employed on more than one job.



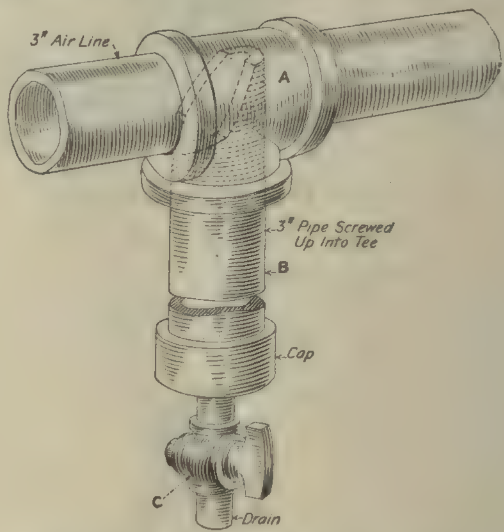
A SHAPER TOOLHOLDER FOR INTERNAL WORK

For rigidity and wide range the holder shown in the illustration is better than many others now in use. The bolt *A*, fitting the toolpost opening of the clapper block is provided on its threaded end with a slot to be engaged by a screwdriver while tightening nut *B*. The cutting tool *C* is held in the V by the strap *D* and bolt *E*. By this arrangement cutting tools of different sizes can be used. It requires little grinding to change the tool from left to right, or right to left.

Separator for Use on Air Lines

By W. B. Lailer

We experienced considerable trouble in the operation of pneumatic chipping hammers at points distant from the source of air supply, due to the presence of water of condensation in the pipe lines, which was discharged



SEPARATOR FOR USE ON AIR LINES

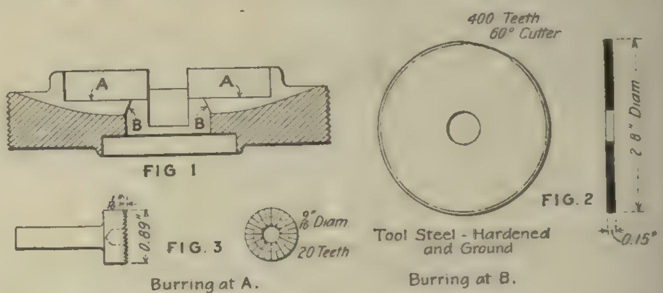
through the exhaust ports of the hammers. To eliminate the presence of water in the air before its entrance to the hose line we devised a separating device, which served its purpose admirably. A tee *A* was placed in the pipe line at a point adjacent that at which the hammers were operated. Into this tee was connected a depending piece of pipe *B*, capped at its lower end, forming a reservoir, or well. A drain *C* was provided for removing the water of condensation.

This device helped greatly to remedy our trouble, and made unnecessary the use of expensive heating equipment for drying the air.

Removing Troublesome Burrs

By H. James

Burring small brass and steel parts after machining is a problem many manufacturers have to meet. Some sandblast, some chip, some file, some use emery or buffing wheels. The problem of removing the burr



FIGS. 1 TO 3. TOOLS FOR REMOVING BURRS

caused by milling the flash channels in fuse base plugs, Fig. 1, at the point where these channels meet the flash hole, was met by mounting on a mandrel the saws from three worn-out Brown & Sharpe screw slotting

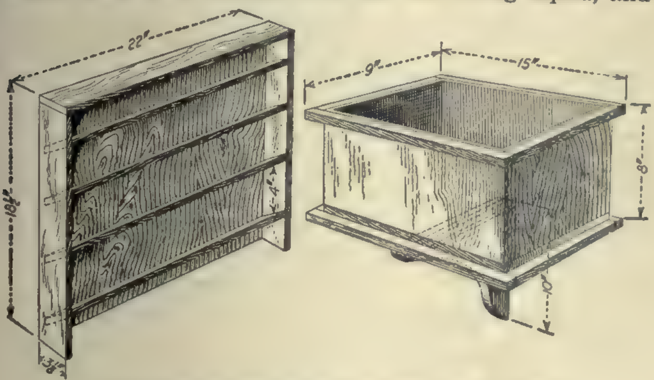
machines. The teeth were staggered, and the plugs were held up to the disk by hand.

The results were so satisfactory that a disk, Fig. 2, slightly smaller in diameter than the milling cutters and as wide as the slot with a little clearance, was made, and a large number of teeth were cut in it. Another tool, Fig. 3, was made for taking off the top burr. Since this time, disks with many teeth cut in them have been used for burring steel parts.

Goggle-Sterilizing Tank and Rack

By Joseph K. Long

Herewith are shown a tank and rack for sterilizing and drying goggles. Our workmen in the different shops are required to wear these safety goggles on various work, and a large number are provided. After being used, they are put into the sterilizing liquid, and



GOGGLE-STERILIZING TANK AND RACK

upon removal are placed on the drying rack, after which they are again ready for distributing to the men.

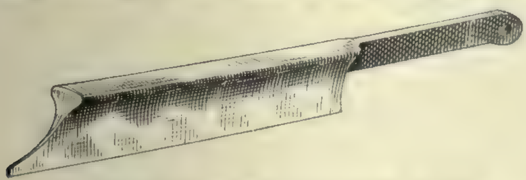
The tank is made of ¾-in. boards dimensioned as shown, is lined with zinc and has a hinged top. The drying rack is made mostly of wood, ⅜ in. thick, and has a top extending out from the back to the front to keep the dust from settling on the goggles.

A Straight-Edge for Gage Work, Etc.

By Gustav Kopsch

One of my fellow workmen certainly knows how to eliminate waste, and when I called his attention to the merit of his novelty, he asked me to pass it along, if I desired.

An old worn-out razor blade was ground and lapped perfectly straight and with a very slightly rounded



A STRAIGHT-EDGE FOR GAGE WORK

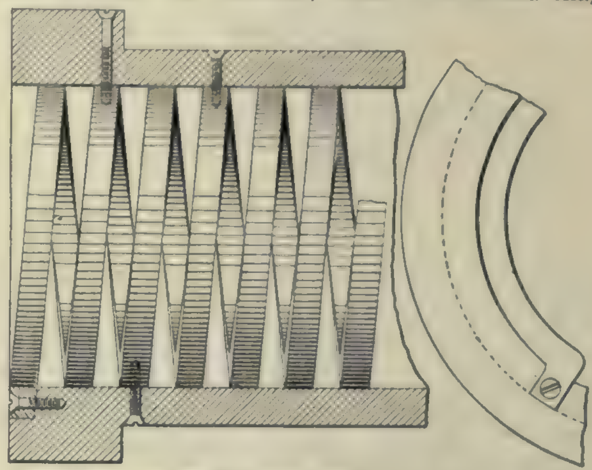
edge, almost sharp. This proved to be of excellent service as a knife straight-edge for fine gage work. The end of the blade formed a handy holder, and thus helped to eliminate any influence due to the heat of the hand. The other end of the blade was ground off as shown in the illustration, for reaching into corners of the work to be tested.

Putting a New Thread in a Stripped Nut

By William O. Kaiser

The illustration shows a steel nut, 6 in. in diameter and about ½ in. pitch, for a geared press. The thread was worn away so far that it stripped almost clean in the nut. Having only an 18-in. x 6-ft. engine lathe, and the thread on the stripped nut being of a pitch which nothing seemed to fit (probably metric measurement), I took the following way of putting in a new one:

I took square machine steel of a section, which fitted in the thread on the screw; annealed and filed it clean so that all scale was removed; rolled it to thread shape



THE WORK WITH NEW THREAD IN PLACE

on the screw; fitted it snug in the steel nut by reboring about $\frac{1}{32}$ larger than the outside diameter of the screw; bent the ends over at right angles, and fastened them to the nut with ¼-in. flat-head screws; and then brazed it with copper spelter.

I finished the job in about 18 hours. For brazing I used a clean charcoal fire of sufficient size and not too much copper spelter. When spelter was running I shut off the fire and turned the steel nut until it cooled so that the spelter would not settle on one side.

I had to take a light cut from the top of the thread on the screw for more clearance, but after lapping the nut to the screw and washing off all emery with coal oil, I had a first-class side fit on the thread which was the thing desired.

I think the accompanying illustration will make my method clear.

Bushing a Small Motor Bearing

Special Correspondence

A method of bushing a small motor bearing with a self-oiling, babbitt bushing is in use at the Wisconsin Electric Co. The babbitt bushing shown in Fig. 1 is made on the screw machine, from round bar. The recessed portion in the center is then wound with wicking to insure perfect lubrication of the finished bearing.

The motor housing in which this bushing is placed is chucked in a hand-screw machine as shown at *A*, Fig. 2, and the journal roughed out with the drill *B*, after which it is reamed and the flange of the housing faced and reamed with the tools in station *C* of the turret.

The machine is now stopped and one of the babbitt bushings with the oil wick in place, is slipped on a

stud arbor in the turret and forced into the reamed hole in the journal. It is roughed out with a drill and then bored with a boring bar. It is next reamed slightly undersize with reamer *D*.

These boring and reaming operations open the slot *A*,

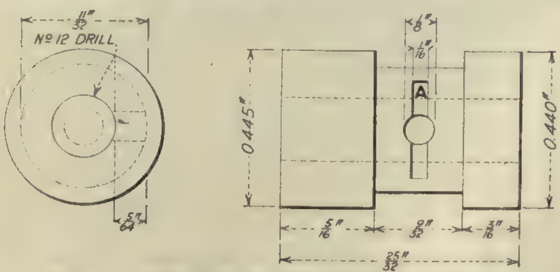


FIG. 1. DETAILS OF BEARING BUSHING

Fig. 1, and allow the wicking to come in direct contact with the motor shaft after assembling.

The tool *E*, Fig. 2, is a burnishing tool and is passed through the reamed bushing to condense the metal and

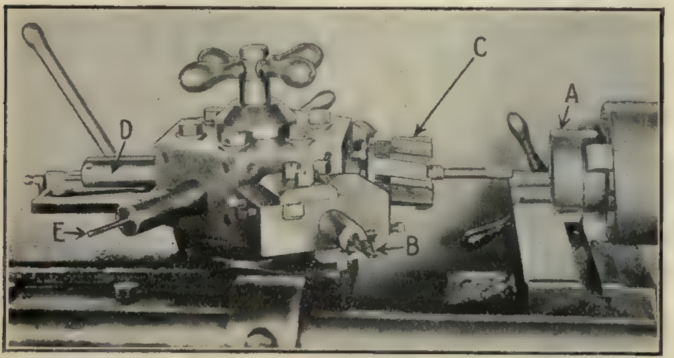


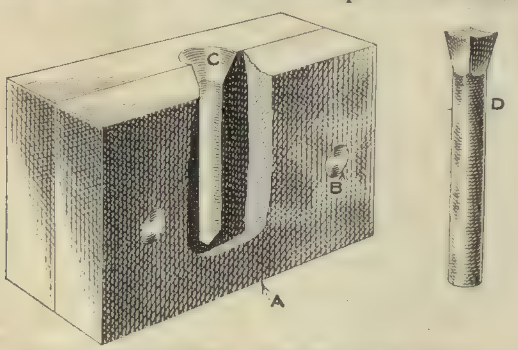
FIG. 2. MACHINING THE MOTOR BEARING AND BUSHING

bring the hole to size. It also puts a high finish on the bearing, which is quite essential in small, high-speed motors of this type which are used for vacuum cleaners, hair driers, and the like.

Making Drifts for Square Holes

By L. S. Watson

The article on page 777, Vol. 47, recalls a set of 1/4-in. punches made for punching square holes in toolholders for screw machines. I used two pieces of cold-rolled



DIE AND DRIFT BEFORE FINISHING

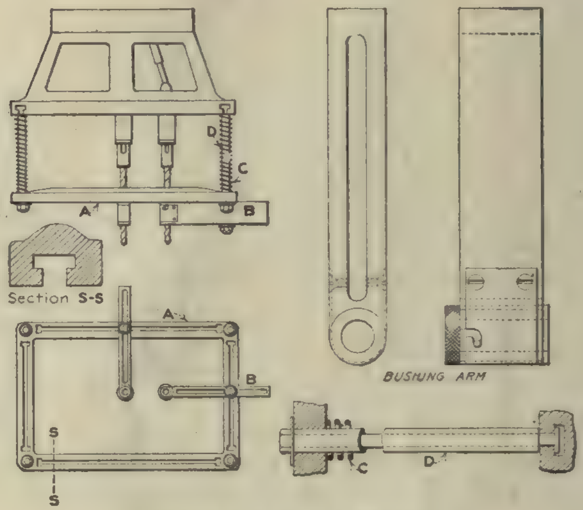
steel *A*, 1 x 3 x 4 in., and made a die as shown. Two 1/4-in. holes were drilled through these pieces to receive pins *B*, one of which was somewhat free. A 1/4-in. hole *C* was then drilled between the two blocks, this hole being 2½ in. deep and countersunk at its outer end as shown.

In making the punch, the die was held in a vise, and five pieces of drill rod heated on one end were placed in the die one at a time and upset large enough to allow for finishing and having the face concaved to obtain the cutting angle. The rods (one of which is shown at *D*) were then squared off on an abrasive wheel leaving about 0.015 for a finish grind. The ends were then ground on a small wheel to secure a good cutting edge. After the rough-grinding operation, the rods were tempered, straightened and finished on a surface-grinding machine with the magnetic chuck tilted to 2.5 deg. Three of the rods were ground off 0.025, 0.015, 0.008 in. respectively; and were consecutively numbered. The punches as made in the manner described stood up well, and they were turned out in considerably less time than would have been required to slot the dies and file all the punches.

A Universal Drill Jig for Multiple-Spindle Work

By W. Burr Bennett

Because of the universal characteristics of the multiple-spindle drilling machine, it is quite logical to apply a universal drilling jig. That is, one where the drill bushings may be easily set to the same positions as the drills. The illustration shows a multiple-spindle drill head arranged to use a jig of this sort. *A* is a cast-



DRILL JIG AND DETAILS

steel frame, slotted as shown at section *SS*. This frame is free to slide up and down on the four corner posts *D*, against the compression of the springs *C*. Bolted to the slots in the frame are the universal bushing arms *B*. Because of the slot in these arms and the slot in the frame, the bushing arms can be moved and locked in any position desired. The slip bushings are secured to the arm by a thin steel strap, which allow a position of minimum centers. A bayonet joint and a pin secure the slip bushings in place.

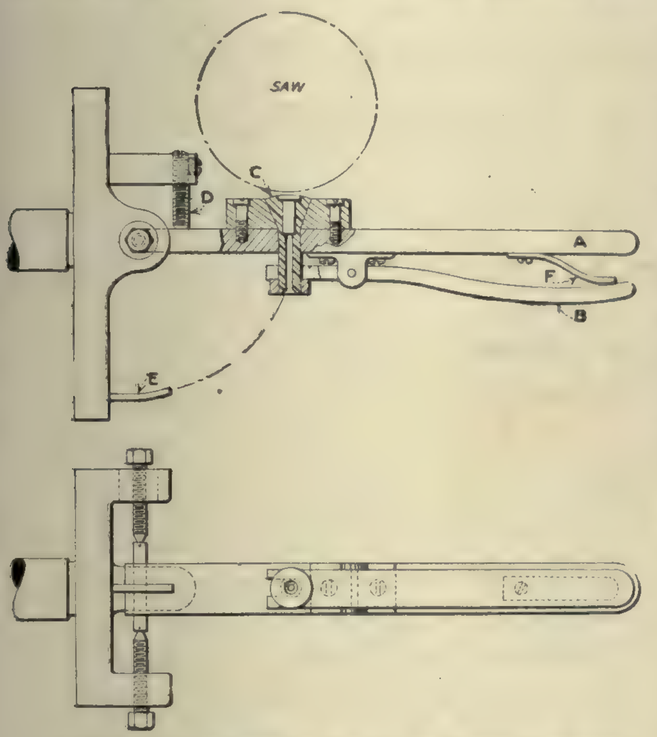
To use this jig some locating parallels are bolted to the table in order always to locate the work in the same position, and either the table is fed up or the head down (depending on the type of machine). As the drills enter the work, the frame with its arms moves up.

A Screw-Slotting Device

By Paul Hetenyi

We profited a great deal by using this handy and inexpensive device for slotting small machine screws in our shop. It can be attached to the toolpost of any small bench lathe, and once set anyone can operate it very rapidly.

It will be noted from the illustration that in pressing the handles A and B together with one hand, the split



A DEVICE FOR SLOTTING SMALL MACHINE SCREWS

taper C is closed on the screw to be slotted, and raising the handles brings the head of the screw against the saw. The depth of the slot can be regulated by adjusting the stop D. The steel spring pin E will knock the screw out of the collet when the handle is dropped down after finishing the slot. Spring F releases the chuck as soon as the handle is let loose. A chuck can be made for each desired screw diameter.

Tables of Angles for Dividing Circles and Laying Out Polygons

By H. J. Randall

In a certain issue of the *American Machinist*, page 1014, Vol. 47, appeared a table of angles for dividing circles, contributed by G. A. MacGregor. The writer begs to differ with Mr. MacGregor in his statement that this table is not included in most reference handbooks. If he will refer to pages 390 and 391 of the second edition, and pages 284 and 285 of the first edition of the "American Machinist Handbook," he will find a much more complete table, including not only the degrees of arc but length of chord for diameters from 1 to 12. This table also appears on pages 68 and 69 of "Machinery's Handbook," giving length of chords for diameters of circles from $\frac{1}{16}$ to 14 inclusive.

The First War-Time Automobile Show

No one would ever guess from the 18th annual Automobile Show that we were engaged in the greatest war of all time; and in a way, this is most disheartening, since it indicates that the majority of people do not as yet realize to the full extent what the war may mean to us. We appreciate fully, the importance of the industry, its marvelous increase, its effect on the machine-tool trade, the fact that it ranks preëminent as the best-developed and best-organized industry of the world; that has been fully demonstrated.

There were a few new cars in the show, and a few of those we knew have dropped out. For the first time in years the Stanley steamer was exhibited; doubtless because of the renewed interest in steam as a motor power on account of the advent of the Doble in last year's show. The Doble is now in more finished shape and looks less like an experiment, dividing honors with the Stanley. There is an appeal in the quietness, the flexibility and the reserve power of the steam engine as a motive power. It has all the flexibility of the magnetic drive and is particularly convenient in traffic, but unless the price of fuel which can be used in internal combustion engines goes considerably higher, there is little likelihood that steam will ever again become the choice of the majority.

There is a growing tendency toward valve in the head motors, and toward lighter cars. This means that less powerful motors can be used; and with a permanent increase in the price of fuel staring us in the face, all these are questions seriously to be considered. Wheel bases have been shortened in some cases, but this does not mean there is necessarily less room in the car. We are learning to utilize this wheel base to better advantage while retaining good riding qualities. Pressure lubrication is gaining ground and there are many refinements of design and construction which are making the American automobile more complete and more perfect in every day.

Fuel economy is being considered much more than ever before, and there is a tendency toward the satisfactory utilization of low-grade fuels. The hot-spot manifolds in evidence this year show the tendency. There is however, a growing belief that there is little use in devoting much time to the utilization of kerosene as this is likely to be much higher, but many of the lower grades of fuel are apparently the ones to consider.

Body lines are changing, and not always for the better. The adoption of the bevel-edge doors and sides, that a straight line from the radiator to the rear end may be secured, has become widespread. However, its general use does not make a car more beautiful, and many freely predict a return to the more pleasing curved edge in the near future. The use of closed bodies is increasing, and the sight of wind-blown, red-eyed and sunburned tourists may become a rarity.

The show was larger than ever before, occupying four floors of the Grand Central Palace. There were eighty exhibitions complete of automobiles and of accessories almost without number. These included devices for signaling from closed cars, nonglare headlights, piston rings, jacks and ignition apparatus, while the ever present tire problem received ample attention both in shoes and inner tubes of various kinds.

Help Save Our Boys—

MEN of the Machine-Building Industry in America, here is your opportunity! The lives of our boys in France are in your hands. You and you only can prevent large losses of life—losses which can be prevented by your full and immediate response to this appeal.

THE GOVERNMENT must have a large number of heavy machine tools at once. There is no time to have them built. They must be taken from such shops as already have them in use. There is no other way.

The Government asks you who have them to relinquish them for the present that our boys in France may have heavy artillery at the earliest possible moment. There is no alternative—the guns must be made, and they cannot be made without the machines which are now in your shops.

WE REALIZE the sacrifice this means to you. But what is any sacrifice we on this side can make, that compares in any way with the great sacrifice every boy makes who faces the foe "over there." This sacrifice of yours will save thousands of our boys' lives! Big guns mean much more than you realize.

Without heavy artillery to clear the way, to shatter the enemy's defenses, to drive such men as remain deep into the ground shelters, to make a veritable inferno of the region to be captured, the loss in life in the assaulting columns runs up to 40 and 60 per cent. With sufficient artillery preparation, with the front cleared by thousands of high-explosive shells which leave no stone unturned—which tear great craters in the fields and wipe out all traces of opposition—the loss is reduced to but 3 to 5 per cent.

When you think of the thousands of sorrowful homes, of the aching hearts that come with every casualty list, there is but one answer: the boys must have the guns and the Government must have the machinery for making them! You must supply it! There is no other way.

an Urgent Appeal to You

The machines needed are:

- **60 x 60 x 20-ft. planing machines.**
- **48 x 48 x 20-ft. planing machines.**
- **36 x 36 x 14-ft. planing machines.**
- **Nos. 4 and 5 plain milling machines.**
- **Nos. 4 and 5 vertical milling machines.**
- **30-in. x 20-ft. engine lathes.**
- **36-in. x 20-ft. engine lathes.**
- **4- and 5-ft. radial drilling machines.**
- **18 x 130-in. cylindrical grinding machines.**
- **10-ft. vertical boring mills.**
- **5-ft. vertical boring mills.**
- **6-in. floor type, horizontal boring and milling machines.**
- **4-in. floor type, horizontal boring and milling machines.**

THESE MACHINES are in your shops. The Government needs them at once to make heavy guns. The Government does not wish to commandeer a single machine and does not believe it will be necessary. It asks you to so rearrange your work that you can release as many of these machines as possible for ordnance work.

These machines will be bought at a fair price or you can arrange for their return after the war. This will be no opportunity for speculators or scalpers—the War Industries Board will see to that. The co-operation of reputable dealers is welcomed. Dealers can assist greatly by giving information as to where these machine tools can be found and putting them in condition to be of more use. You can assist in the same way—and this is a case for volunteer service—by offering your machines and offering them promptly, that there may be no further delays.

Let us look the situation squarely in the face. We must win. We cannot falter or turn back. A German victory and a German peace would take far more than your machine tools. It would leave little for years to come, save assets with which to pay indemnities. If you doubt it, think of the levies in every city in Belgium.

TO YOU, men of the machine-building industry, is given the opportunity of sacrifice and of service which will make huge returns—if not in dollars or dividends yet in the heartful gratitude of thousands of wives and mothers and daughters of the boys in France! You have the opportunity to save thousands of lives; by a prompt offering of these machines you can prevent hundreds from being crippled.

We know we do not ask in vain. The machine-building industry can be depended on to stand behind the country in every crisis. Its patriotism is big enough and broad enough for any sacrifice which will save our soldiers and insure victory.

Your opportunity for service has come. Which of these tools can you furnish **now**? Which in thirty days?

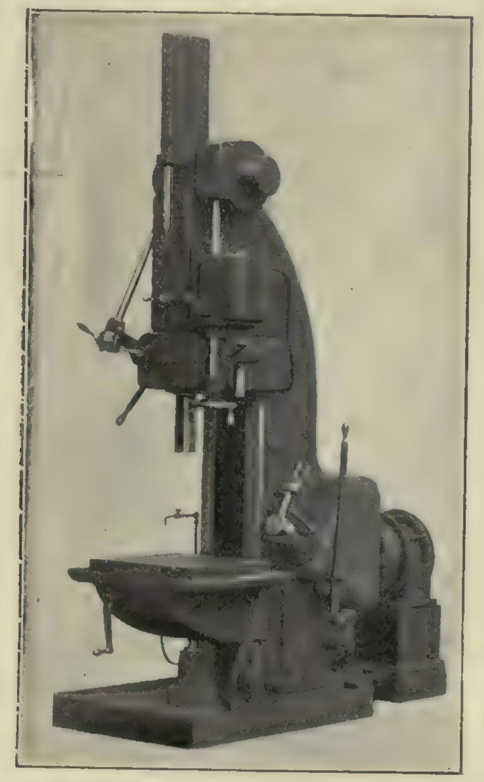
Write or wire the

MACHINE TOOL SECTION
of the
WAR INDUSTRIES BOARD
COUNCIL OF NATIONAL DEFENSE
Washington, D. C., and do it NOW.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Defiance 24-in. Drilling Machine No. 3

The Defiance Machine Works, Defiance, Ohio, has recently placed on the market a new heavy-duty, 24-in. drilling machine known as its No. 3. The machine will handle 3-in., high-speed drills in solid steel and is completely inclosed, which allows the use of a gravity oiling system. The oil reservoir is at the bottom of the hous-



DEFIANCE 24-IN. DRILLING MACHINE NO. 3

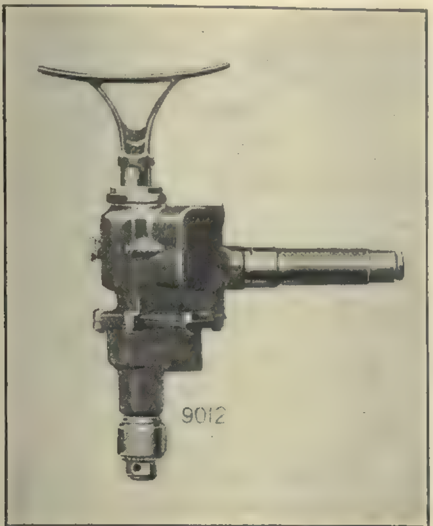
Capacity with high-speed drills in solid steel, 3 in.; length of power feed, 16 in.; diameter of spindle nose and drive, $3\frac{1}{2}$ in.; taper in spindle, Morse No. 5; diameter of spindle sleeve, $3\frac{1}{2}$ in.; rack in sleeve, 2 in. wide, 6 pitch; diameter of pinion shaft, 3 in.; width of helical gear for spindle drive, $2\frac{1}{2}$ in.; maximum distance spindle nose to top of table, 32 in.; working surface of plain table, 20 x 22 in.; working surface of compound table, $17\frac{1}{2}$ x 35 in.; longitudinal adjustment of compound table, 18 in.; cross adjustment of compound table, 9 in.; vertical adjustment of table, 15 in.; feed changes, four, 0.007, to 0.046 in. per spindle revolution; spindle speeds, eight; 51, 81, 102, 128, 162, 204, 253 and 408 r.p.m.; driving pulley, 22 x $5\frac{1}{4}$ in., 425 r.p.m.; horsepower required, 10; floor space, 38 x 66 in.; weight, 4570 lb.; floor space of motor-driven machine, 38 x 81 in.; weight of motor-driven machine, 5400 lb.

ing and the oil is pumped to the top of the spindle, whence it flows by gravity to all parts of the machine and back to the reservoir. The machine has a single pulley drive, and the various spindle speeds are obtained by means of two cones of hardened gears. These gear cones run idle except when meshed by a roll-in gear, operated by a lever within reach of the operator. Helical gears are used for the spindle drive, the thrust being taken on a thrust bearing. All slow-feed bearings are bronze bushed. The spindle is of forged, high-carbon steel, the thrust being carried on ball thrust-bearings. A box-type table is used and the elevating screw is placed somewhat nearer the column than the spindle; this construction allows boring bars to pass through the table. Four changes of feed are obtained by means of two cones of gears, and the power-feed stop is operated by a lever connected to a clutch on the worm shaft. It is operated by an adjustable stop rod connected to the top of the spindle, which it is claimed, eliminates the customary troubles. Rapid traverse of the spindle is obtained by means of a handle placed within reach of the operator. A complete system for circulating cutting compound is provided, the tank being located in the base. The pump has a relief valve allowing the flow of compound to be controlled by a single valve near the outlet. The drive is a unit located in the back of the housing and consists of two cones of four gears each which run idle except when in use. These cones are driven by back gears operated through a Johnson friction clutch located on the pulley shaft. The compound table consists of a special box-type bracket supporting the intermediate slide and the table. The table has three T-slots running lengthwise, and an oil groove. The screw for elevating this table is the same as that used for the plain table. When the compound table is furnished, it is necessary to use a higher column, if the same maximum distance from the nose of the spindle to the surface of the table is desired. A tapping attachment, which can be furnished as an extra, is an all-geared fixture located directly behind the main spindle-gear, and is operated by a lever connected to a jaw clutch between the forward and reverse gears. If desired, the machine can be equipped for a motor drive.

"Little David" Pneumatic Drill

The Ingersoll Rand Co., 11 Broadway, New York City, has added a new lightweight, high-power, nonreversible drill to its line of "Little David" pneumatic tools. Its capacity on reaming work is up to $\frac{5}{16}$ in., and on drilling work is up to $\frac{9}{16}$ in. The new drill is known as the No.

5, weighs 15 lb. and develops a free-spindle speed of 1000 r.p.m. The motor has four pistons, and by the removal of five capscrews the entire crankshaft assembly may be withdrawn in its entirety. The valve is of the rotary type and is gear driven. Ball bearings are used on the crankshaft while those on the connecting rods are



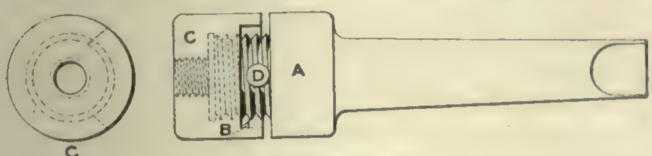
LIGHTWEIGHT PNEUMATIC DRILL

of the roller type. The machine may be furnished either with breast plate, spade handle or a telescoping feed screw. The length of feed by means of the feed screw is 2¼ in. at one setting. The over-all length of the machine with a drill chuck is 14⅝ in., and the distance from the side of the drill to the center of the drill spindle is 1½ in.

A Stud-Driver

By D. S. Mann

The stud-driver shown in the accompanying illustration has proved its worth through long-continued use. It is entirely automatic in action, and does not require the driving back of taper pins or other releasing arrangements. The shank *A* of the driver is provided with a coarse pitch thread *B* at the lower end onto which screws



A STUD-DRIVER

a cap *C*, an end view of which is shown. The end of this cap is tapped for the stud desired. Approximately 90 deg. of the cap are cut away, and a pin is screwed into the body of the driver at *D*, so that, when driving the stud, this pin will strike the edge of the cap, the end of the stud resting against the end of the driver. After being driven to the correct depth the spindle is reversed, and the coarse pitch thread immediately releases the body of the driver unscrewing from the cap until the pin strikes the other side, when the cap will unscrew. The minute the body of the driver has started to reverse, the stud is released. Caps for the various sizes of studs are provided, and it is only necessary to unscrew the small pin and slip these on.

Punch and Die for Experimental Work

By Joseph Calcaterra

The illustrations show a punch and die, which have saved me a great deal of time, trouble and expense in punching pieces for experimental work in sheet metal, and which I think will be of considerable interest.

The particular piece for which I designed the punch and die is shown at *A* in Fig. 1. It was to be one of the many pieces used for magnet laminations, and was to be punched from 0.010-in. pure sheet iron, but the die can easily be adjusted to punch the pieces shown at *B*, *C*, *D* and *E*.

Fig. 2 shows the die proper with the slot *F* made ⅝ in. wide; that is, as wide as the slots in *A*, Fig. 1, are long. *G* and *H*, Fig. 2, are the guides, and *I* is the stop. Guides *G* and *H* can be adjusted for any width of opening by sliding them one way or the other by means of the slots *J*, *K*, *L* and *M* on the studs *NOPQ*. The distance *R* that the guide *G* is adjusted, equals the depth of the slot to be punched in the piece. The distance from the inside edge of *G* to the inside edge of *H* gives the width of the part *S*, Fig. 1, and the distance that the stop *I*, Fig. 2, is adjusted by means of its slot *U* and stud gives the distance of the slot from the end distance *V*, Fig. 1.

In the particular piece in question, therefore, the distance *V*, Fig. 2, would be ¼ in.; the distance *W* would be 1 in. and the distance *R* or depth of slot would be

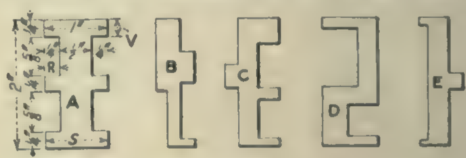


FIG. 1

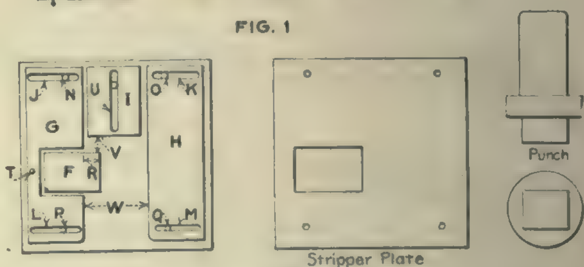


FIG. 2

FIGS. 1 AND 2. SAMPLES OF THE WORK AND THE PUNCH AND DIE USED

¼ in. The length of the slot would be ⅝ in. A separate operation would be needed for each slot to be punched. In a similar way the die could be adjusted to punch the parts shown in Fig. 1 at *B*, *C*, *D* and *E*. When the slot is longer than ⅝ in. it can be punched by just punching a ⅝-in. slot, and then adjusting the stop *I*, Fig. 2, and punching the rest of the slot. If it is desired to punch slots in the ends of the pieces, the guides can be shifted around; if the distances between studs, *MNOP* are made equal, and a stud is put at point *T* for the stop *I* to slide on, then slot *J* would slide on stud *Q* and *M* on *N* letting *K* remain on *O* and *L* on *P*. Although due to the many operations involved this would not be an efficient punch and die for production work. It is very handy for experimental work, and especially where pieces of the same form, but of different proportions are needed, and since it can be suited to a great variety of work.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Jan. 12, 1918—An interesting phase of our new artillery manufacturing enterprise is in the purchase of a large artillery proving ground at Aberdeen, Md. This is to occupy about 35 square miles, with a maximum length of 28 miles. Here are to be built the concrete gun bases for mounting the guns for testing purposes. These bases are designed to test guns of all calibers, including some in extremely large sizes, and utilizing much of the material heretofore located at the Sandy Hook proving ground.

The contract for clearing and developing this proving ground has been awarded, and the work is already well under way. All the material is being bought by the Government and the contractor is to be paid on a cost-plus basis. The work includes the rebuilding of the main road from the Aberdeen station to the proposed gun bases, a distance of nearly four miles. This necessitates railroad switches, new culverts and much work of the kind. While there will be many features in connection with this work which should not be published, we shall hope to have more details in the near future. It is a most encouraging sign that the work is already under way, even before the guns now being built are ready for test.

No Real Labor Shortage Yet

One of the most notable recent developments is the establishment of a United States Employment Office to meet the need of the various industries of the nation for workers of both sexes in the many lines of work belonging to war activities.

This promises to be the beginning of a very important service. What it really means is the very material enlargement of the United States employment service and its transfer from the Bureau of Immigration to the Department of Labor. The employment service as previously developed, included but 96 employment centers, and many of these were hardly worthy of the name. It was naturally impossible for these to handle with any degree of satisfaction the problem of properly distributing labor, even in times of peace; and it was utterly impossible for this organization to compete with the several thousand other agencies throughout the country.

The present difficulty in the large manufacturing centers is not so much an actual shortage of men as their improper distribution. While it is undoubtedly true that there is a real and distinct shortage of highly skilled mechanics, and that this has been made more acute by the failure of those in charge of the draft board to recognize the skilled mechanic's value to the country through its own industries, it does not furnish an altogether new problem, while it is one for which the industry as a whole is more or less to blame. Had we paid more attention to the systematic training of skilled men along various lines, there would not be the same shortage as now exists.

The main difficulty, however, is that of a surplus of general labor in some localities and a decided scarcity in others. This can be attributed both to a lack of proper distribution and to the unsettled conditions of the industry by which the excessive wages paid in some localities attract men from less favored districts, causing a high labor turnover which is detrimental to all concerned.

To some extent the manufacturers themselves are to blame for this condition. The more they complain about the shortage of labor, the more thoroughly it is impressed on the minds of the workmen that they are indispensable, and they very naturally hold out for the highest rate of wage to be obtained. No shop which has a stream of men constantly coming and going should complain of a shortage of labor. True, it may not be exactly the class of labor it would choose, but the more the complaints of shortage the more insistent will be the demand for increased wage and the more likely a man is to leave one position to try his luck at something else. The sooner we realize that as yet the main difficulty lies in the lack of distribution rather than in the actual shortage of men, the more we will appreciate the possibilities of this new employment service if it is carried out as we hope it may be.

There is no question but that a well organized net-work of employment offices, interested only in securing a proper distribution of labor, of preventing congestion at one point and actual shortage in some other locality, can do much to increase production in the various plants and in the many industries.

Some Possible Advantages

Such a net-work of employment agencies, each reporting to a central head in its district, and if necessary all of these districts reporting to a one head which is centrally located so far as the employing area is concerned, could do much to secure a proper distribution of labor, and be extremely beneficial in every way. These heads would act as clearing houses and could readily balance supply and demand to the advantage of all concerned.

It is easily conceivable that the time may come when

such an agency would be authorized to look into the condition of certain plants in which the labor turnover was unusually high, and recommend ways and means of remedying this waste, for excessive turnover, affects not only the individual plant involved but the whole community in which it is located, and in fact extends to a much wider radius. It is to be hoped after we are reasonably sure that labor is fairly well distributed, we shall know how much real shortage there is or is likely to be, and may then take what steps shall be necessary toward supplementing proper labor distribution by introducing women into the shop.

Another of the present difficulties which will be corrected to some extent at least, is that arising from the cost-plus shop which can now draw men from other equally important industries by the payment of almost any wage which may be necessary to secure them.

Uncertainty as to Machines Needed

A lamentable feature of the present crisis, which is not so much a criticism as a statement of fact, is an inability to anticipate the needs along different lines so as to prevent such interruptions as exist at present. Machine-tool builders are for the most part, extremely busy on orders for machines which are urgently needed. On the other hand there are builders of different classes of machine tools who are obliged to lay off men because no orders are forthcoming and because there is no intimation as to what size machine is likely to be needed when the great rush begins again. The laying off of men is particularly to be deplored in some cases, because it robs this branch of industry of a large amount of skill which has been acquired in this particular line, and which is of far greater value here than elsewhere. The manufacturer, however, does not feel safe in tying up his shop or his capital, in starting a lot of machines without knowing in the least what kind or size is likely to be needed.

While it would probably not be advisable to announce the kind of work which must be done, in advance of the preparation of the designs, even to those who build the machinery, there should be some way devised to let them know what sizes of machines are likely to be needed. This might well be a branch of the Priority Board—which could be informed in advance for example, that a large order for fuses was likely to be placed in the near future. Then this board could inform makers of machines which might enter into the construction of fuses, that they might have some ideas as to the sizes of machines to build.

Even this would not altogether solve the problem, since the contractor might have his own peculiar notions as to the machines he would buy for the work. But the time may come in our present emergency, when each builder may be directed as to the kind of a machine to build, and the contractor as to what he must use.

A Lack of Planning

Few of us yet realize the real man's-size job that we have undertaken, and even those who were supposed to wear preparedness as a middle name, have been at sea concerning much that needs to be done. It is one thing to blame Congress for not giving sufficient appropriations and quite another matter to know what to do with them when Congress suddenly loosens up the purse strings as it did at the last session. This put up to the powers-that-be, a much bigger job than they evidently realized, even after studying the European situation for nearly three years, and much of the delay has been due to building up organizations big enough to handle the new work, and to getting an idea as to just how big a job it really was. We all sympathize with the works-manager who cannot get his directors to give him sufficient funds to modernize his shop, but we do expect him to have some definite plans already to put into operation when the directors finally loosen up. When there is a failure to connect with opportunity we begin to wonder if the right man was running the shop.

There is no denying that the work to be done has assumed staggering proportions, the size far exceeding the business ever dreamed of a few years ago; billions of expenditures instead of hundred of thousands, and no organization which could handle it! No plan on which such a huge organization could be got together! And so much valuable time has been lost—just as it was in England until the old order of things gave way to the new, and business men were brought in to straighten out the tangles. How well they have been straightened out is shown by the fact that over four thousand shops in England are now making munitions, and that General Haig never wants for all the ammunition he needs for his big drives.

Changing Specifications and Orders

One of the great difficulties which is manifesting itself in several lines is the apparent inability of those in charge to realize how much a few changes in design can delay production and delay deliveries, to say nothing of increasing costs. Instead of utilizing the best available designs and ordering them in sufficient quantities to enable rapid and economical manufacture, orders for small lots are given, and in the meantime some individual with notions, proceeds to invent or design something new so as to have a standard design.

Every one realizes the desirability of having the very best of everything for our boys to fight with. No one wants to deter the best inventions from being perfected, and new designs from being worked out; but in the meantime, while these are being perfected and tried out, let us buy all that we can get of the very best devices now obtainable. It takes far more time than some of those in charge realize, to perfect a new device or design and get it into manufacture, and this should not be allowed to interfere in any way with the production of instruments which are needed at the present time.

The particular case in point has to do with the equipment of airplanes and those in charge seem determined to repeat the tactics of the machine-gun board. It is not a regular army officer either, but a reserve officer who is gumming the game at this time. It does not matter just where the man comes from or what his training, so long as it is not the proper training for the particular job in hand. It is another case of allowing a man with an inventive turn of mind to have charge of production. Every machine shop manager who is responsible for results, knows what happens when this sort of a man is placed in charge of getting out work or passing on it. This is particularly exasperating when they turn down the instruments which were built at their request a few months ago and which are still being used very satisfactorily by the Canadians and

others who are away past the theorizing stage, and who are sending machines to the front every day.

In this same connection it is interesting to note that the British have centralized the control of airplane compasses in the hands of the Navy, instead of having each branch of the service maintain a separate department with conflicting notions. All compasses must be passed by the Compass Observatory, which corresponds to our Naval Observatory at Washington. This centralization is further carried out by having all airplane compasses adjusted by men from this department, after being installed, and they are periodically inspected by men from the same department. Here is another place where we can probably take a leaf out of British experience to our advantage.

The priority question is becoming serious, and a new shuffling of the cards seems to be one of the next steps; for when every order that comes into a machine-builder's shop carries an A-1 priority certificate, it simply takes its place in the list of deliveries the same as usual, as if there were no priority certificates issued.

One plan which has been proposed by a leading machine builder is to divide the machine-tool division of the priority committee into several sections, each one in charge of a competent man, all to be under the supervision of such a man as George Merryweather, who is now at the head of this division. These divisions would include lathes, milling machines, boring machines, drilling machines, planing machines, etc. Each division would keep a record both of machines to be had and the capacity of every manufacturer in its class.

With this information available at all times it would be easier to apportion machines as needed, taking them from whatever source could furnish them with most facility, according to the quantity on hand and its nearness to the point of use. When a new shop was needed for special work, its equipment could be apportioned from among the machines in stock or in prospect, substituting other machines which could do the work, should that become necessary. This apportioning would have to be done by an expert in machine tools, such as now heads this department; and he might have to be a sort of machine tool dictator, but the result could not fail to be beneficial.

This would obviate one of the great troubles of the present, the tying up of high-grade special machines, with work which could be done equally well on very much cheaper and more easily obtainable machines. A case in point is where a Lucas precision boring machine, which is in demand from every quarter, was being used for drilling a lot of holes which could just as well have been done on any one of a dozen other drilling machines which were available.

Without supervision by a thoroughly competent man, the contractor on any job selects his own equipment, gets a priorty order for the machines, and in many cases keeps these machines away from shops which actually need them much more than he does. If we are to make the most of our resources, centralized control must extend to all such activities as can interfere with other sources of supply which are equally urgent. After taking over the railways we should be prepared for any other form of control which can possibly assist in coordinating the work of various branches of the same industry as well as different industries. In this way priority orders could be made more effective and delays in securing needed equipment could be lessened in many cases. Every delay makes peace more distant.

Personals

C. P. Coleman has been elected president of the Worthington Pump and Machinery Corp., 115 Broadway, New York City.

J. C. Broadnax has been appointed superintendent of the electric furnace department of the Watertown arsenal, Watertown, Mass.

A. N. Martin has resigned as industrial agent of the Baltimore & Ohio Railway Co. to take the position of general sales manager for the Fulflo Pump Co., Cincinnati, Ohio.

John F. Guider has resigned his position as superintendent of the Pierce-Arrow Motor Car Co., to become vice-president of manufacturing of the Cadillac Motor Car Co., Detroit, Michigan.

Richard P. Williams, special working inspector for the Brooklyn Rapid Transit Co., has severed his connections with that company and is now connected with the Lorain Steel Co., Johnstown, Pennsylvania.

E. F. Lake has moved to Chicago and taken the position of assistant superintendent of the Rich Tool Co., which is now manufacturing one-piece valves of high-speed steel for automobile and airplane engines.

George A. Lautz, who for 27 years has been general manager of the Niagara Machine and Tool Works, Buffalo, N. Y., and its president for about 10 years, will discontinue his active and financial connection with the firm about the end of February.

J. A. Camm, vice president of the Cleveland Milling Machine Co., Cleveland, Ohio, has severed his connection with that company and has taken a similar position with the Davie Tool Co., of the same city. He has disposed of his interests in the former company to **F. S. Shields**.

James McNaughton has been made president of the Eddystone Munitions Co., Eddystone, Penn. **Capt. Walter Wilhelm** has become vice president and **C. J. Schlacks** has been made chairman of the board of directors. Mr. Schlacks still retains his position as general manager of the Remington Arms Co.

Business Items

The Welsmore Manufacturing Co., Inc., is now located in its new factory at 302-304 Congress St., East, Detroit, Mich.

The Champion Tool Works Co., Cincinnati, Ohio, emphatically denies the report recently published, that it had been sold to another company. The president, H. W. Kreuzberg, states that the company is still doing business as usual.

The Joseph Pollak Tool and Stamping Co. has recently moved its factory and office to 76 Freeport St., Boston, Mass., Dorchester district. The company will have a sales office at 201 Devonshire St., Boston, Mass., in charge of W. B. Arnold.

The Boston Scale and Machine Co., Boston, Mass., asks the indulgence of its friends in regard to delayed deliveries, as its factory was destroyed by fire on Dec. 23. All orders will be filled in due course with as little loss of time as possible.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Feb. 7, 8 and 9. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month Oscar S. Teale, secretary, 35 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Machine, Power Feed No. 1

Wilmarth & Morman Co., Grand Rapids, Mich.

"American Machinist," Jan. 3, 1918

This company is now supplying its No. 1 universal cutter- and tool-grinding machine with an automatic feed mechanism, so arranged that it can be attached with very little work, to hand-feed machines of this type already in use. The table is driven by means of a rack and pinion mechanism, the pinion shaft being so arranged as to allow the disengagement of an idler gear. This makes it possible entirely to disengage the power feed in case hand feed is desired. The gears run in a bath of oil. The eight feed changes are 12, 16, 22, 28, 34, 41, 61 and 75 in. per minute

Furnaces, Recuperative Oven, Series H

Tate-Jones & Co., Inc., Pittsburgh, Penn.

"American Machinist," Jan. 3, 1918

Designed for temperature ranges of from 1600 to 2400 deg. F. The burners operate on the blast system, the gas and air being mixed at some distance from the point of combustion. Provision is made for inserting a thermocouple through the firebrick at the rear, the couple lying in a recess in the hearth. The furnace is of such height that a man from 5 to 6 ft. tall standing at a working distance can see any work. Made in 8 sizes from 5 x 3 x 10 in. to 10 x 5 x 25 in., with weights of from 950 to 1435 lb., operates on gas pressures from 4 oz. to 2½ lb. and air pressures from 1½ to 2½ lb.

Torch, "Gaselectric"

Naab Manufacturing Co., 1384 Hird St., Cleveland, Ohio

"American Machinist," Dec. 27, 1917

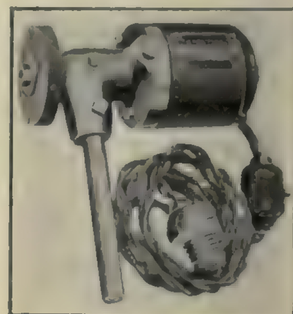
The torch is entirely self-contained, an electric pressure fan being attached directly to the burner in order to eliminate all air leakage. The flame may be adjusted to any length from 3 to 24 in., and the temperatures attained are up to 2500 deg. F. When operating at maximum capacity the gas consumption is 180 cu.ft. per hour, and the electric consumption is 80 watts per hour. A universal-type motor is used, being adapted for either direct or alternating current. The torch can be located at any height or angle on a supporting standard and the complete outfit weighs 23 lb.

Truing Device for Grinding Wheels

Precision Truing Device Co., 519 Main St., Cincinnati, Ohio

"American Machinist," Jan. 10, 1918

This device consists of a small wheel of hard abradent driven by an electric motor at an approximate peripheral speed of 8000 ft. per min. in the opposite direction to that of the wheel to be trued. The motor is series-wound for either direct or alternating current. It is claimed that this mechanism not only trues grinding wheels at a much smaller cost than is possible where diamonds are used, but that wheels which are sharpened with it hold their cutting edge longer. It is also claimed that the device adds to the life of the grinding wheels

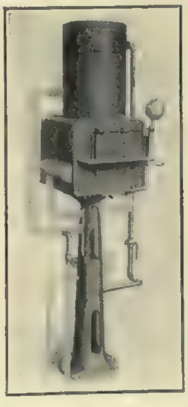


Furnaces, Recuperative Oven, Series A

Tate-Jones & Co., Inc., Pittsburgh, Penn.

"American Machinist," Jan. 3, 1918

Designed for temperature ranges of from 900 to 1600 deg. F. The burners operate on the blast system, the gas and air being mixed at some distance from the point of combustion. Provision is made for inserting a thermocouple through the firebrick at the rear, the couple lying in a recess in the hearth. The furnace is of such height that a man from 5 to 6 ft. tall standing at a working distance can see any work. Made in 11 sizes from 6 x 4 x 12 in. to 12 x 6 x 36 in., with weights of from 850 to 1440 lb. Operates on gas pressures from 4 oz. to 2½ lb. and on air pressures from 1½ to 2½ lb.



Truck, Elevating "Jacklift" Type K

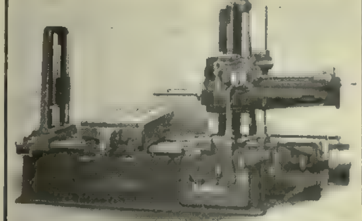
Lewis Shepard Co., 48 Binford St., Boston, Mass.

"American Machinist," Jan. 10, 1918

The capacity of the truck is 8000 lb., and the features claimed are higher, easier, vertical lift and free lifting handle. The maximum lift is 3 in., and the lifting ratio is such that one man can elevate the maximum load. Ten models are made, five having 7-in. wheels and five 10-in. wheels

Boring Machine, Horizontal No. 0

Giddings & Lewis Manufacturing Co., Fond du Lac, Wis.

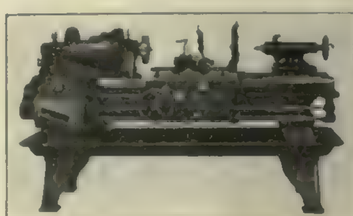


"American Machinist," Jan. 3, 1918

This company has redesigned the machine formerly manufactured by the Fosdick Machine Tool Co., Cincinnati, Ohio. Many of the details as well as several minor points have been changed. Diameter of spindle, 3⅛ in.; horizontal spindle traverse, 26 in.; vertical travel on column, 25½ in.; size of platen, 24 x 50 in.; longitudinal travel, 32 in.; cross travel, 30 in.; weight, 9500 lb.

Lathe, "Sundstrand," 16-In.

Rockford Tool Co., Rockford, Ill.



"American Machinist," Jan. 10, 1918

Swing over bed, 16⅞ in.; swing over carriage, 9⅞ in.; distance between centers, 6 ft. bed, 32 in.; front bearing, 2¾ x 5½ in.; rear bearing, 2⅜ x 3⅞ in.; hole through spindle, 1⅞ in., Morse taper No. 4; ratio of back gears, 10⅞ to 1; toolpost takes ⅞ x 1½-in. tool; length of carriage on bed, 24 in.; weight, 6-ft. bed, approximately, 2800 lb.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Jan. 11, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$23.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia................	33.75	33.75	30.00
*No. 2, Valley......................	33.95	33.00	31.00
No. 2, Southern Cincinnati...........	35.90	35.00	25.90
Basic, Eastern Pennsylvania..........	33.95	30.00	30.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Jan. 11, 1918	One Month Ago	One Year Ago	Jan. 11, 1918	One Year Ago	Jan. 11, 1918	One Year Ago
Structural shapes ...	$4.20	$3.95	$3.75	$4–4.04	$3.85	$4.20	$3.75
Soft steel bars......	4.10	3.85	3.75	4–4.04	3.85	4.10	3.85
Soft steel bar shapes.	4.10	3.85	3.75	4.14	3.85	4.10	3.75
Plats, ¼ to 1 in. thick	4.45	4.75	4.75	4.39	4.50	4.35	4.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Jan. 11, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York..................	4.70	3.75
Warehouse, Cleveland	3.98½	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Jan. 11, 1918	One Month Ago	One Year Ago	Jan. 11, 1918	One Year Ago	Jan. 11, 1918	One Year Ago
*No. 28 black......	5.00	6.45	6.45	5.50	6.45	5.50	6.45	5.00
*No. 26 black......	4.90	6.35	6.35	5.40	6.35	5.40	6.35	4.90
*Nos. 22 and 24 black	4.85	6.30	6.30	5.35	6.30	5.35	6.30	4.85
Nos. 18 and 26 black	4.80	6.25	6.25	5.30	6.25	5.30	6.25	4.80
No. 16 blue annealed.	4.45	5.65	5.65	4.85	5.65	4.95	5.65	4.70
No. 14 blue annealed.	4.35	5.55	5.55	4.75	5.55	4.85	5.55	4.60
No. 10 blue annealed.	4.25	5.45	5.45	4.65	5.45	4.75	5.45	4.50
*No. 28 galvanized..	6.25	7.70	7.70	7.50	7.70	7.00	7.70	7.25
*No. 26 galvannzed..	5.95	7.40	7.40	7.20	7.40	6.70	7.40	6.95
No. 24 galvanized...	5.80	7.25	7.25	7.05	7.25	6.55	7.25	6.80

*For painted corrugated sheets add 25c. per 100 lb.; for galvanized corrugated add 5c.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Jan. 11, 1918	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Jan. 11, 1918	One Year Ago
New York	$15.00	$8.00
Cleveland	15.30	7.50
Chicago	15.00	6.00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
⅝, $\frac{11}{32}$, $\frac{5}{16}$, ¼, $\frac{7}{32}$, $\frac{9}{16}$	21.00@30.00
No. 8, $\frac{3}{32}$ and No. 10	
⅛	
No. 12	
$\frac{3}{32}$, No. 14 and $\frac{1}{16}$..	
No. 18	
No. 20	

*Very scarce.

Cast-Iron Welding Rods	
$\frac{3}{16}$ by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire	
⅛	33.00
$\frac{5}{32}$	30.00
$\frac{9}{16}$	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Jan. 11, 1918	Cleveland Jan. 11, 1918	Chicago Jan. 11, 1918
Tire	4.10	5.00	4.10
Toe calk	5.70	5.50	4.35
Openhearth spring steel...	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	14.00	11.25	12.00
Coppered bessemer rods....	9.00	....	7.00
Hoop steel	4.95	....	4.95
Cold-rolled strip steel.....	9.00	....	8.50
Floor plates	6.19½	....	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel: Inches	Black	Galvanized	Iron: Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD. EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			
LAP WELD. EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4.......	29%	17%
4½ to 6......	44%	32½%	4½ to 6.......	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings. Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Jan. 11, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	30.00
Tin, in 5-ton lots....................	85.00	74.00	42.88
Lead	6.50	7.25	7.50
Lead	6.70	7.25	7.50

*Government price.

ST. LOUIS

Lead	6.55	7.13	7.33
Spelter	7.75	7.63	9.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Jan. 11, 1918	One Month Ago	One Year Ago	Jan. 11, 1918	One Year Ago	Jan. 11, 1918	One Year Ago
Copper sheets, base.	31.00–33.50	35–37	41.00	32.50	44.00	32–33	42.00
Copper wire (carload lots)	32.00	36.00	36.00	28.50	44.00	31.50	36.50
Brass pipe, base...	36.50	38.50	47.50	38.00	52.00	39.00	46.50
Brass sheets	30.75	35.75	45.50	30.00	47.00	31.50	44.00
Solder ½ and ½ (case lots)	48.00	40.50	27.50	43.25	28.25	44.00	28.25

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Jan. 11, 1918	One Year Ago
Mill	$25.00	$42.00
New York	30.00	45.50
Cleveland	34.00	42.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.. 19.00

	In Casks		Broken Lots	
	Jan. 11, 1918	One Year Ago	Jan. 11, 1918	One Year Ago
Cleveland	21.00	23.00	21.25	23.25
ew York	20.00	22.00	20.50	23.00
Cleveland	21.00	22.50	22.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Jan. 11, 1918	One Year Ago
New York	14.75	15.00
Cleveland	17.75	16.75
Chicago	16.00	15.75

Making TYPEWRITER PARTS

by
M. E. Hoag

I—Milling and Grinding Fixtures

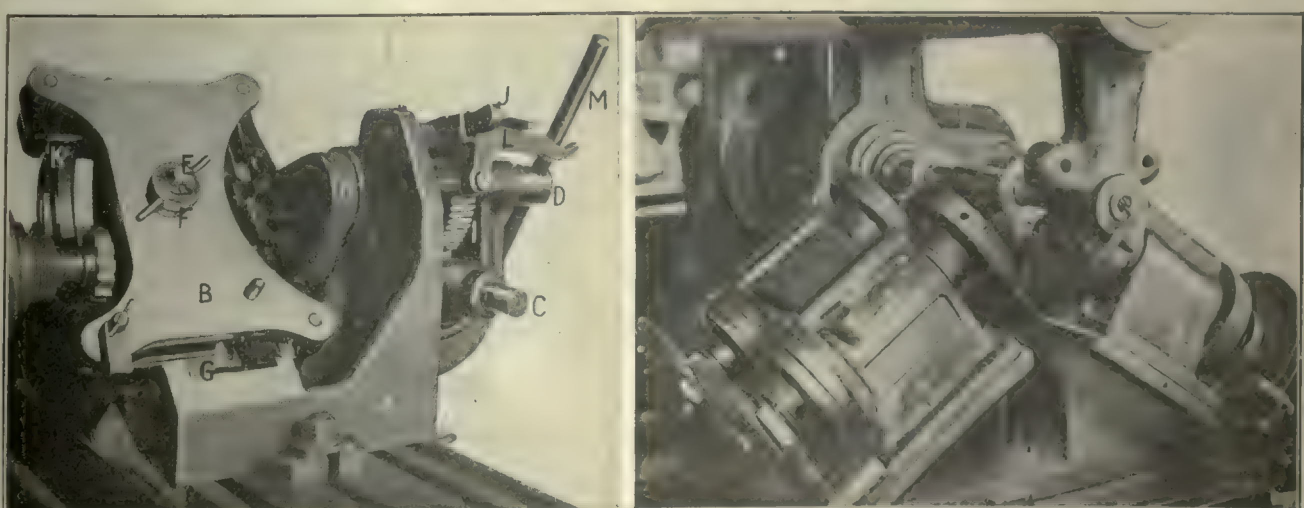
The "American Machinist" has from time to time published articles dealing with the manufacture of typewriters and adding machines. This work is so varied in the different factories that it is almost an endless subject, and while much of it is almost identical, the different methods, tools, dies, etc., used in obtaining the desired results in many cases show great skill both in design and execution. It is some of these unusually clever devices which are in use at the Woodstock Typewriter Co.'s factory at Woodstock, Ill., that have been selected for this series of articles.

IN THE front of the typewriter-frame base there is a semicircular recess which is generally padded with felt or other material, and on which the type end of the typebar rests. The location of this rest is quite important, otherwise, the distance the different type have to travel will not be the same and a variation in the keystroke will result. To machine this recess, or typebar rest, the milling fixture shown in Fig. 1, was built.

The fixture consists of three primary parts: the base *A*, which is keyed and bolted to the milling-machine table; the body *B*, which is a locating jig for the part being machined and is supported by and rotates in the base *A;* and the driving mechanism *CD*, which is actuated by a sprocket on the opposite end of the worm shaft *C*, and driven by a chain and sprocket on the milling-machine feed.

The body of the fixture has suitable locating devices and the work is held in place by the cover, which in turn has certain locating pins and is clamped by the stud *E*, and the bushing *F*, on the top of which are two eccentric bands that engage the crosspin in *E*. The body *B* is supported by a grooved and gibbed way as seen at *G*, and by a shaft which passes through the base at *H*, and on its outer end carries the bronze worm *I*, which meshes with the worm shaft *C*. The worm shaft *C* is pivoted in such a manner that it can be disengaged from the worm shaft by releasing the levver *J*.

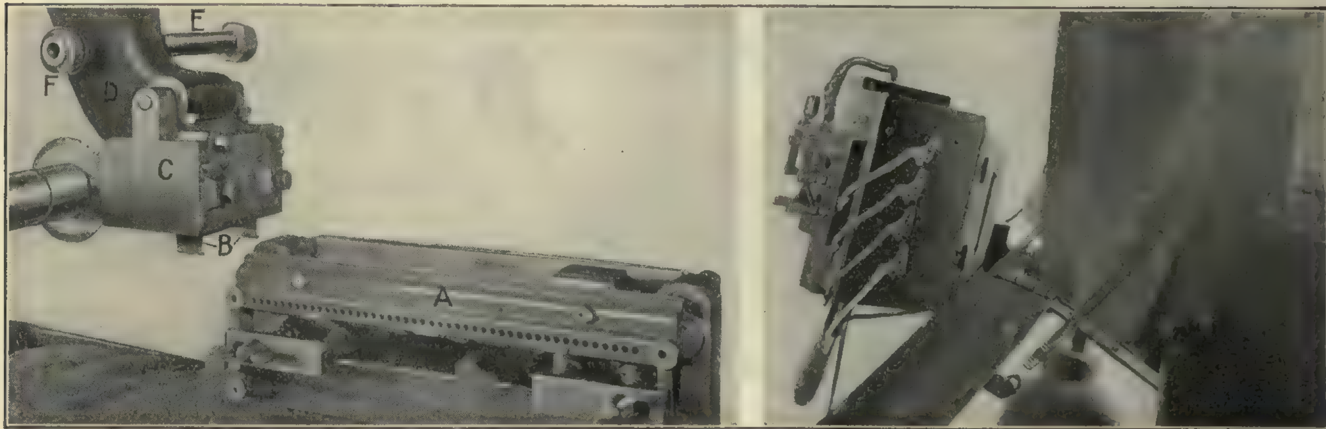
To operate the fixture, the table is slightly lowered, the work clamped in place with the fixture turned so the cutter will start the cut at *K*. The worm and worm gear being disengaged, the table is raised until the cutter has reached the proper depth of cut. The worm and gear are now engaged, the latch *L*, engaging the lever *J*,



FIGS. 1 AND 2. SPECIAL MILLING FIXTURES

and holding it in place until the end of the cut is reached when it is disengaged by the handle *M*, striking the latch *L*, so that the cut is stopped at the proper time.

After dropping the carriage and unloading the fixture, it is returned to starting position by turning it back with the handle *M*.



FIGS. 3 AND 5. MILLING, BROACHING AND GRINDING OPERATIONS

The slotting of the segments or parts in which the typebars are pivoted is very exacting, for they must be properly spaced, and of exact width; otherwise, the type will not strike the platen at the right point and will be either too loose, or will bind and stick and cause trouble.

The quadruple indexing feature for handling eight segments at once is shown in Fig. 2. Each indexing head holds two segments which are located by pins and are held in place by threaded studs with nuts and split washers.

The index plates are notched for the exact number of divisions required in the segments so that it is impossible for the workman to lose his count and make too many cuts.

To load this fixture the milling-machine table is lowered, and after placing and clamping the work in place it is fed up against the cutters, then lowered, the fixtures indexed and again fed to the cutters.

On account of the weight of this fixture there might possibly be some danger of the nut on the feed screw stripping, in which case there would be a considerable smash up. To guard against such an accident, a heavy positive stop is placed under the table so that it is impossible for it to drop more than a few inches. The fixtures here shown were built by the Brown & Sharpe Mfg. Co.

The key-lever subframes, one of which is shown at *A*, Fig. 3, have narrow slots milled their full length as shown in the illustration. In order to retain a wire rod which is slightly larger in diameter than the width of the slot, it becomes necessary to enlarge this milled slot at the bottom.

This part of the operation is done with the two round broaches *B*, which are clamped and held in the hinged holder *C*, which is supported by the arm *D*. The rod *E*, is screwed into the milling-machine body and held with a locknut as shown. Knurled nuts *F* on this rod, engage spots on the arm *D*, and serve to give the broaching fixture very fine lateral adjustment independent of the position of the cutters and the pieces being machined up.

To operate, the milling-machine table is run to the left and the fixture loaded with two subframes. The hinged broach holder is raised up out of the way until the saws have completed their work, after which the table is run out to the position shown in the illustration and the broach holder is brought down. The table is then run back to starting position by hand, the broaches doing their work on the return of the carriage, thus handling two operations on one machine with one setup.

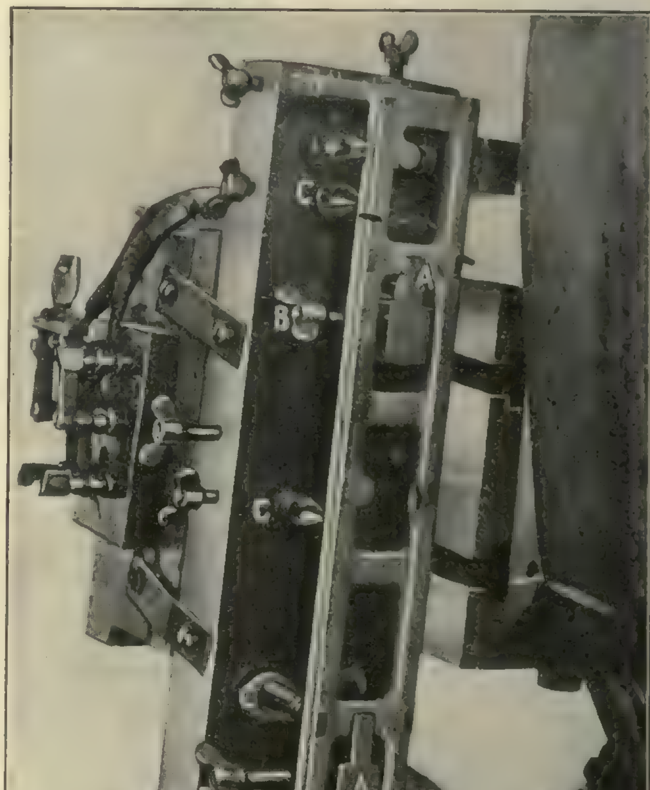


FIG. 4. MAGNETIC CHUCK ON A DISK-GRINDING MACHINE

A great deal of the work in this factory is done on Besley grinding machines of the ring-wheel type, the work being held on specially constructed Walker magnetic chucks as shown in Figs. 4 and 5.

The chuck or fixture shown in Fig. 4 is for holding the carriage frame while the several spots are ground. The fingers *A*, are pivoted and held by springs so as to secure an even tension on the work which is dropped into position behind them. The wing nuts *B*, lock these fingers when the work is in place and a number of magnetic studs *C*, aid in holding the work in position. The whole fixture is mounted on a swinging head which passes the work back and forth across the wheel.

Each machine operator is supplied with a surface plate on a stand adjustable for height, so that it can be raised and lowered to meet the level of his eyes. Any inequality in the work will permit the light to pass.

The body of a typebar is slightly thicker than the part which enters the slots in the segments, and the fit of these parts must be very close, so for this reason very small limits are allowed on the thickness.

One of the magnetic chucks for holding the typebar while grinding to thickness is shown in Fig. 5, and hardly needs description. The face of the chuck is recessed to receive the larger portion of the typebars, four of which are ground at once as shown in the illustration. After grinding on one side the bars are placed in another chuck and the opposite side ground in the same manner.

(To Be Continued)

Screw-Thread Tolerances For Munitions

SPECIAL CORRESPONDENCE

This article deals with tolerances of U. S. S. form of screw threads as established by the Ordnance Department for the manufacture of artillery ammunition, trench warfare material and for gun parts. Practically everything now designed is based on "medium fits." In artillery ammunition where parts function but once, it would be absurd to require such fits as would be necessary on machinery subjected to vibration and wear, and it would limit production.

FIG. 1 illustrates the condition of the neutral space between the assembled members of a complete couple comprising male and female threads, when the male member or screw and the female member or nut are respectively at the maximum and minimum sizes allowed by the tolerances established by the Ordnance Department.

The screw at its maximum size, is the base from which all dimensions have been computed. All tolerances applied to diameters of the different thread elements of this member are minus (—) while tolerances applied to corresponding diameters of the nut are plus (+). the application of such class of tolerances as has been selected to suit the use and conditions of the part under consideration.

Fig. 3 shows the dimensions and tolerances of a nut which is to be a medium fit on a screw of the dimensions

TABLE I. TOLERANCES FOR CLOSE FITS

No. of Threads Per Inch	Tolerances on Screws D Full Dia.	E Effect. Dia.	K Core Dia.	Neutral Space Between Max. Screw and Min. Nut	Tolerances on Nuts D′ Full Dia.	E′ Effect. Dia.	K′ Core Dia.	Minimum Per Cent. Strength (Approx.)
4–6	+0.000 —0.008	+0.000 —0.008	+0.000 —0.025	0.008	—0.000 +0.025	—0.000 +0.008	—0.000 +0.008	87
7–10	+0.000 —0.006	+0.000 —0.006	+0.000 —0.016	0.006	—0.000 +0.016	—0.000 +0.006	—0.000 +0.006	84
11–18	+0.000 —0.005	+0.000 —0.005	+0.000 —0.010	0.005	—0.000 +0.010	—0.000 +0.005	—0.000 +0.005	76
20–28	+0.000 —0.004	+0.000 —0.004	+0.000 —0.008	0.004	—0.000 +0.008	—0.000 +0.004	—0.000 +0.004	70
30–40	+0.000 —0.003	+0.000 —0.003	+0.000 —0.006	0.003	—0.000 +0.006	—0.000 +0.003	—0.000 +0.003	68
44–56	+0.000 —0.002	+0.000 —0.002	+0.000 —0.004	0.002	—0.000 +0.004	—0.000 +0.002	—0.000 +0.002	70
64–80	+0.000 —0.0015	+0.000 —0.0015	+0.000 —0.003	0.001	—0.000 +0.003	—0.000 +0.0015	—0.000 +0.0015	70

and tolerances as shown in Fig. 2. The minimum diameters of the thread elements in the nut were found by adding the amount of the neutral space between the members, to the corresponding dimensions of a screw of maximum size. The amount of this neutral space is

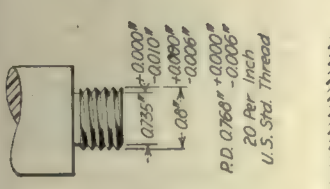


FIG. 2

All Diameters of the Maximum Male Thread, or Basic Size, are to be Expressed to the nearest Thousandth of an Inch

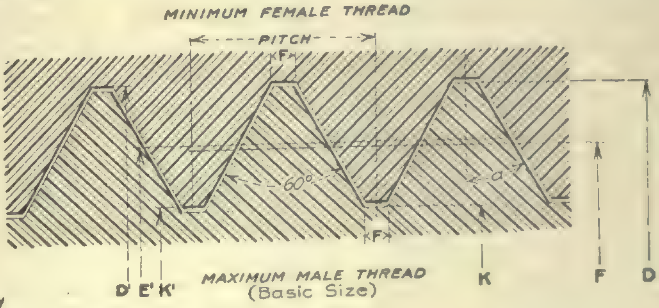


FIG. 1

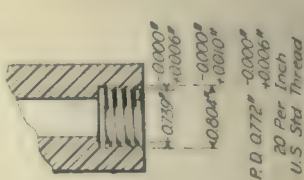


FIG. 3

FIGS. 1 TO 3. SCREW-THREAD TOLERANCES

Fig. 1—Neutral space between threaded members. Fig. 2—Dimensions and tolerances on drawing of a screw. Fig. 3—Dimensions and tolerances on drawing of a nut

This makes allowance for the wear that will necessarily take place in all internal threading tools which are non-adjustable.

Fig. 2 illustrates the proper method for dimensioning a drawing of a part to be externally threaded, and shows of course determined entirely by the grade or class of fit desired. All detail drawings of parts to be threaded, should be made in accordance with the methods shown in Figs. 2 and 3.

By reference to the tables I, II and III, it will be seen

that tolerances have been determined for three classes or grades of fits; namely, close, medium and loose.

The class of tolerance to be applied to any nut and screw must depend entirely on the function of the parts. If a matter of strength is the principal thing sought for in design, then considerable attention should be paid to the last column in the tables. This column shows the approximate, minimum percentage of strength of a full thread of the various dimensions given, and will be found of great interest to the designer of threaded parts.

TABLE IV. U. S. STANDARD SCREW-THREAD DIMENSIONS

Coarse Threads

No. of Threads per Inch	h Single Depth	2 h Double Depth	Width of Flat		Pitch
4	0.1624	0.3248	0.0312	0.02702	0.2500
5	0.1299	0.2598	0.0250	0.02165	0.2000
6	0.1083	0.2165	0.0208	0.01801	0.1667
7	0.0928	0.1856	0.0179	0.01550	0.1430
8	0.0812	0.1624	0.0156	0.01351	0.1250
9	0.0722	0.1443	0.0139	0.01204	0.1111
10	0.0650	0.1299	0.0125	0.01082	0.1000
11	0.0590	0.1181	0.0114	0.00987	0.0909
12	0.0541	0.1083	0.0104	0.00900	0.0833
13	0.0500	0.0999	0.0096	0.00831	0.0769
14	0.0464	0.0928	0.0089	0.00770	0.0714
16	0.0406	0.0812	0.0078	0.00675	0.0625
18	0.0361	0.0722	0.0069	0.00597	0.0556

Fine Threads

No. of Threads per Inch	h Single Depth	2 h Double Depth	Width of Flat		Pitch
20	0.0325	0.0650	0.0062	0.00537	0.0500
22	0.0295	0.0590	0.0057	0.00493	0.0454
24	0.0271	0.0541	0.0052	0.00456	0.0417
28	0.0232	0.0464	0.0045	0.00389	0.0357
30	0.0217	0.0433	0.0042	0.00363	0.0333
32	0.0203	0.0406	0.0039	0.00337	0.0312
36	0.0180	0.0361	0.0035	0.00303	0.0278
40	0.0162	0.0325	0.0031	0.00268	0.0250
44	0.0148	0.0295	0.0028	0.00242	0.0227
48	0.0135	0.0271	0.0026	0.00225	0.0208
56	0.0116	0.0232	0.0022	0.00190	0.0179
64	0.0101	0.0203	0.0020	0.00173	0.0156
72	0.0090	0.0180	0.0017	0.00147	0.0139
80	0.0081	0.0162	0.0016	0.00138	0.0125

The three classes of fits as set forth in these tables will practically cover all requirements in the manufacture of munitions, and it will be necessary only for the designer to determine the class of accuracy best suited to the conditions to be met; having settled this point all the necessary data can quickly be found in the tables.

TABLE II. TOLERANCES FOR MEDIUM FITS

No. of Threads Per Inch	Tolerances on Screws D Full Dia.	E Effect. Dia.	K Core Dia.	Neutral Space Between Max. Screw and Min. Nut	Tolerances on Nuts D′ Full Dia.	E′ Effect. Dia.	K′ Core Dia.	Minimum Per Cent. Strength (Approx.)
4–6	+0.000 −0.016	+0.000 −0.016	+0.000 −0.035	0.008	−0.000 +0.035	−0.000 +0.016	−0.000 +0.016	78
7–10	+0.000 −0.012	+0.000 −0.012	+0.000 −0.022	0.006	−0.000 +0.022	−0.000 +0.012	−0.000 +0.012	72
11–18	+0.000 −0.008	+0.000 −0.008	+0.000 −0.014	0.005	−0.000 +0.014	−0.000 +0.008	−0.000 +0.008	65
20–28	+0.000 −0.006	+0.000 −0.006	+0.000 −0.010	0.004	−0.000 +0.010	−0.000 +0.006	−0.000 +0.006	60
30–40	+0.000 −0.004	+0.000 −0.004	+0.000 −0.007	0.003	−0.000 +0.007	−0.000 +0.004	−0.000 +0.004	60
44–56	+0.000 −0.003	+0.000 −0.003	+0.000 −0.005	0.002	−0.000 +0.005	−0.000 +0.003	−0.000 +0.003	59
64–80	+0.000 −0.002	+0.000 −0.002	+0.000 −0.003	0.001	−0.000 +0.003	−0.000 +0.002	−0.000 +0.002	63

It will be noticed that the tolerances in the various classes of fit for the core diameter of a screw and the full diameter of a nut, differ from the tolerances specified for the diameters of other elements of the thread. Under these conditions it will be possible to produce a screw in which the flat of the thread at the root is narrower than is specified for the flat of a true U. S. S. form of thread.

TABLE III. TOLERANCES FOR LOOSE FITS

No. of Threads Per Inch	Tolerances on Screws D Full Dia.	E Effect. Dia.	K Core Dia.	Neutral Space Between Max. Screw and Min. Nut	Tolerances on Nuts D′ Full Dia.	E′ Effect. Dia.	K′ Core Dia.	Minimum Per Cent Strength (Approx.)
4–6	+0.000 −0.030	+0.000 −0.030	+0.000 −0.045	0.008	−0.000 +0.045	−0.000 +0.030	−0.000 +0.030	61
7–10	+0.000 −0.020	+0.000 −0.020	+0.000 −0.030	0.006	−0.000 +0.030	−0.000 +0.020	−0.000 +0.020	56
11–18	+0.000 −0.012	+0.000 −0.012	+0.000 −0.018	0.005	−0.000 +0.018	−0.000 +0.012	−0.000 +0.012	51
20–28	+0.000 −0.008	+0.000 −0.008	+0.000 −0.012	0.004	−0.000 +0.012	−0.000 +0.008	−0.000 +0.008	48
30–40	+0.000 −0.006	+0.000 −0.006	+0.000 −0.008	0.003	−0.000 +0.008	−0.000 +0.006	−0.000 +0.006	45
44–56	+0.000 −0.004	+0.000 −0.004	+0.000 −0.006	0.002	−0.000 +0.006	−0.000 +0.004	−0.000 +0.004	48
64–80	+0.000 −0.003	+0.000 −0.003	+0.000 −0.004	0.001	−0.000 +0.004	−0.000 +0.003	−0.000 +0.003	47

As a matter of fact the tolerances for core diameters of screws and for full diameters of nuts have been so proportional as to allow the manufacture and use of taps and threading tools with flats having a width of not more than 75 per cent. of the flats on true U. S. S. screws and nuts of the same nominal size. Tolerances which admit of these conditions will not result in the production of screws or nuts whose threads are cleared more than midway between the true U. S. S. form and the sharp V-form. Tolerances that allow the use of tools having flats differing from the flats of true U. S. S. threads as noted above, are permitted; for the reason that they provide for more than the usual amount of wear in the cutting tools, and still allow the members to function properly.

In order to prevent errors in the design and construction of gages, it is very necessary that the above conditions be thoroughly understood, and it is very desirable that all parts-drawings having any relation to the gages for threads, or to the parts to be threaded, should have the following note conspicuously displayed: Note: Threads do not conform at root to U. S. S. form, owing to additional tolerance being allowed.

Table IV shows the dimensions of the U. S. S. screw threads.

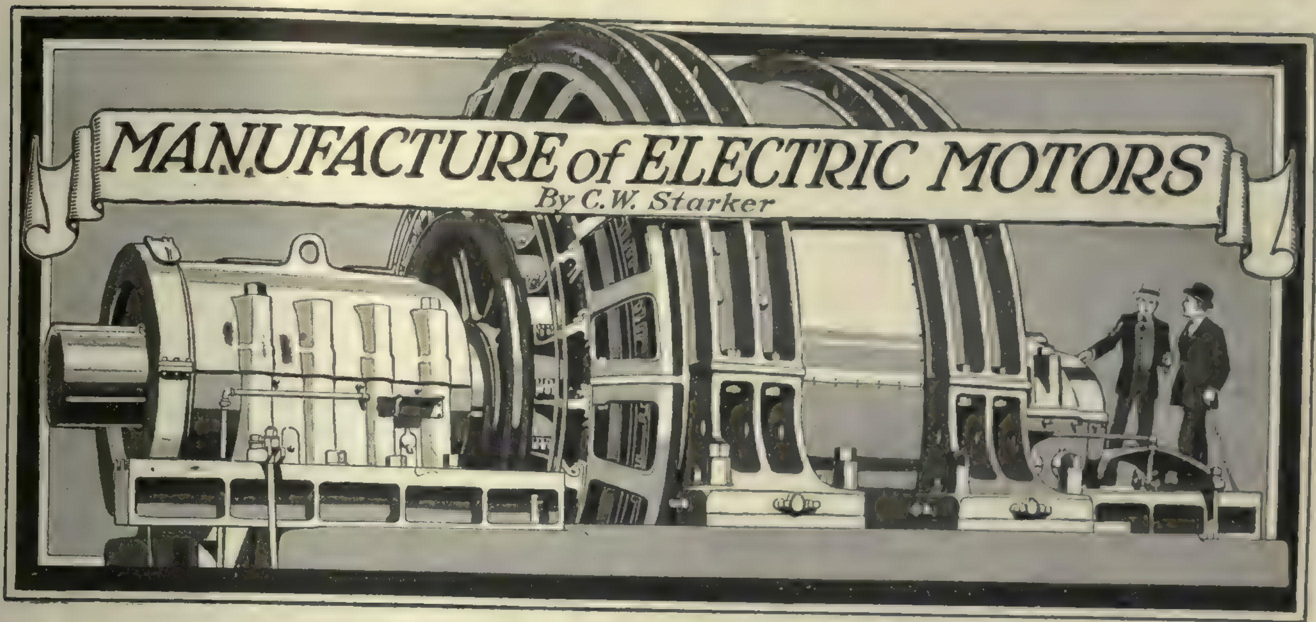
A New Problem of Women in the Shop

The employment of women in the shops brings us new problems. The unexpected happened the other day in a shop which was beginning to employ girls in the assembling work. It was not about bloomers or knickerbockers or overalls, nor yet about what kind of a skirt or hair protection the lady wore, but it pretty nearly broke up the experiment.

It was a shop where very delicate compasses were made and the superintendent was watching the girl to see how she took hold. She was very apt and seemed eager to get on the work, but the compasses acted as though they were invested with demoniacal power. There was not any rhyme nor reason in their antics.

Every one was puzzled, then the superintendent had a bright idea. He went to the forelady and held a whispered consultation. The forelady passed on the word to the learner, who disappeared a few moments and then went back to work.

Presto! everything was changed. The compasses behaved in a perfectly proper manner. The mystery was solved. The steel in the front of the lady's corset had played havoc with the compass.



IX—Primary Windings, Armature Coils and Field Coils

The primary coils of alternating-current motors and the coils used in wound-rotor or direct-current armatures are quite similar in construction. Both are wound from double cotton-covered copper wire, formed into diamond shape and are imbedded in the slots of laminated cores.

IN THE manufacture of primary coils there are three principal requirements: they must be accurate in order to fit together properly and tight in the slot, they should be economical in manufacture, and their construction must be such that repairs to damaged windings can readily be made, either at the motor user's own repair shop or at the service stations maintained for the purpose by the manufacturer.

There are three commercial methods of making coils: the mold type, formed coils and pulled coils. Molds are substantially wooden blocks with grooves of suitable size and shape to receive the wires. Mold coils may be wound either promiscuously, so-called basket winding, or in layers and turns. In the latter case a coil of only one wire in width, a single coil, is made first, the turns tied together and then several single coils assembled and connected together into a complete coil. By this method round wire only can be used without danger to the insulation. Present-day machines, however, are designed for ribbon or strap coils, which material uses the slot space more economically, and it is only in the smaller sizes of motors, below about 5 hp., that wire is used and the above method applicable. From a manufacturing standpoint the mold method has the disadvantage of being a slow process, of requiring much space for storing a multitude of different molds and of frequently necessitating a soldered joint in the coil. Fig. 87 shows one of these molds and a coil wound on it.

The second type, formed coils, are made on formers of wood or cast iron, shaped to conform to the coil to be made. Iron formers are as a rule used for comparatively heavy strap or ribbon. The material after cutting to length is bent around a pin before placing on the former and then pounded into shape. Accurate coils are thus obtained, and that part of the coil outside the slot may therefore be short and the whole machine will be comparatively narrow. Fig. 88 illustrates this method.

The most up-to-date method of manufacturing coils is on the "puller." The wire or ribbon is first made into a loop on a shuttle, Fig. 89, which is a wooden block with two pins and arranged for winding on a lathe. This loop is then spread apart, "pulled" to the required diamond shape on the apparatus shown in Fig. 90. Such a puller may be made adjustable, that is, practically universal, and the time required for making a coil by this method is only about one-third of that required for making a complete coil on a mold.

Insulation of Coils

An item of particular importance in coils is the insulation. It is not difficult to find materials of the dielectric strength required for the comparatively low voltages customary on industrial motors, but the mechanical strength of these materials must not be lost sight of. Compared with other branches of the machine industry the insulation requirements in electric-motor manufacture present an added difficulty. However, the problem has been mastered to such an extent that today we have insulating materials which not only guarantee a very long life to the motor insulation and which are economical in slot space, but we also have special treatments which render windings resistant to acids, alkali, moisture, heat and oil. The terms "fire-proof," "acid-proof," etc., are perhaps somewhat too strong.

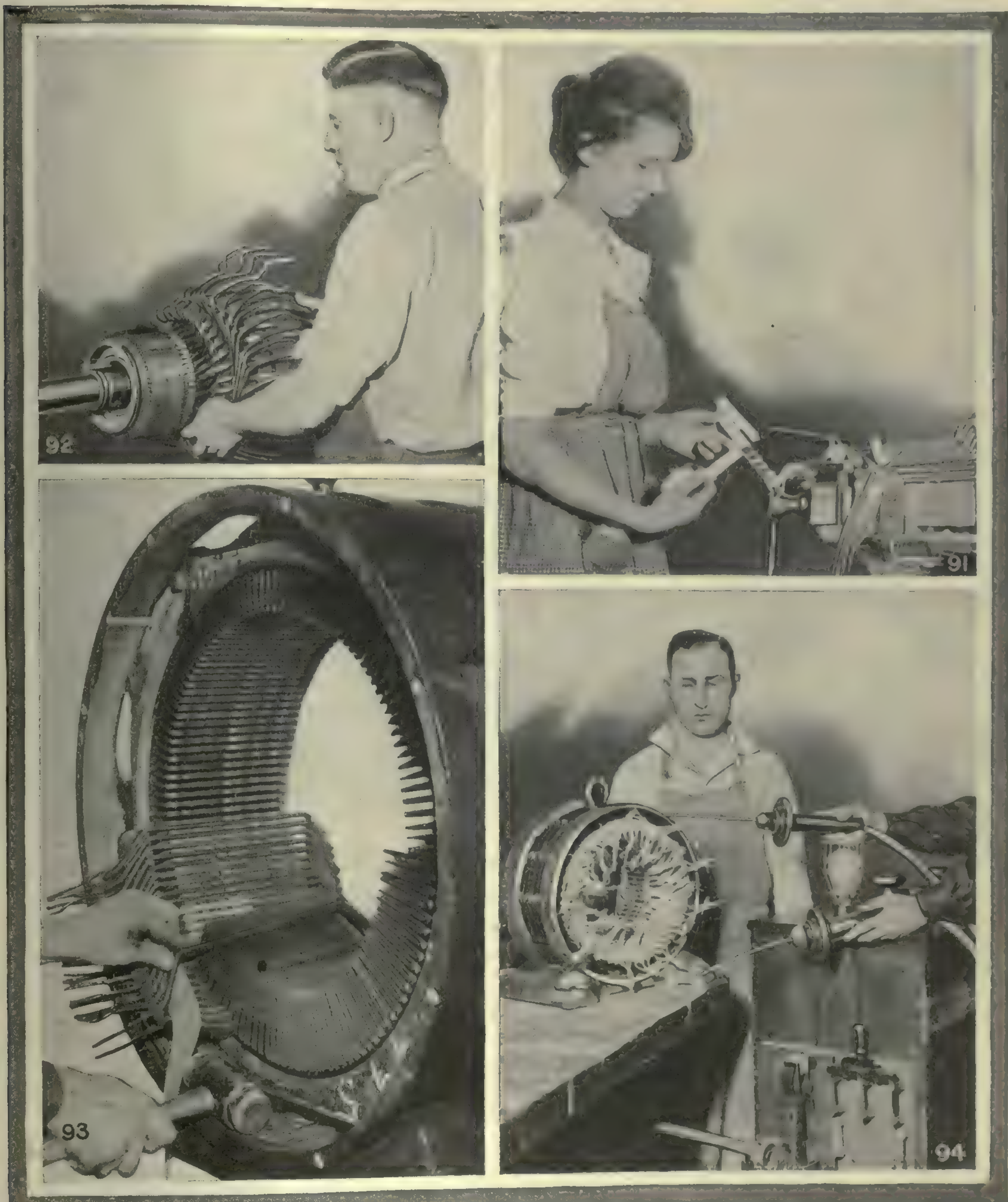
The mechanical stresses to which a coil and its insulation are subjected in action are to be considered; handling and placing the coils in the slot, including roping and banding, would involve as a rule a certain amount of pounding and abuse. In service, centrifugal stresses in the case of revolving coils, vibration, the action of the magnetic field, etc., are to be considered. Also high temperature, with its tendency to cause shrinkage and eventually carbonization of the insulating material, must be kept in mind. The performance char-

acteristics required on modern motors, on the other hand, require a maximum amount of copper in the slot; therefore, the most economical use of slot space and minimum thickness of insulation consistent with the other requirements referred to are to be sought after. Double or triple cotton covering around the wire is generally employed, but strap conductors are formed bare and taped afterward, as shown in Fig. 91. Outside the slot the strap conductors are insulated by layers of cotton tape, or for high temperatures, of mica. A coil which is completely formed and insulated before inserting into the slot is the best type of coil from an insulating standpoint. In such coils the individual groups of small conductors are held together for handling by shellaced strips of paper between layers; or better: by paper perforated so that the gum or varnish may penetrate. In the slot the coils are wrapped with treated paper and cloth. Outside the slot, flexible tape such as empire cloth or varnished cambric, is employed. These materials have high dielectric strength, are flexible, strong, elastic and of long life. Cells from tough paper treated with paraffine are placed in the slots before winding. This facilitates the insertion of the coils in the slot. A tight fit of the coil in the slot is essential

FIGS. 87 TO 90. A NUMBER OF METHODS OF MAKING COILS
Fig. 87—Wooden mold for alternating-current primary coil and coil loop made on it. Fig. 88—Iron mold for strap coils and coil made on it. Fig. 89—Shuttle and loop for pulled coils. Fig. 90—Puller and pulled coil

to prevent slipping in service and thereby chafing of the insulation. Figs. 92 and 93 show the process of winding a modern direct-current armature and an alternating-current motor primary with pulled coils.

ground, the other determines the condition of the insulation as to dryness and cleanliness. The first is called a test for dielectric strength and is performed, according to the standardization rules of the American



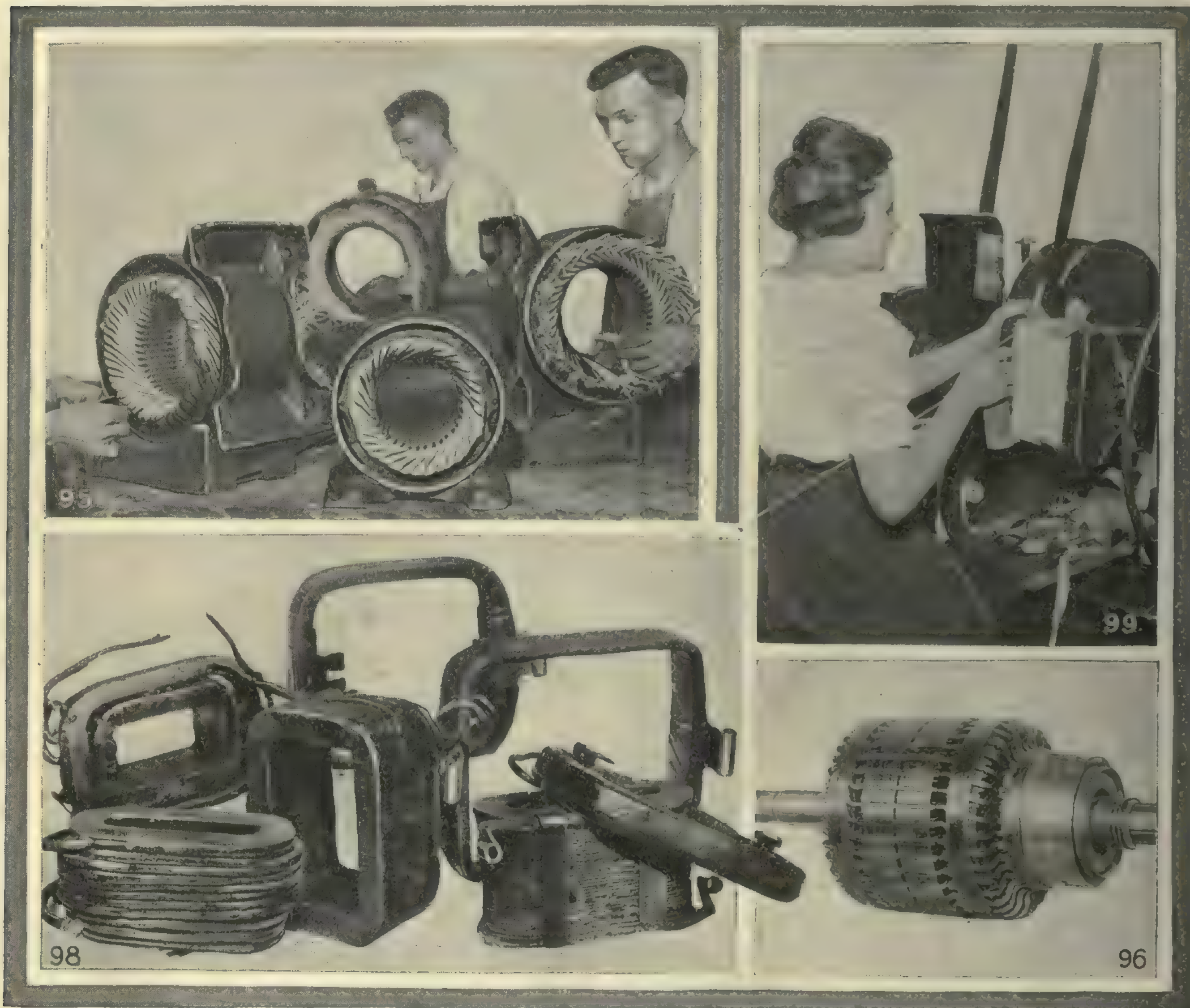
FIGS. 91 TO 94. TAPING, WINDING AND TESTING COILS
Fig. 91—Taping of coils. Fig. 92—Winding direct-current armature with pulled coils. Fig. 93—Winding, alternating-current, stator-formed coils. Fig. 94—Insulation test of coils, or windings

The insulation tests applied to the individual coil and the finished-wound machine are two-fold: the one measures the ability to withstand the voltage strains occurring between the parts of the winding and the

Institute of Electrical Engineers, by applying for one minute between the winding and the ground an alternating current equal to twice the normal voltage of the circuit to which the apparatus is to be connected, plus

one thousand volts. The second test is called a test for insulation resistance and is usually made by applying a direct-current voltage of 500 volts between conductors and ground, using a voltmeter in series with the insulation. This latter test is, however, of secondary importance and is subject to variations of temperature, humidity, etc. Fig. 94 shows the testing of such coils and the test box used, on which voltages up to 16,000 volts are obtainable. While the ordinary alternating-current motor coil is designed to pass test on two times normal voltage plus 1000 volts, it is necessary to provide a margin in manufacture. The individual coils are therefore subjected to a still higher voltage, so that after the coils are placed in the slots and roped no failures on test will occur which would delay production. As a matter of fact, practically every one of the motor coils under description, although used on only 220 volts, will withstand as much as 4000 or 5000 volts.

Small alternating-current stators and direct-current armatures are made with partially closed slots, the individual wires of the coils being threaded through the small opening in the slot, as shown in Fig. 95. On larger machines the possibility of quick repairs becomes more important, hence above 5 or $7\frac{1}{2}$ hp. open slots are used. The coils in this case are retained in the slot by fiber wedges, or in some of the small direct-current armatures by a banding wire imbedded below the surface of the core. Fig. 96 shows a finished-wound, up-to-date construction of direct-current armature. On alternating-current motors the open slot is very undesirable electrically, inasmuch as the open slot space has a result equivalent to an increase in air gap. Metallic wedges have therefore come into general use, and to



FIGS. 95 TO 99. A NUMBER OF DIFFERENT WINDING METHODS
Fig. 95—Winding alternating-current stators, threaded-in coils. Fig. 96—Finished-wound, direct-current armature. Fig. 98—Shunt coils and strap-wound, commutating pole coils. Fig. 99—Semi-automatic winding machine for wire-wound field coils

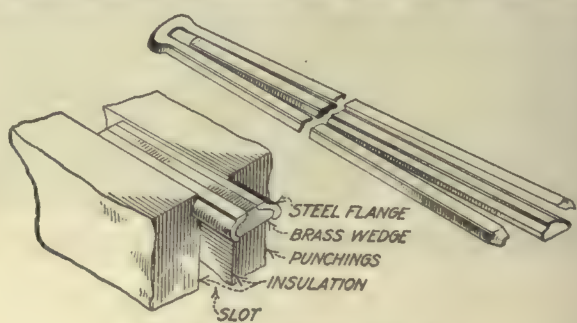


FIG. 97. MAGNETIC WEDGE

a large extent duplicate electrically the condition of an overhanging tooth and at the same time permit easier removal of the coil than with the partially closed slot. The best form of such wedges is the 3-piece or so-called hairpin type of wedge, shown in Fig. 97. The center part is made of a strip of drawn brass and is flanked on each side by an accurately drawn steel strip, the whole being insulated from the primary teeth when being inserted in the slot by means of Fuller-board strips. The hairpin form together with a clinching of the strips at the open end, very effectively prevents the wedge from loosening or coming out under the influence of magnetic pull or vibration in service.

Shunt field coils for direct-current motors are made from single cotton-covered wire, wound on spools from

FIG. 100. VACUUM IMPREGNATING TANKS FOR MOTOR WINDINGS

treated Fuller board. For higher currents, in series or commutating coils, square wire or strap is used, wound either flat or edgewise and insulated between turns by layers of tape or asbestos. Fig. 98 shows both of these types of field coils, while Fig. 99 shows a special machine designed to do this work expeditiously, both for the large number of turns of fine wire required in shunt coils and the comparatively heavy strap for series coils. All these coils, after winding are given a thorough impregnation of insulating gum, applied in vacuum, followed by pressure, so as to insure thorough penetration, and they are kept at a temperature of 300 deg. F. for about 2 hours. Large iron tanks, equipped with temperature- and vacuum-controlling apparatus are used for this purpose, Fig. 100.

Ball Bearings for Electric Motors—Erratum

On page 1080, Vol. 47, the fifth line of the second column, the air-gap space should be 0.023 in. instead of 0.0023 in. as printed.

The Gagemaker's Inspection of His Own Product

By H. J. Bingham Powell

At the meeting of the American Society of Mechanical Engineers on Dec. 4, 1917, in the Section of the Annual Convention devoted to gages, the writer was asked to speak. He had not come to the meeting prepared to take part in the discussion, but on hearing the report of the gage committee recommending that master inspection gages and reference gages be sent to the Bureau of Standards for verification and certification, he was strongly impressed by the necessity for firms themselves taking steps to make this desirable measure effective by having a reliable gage inspection of their own as a necessary auxiliary to the Government inspection, and he brought this point forward at the meeting. During extensive experience of the last year and a half on inspection of all classes of gages in charge of the British Gage Inspection Department in this country, the writer has often felt how helpless many gagemakers are through the lack of proper inspection methods of their own. As a rule, such a gagemaker is content if he possesses a set of Johansson blocks, micrometers (thread and plain), and wires. With such equipment he believes that all requirements have been met. But he really knows very little of the condition of his gages (and here the writer especially refers to screw gages) by such elementary means of checking; and is surprised and troubled when his gages are returned by the Gage Department as rejected or to be rectified.

Help for Gagemakers

To help gagemakers to establish a scientific inspection of their product, the writer has recently written and extensively circulated an illustrated brochure on the subject, entitled "The Inspection of Screw Gages for Munitions of War." The text has been lately republished in the *American Machinist*, so the methods of inspection brought forward in the brochure need not be further referred to here, but some comments on the subject of firm's-inspection and the necessity of it as a means to the end of producing large quantities of correct gages, are desirable.

Munitions gages must be accurate. The maker does not always understand the why and wherefore of the low tolerances he is required to work to, but he may be assured that the reasons are sound, and not merely capricious, as he often seems to think.

The Question of Tolerances

The tolerance of accuracy of a gage bears, of course, a definite relation to the closeness of workmanship required in the product on which it is to be used. Now, the allowances in the dimensions of munitions are small, very small. Does the average gagemaker realize what a very accurate and precise piece of work for instance, a shell or a fuse is? A shell must be kept close to weight, to size, and be finely balanced. The fuse that screws into it must be a tight fit, and fit any of the millions of shells it may be fixed to, without delays and in the turmoil of the battle line. The fuse itself is a complicated mechanism, and the parts must function perfectly

to insure safety and accuracy of fire. Looseness or tightness of the moving parts would be fatal and might cause premature explosion, thereby bringing disaster to some of our own men and demoralization to others. It is to be remembered also, that our trenches and the enemy's are only a very short distance apart, that curtains of fire, move but a few yards in front of the advancing troops; thus one can realize what ensues if the shells do not range exactly right or explode before the calculated moment. Then in the gun itself: a jammed cartridge case, or one with a convex head that prevents the breech being closed! what moral effect would that have on a perspiring gun-crew loading over twenty shots a minute?

Great Accuracy Necessary

It will be seen there may be no question of the extreme accuracy required in munitions, and therefore the gages must, on their part, correspond. The tolerance in a gage can only be a fraction of that allowed in the product. Otherwise, not only will the munitions be dangerous in use and worthless in action but also the quantity or output of munitions, will be seriously prejudiced; because good work would be rejected by a poor gage, equally as bad work is accepted. Thus the writer would press the point: to obtain without delays the large quantities of correct gages that must be available in the next few months, gagemakers should take immediate steps to do their part in the inspection. After all, a gage is a precise measuring device, and its accuracy is not a matter of opinion but of careful and precise inspection.

What Happens With Conditions As They Are At Present

As now generally happens, the maker of the gage does his best in meeting specifications by verifying its accuracy with the deficient means at his disposal, and has to trust largely to luck to get it passed by Government inspection. Often he is unfortunate and the gage is rejected, or else sent back to him for rectification. In both instances, he is wasting time—valuable time of his own and that of the Government—and losing money. If he knew, by a correct and careful inspection of his own, that the gages at the various stages of making were meeting the specifications, what a satisfaction that would be! As a mere example: often a poor screw gage can be saved in the lapping operation, when slightly out of form or deficient in the lead. Also, the workman would have more self confidence if he knew how his gage was coming along on the various operations. A matter of two thousand dollars can equip a gagemaker with the following essential equipment, apart from the usual measuring devices of the workshop:

1. A "Projection" apparatus.
2. A screw diameter-measuring machine, with wires.
3. A pitch (or lead Machine.
4. Standard sized blocks, by which to set the machines and micrometers.

In the booklet previously referred to all this equipment is described and the writer trusts he has been able to impress on gage makers the vital necessity of acquiring it.

Ship Draftsmen Are Needed for Emergency Fleet Work

The Civil Service Commission issues the following important notice:

There are not enough ship draftsmen in the United States to do the drafting work needed to carry out the naval- and merchant-shipbuilding programs. Our country is engaged in the execution of the greatest warship construction plan in history, providing for 787 vessels, including all types from superdreadnaughts to submarine chasers. Naval appropriations aggregating nearly two billions of dollars have been made since August, 1916.

Coincident with the demand for increased naval work there is an equally urgent call for an increase of merchant-ship construction. It is betraying no secret to say that in both branches there is a shortage of technical men available for the work.

The United States Civil Service Commission is endeavoring to relieve the dearth of ship draftsmen by recommending to the heads of colleges and technical schools that senior students in engineering courses be given intensive training in naval architecture during the coming spring, with a view to making them available for employment as ship draftsmen in June. The commission is also receiving applications from qualified architectural, mechanical, and structural steel draftsmen, and is certifying them for employment in the Navy Department and in navy yards on ship work.

Local boards of civil service examiners at the post offices in all of the larger cities are furnishing detailed information and application blanks. Applicants are not required to appear in an examination room for a written examination, but are rated upon their education, training, and experience.

Keeping the Good Will of the Employee

By I. B. Rich

The article by H. D. Murphy, on page 17, is excellent and should be carefully considered by shop managers generally. There is, however, one point about which there might be some discussion. I refer to the paragraph on paternalism, and presume that we should agree on that if we talked it over a little.

I agree that paternalism of the condescending my-good-man type, does not get very far; but the paternalism which is keeping an eye on the housing conditions of employees, that the health of the worker and of his family may be insured is quite likely to receive response in most cases. This is especially true when there is an epidemic of some sort in poorly kept districts, and the children of the paternalized district escape.

Of course, I agree that this should be a municipal task but until it is, we must welcome the next best. An increase in the pay envelope might enable the worker properly to adjust matters for himself, but we have no assurance that he would.

I am not advocating paternalism, but there are cases where it seems the only way until our municipal or community conscience gets busy and we demand proper living conditions for all in the interests of self-protection if of nothing else.

Series for Executives

A Fair Royalty Contract For Employees

BY GLENN B. HARRIS

The writer of this article has commented extensively on statements made under the above heading in a previous issue. Creative reasons for inventions are set forth and the human side of the inventor discussed.

THERE appears on page 1027, Vol. 47, of the *American Machinist*, an article by R. G. Pilkington, entitled "A Fair Royalty Contract for Employees." In this article, views possessing both wisdom and truth are expressed, and the author has undoubtedly had some experience with patents and with the methods of marketing them, but some of his ideas are not practical; as an instance: he told his friend to get along on his salary and to put every cent of his royalties into the stock of the company. This is an idealistic situation, presupposing first, the invention of an acceptable device; secondly, its immediate adoption by the employer of the inventor. To tell a man, no matter how extensive his shop knowledge, closely to follow the lines to which he is intimately allied and to look for avenues of improvement, is undoubtedly sound. But how many men with fair educations, with a thorough knowledge of their duties—be they in any of the multifarious lines of manufacture—have been capable of producing anything of real practical value to the world, or even to those by whom they are employed? They conjure their brains as to what to devise, but mostly without avail.

AS A rule an invention is an inspiration; maybe created by thought on a given subject, perhaps by suggestion; or as more frequently happens, it may be the result of an idea that flashes through the mind, which is more or less an inspirational means to the creative end. There are professional inventors, and by this term is meant men who are mechanical, electrical, or chemical engineers, brought into consultation to solve a given problem. To them is explained what is desired, and they proceed with their work in precisely the same methodical manner as does an architect in preparing plans for the erection of an edifice. While what they produce may unquestionably prove patentable subject matter, the fact remains that they are solving only a submitted problem.

There are many little devices involving practically no mechanical knowledge, yet which involve true invention, and which have made fortunes for their originators. As an example the egg beater: a simple, practical and ingenious contrivance. The man who devised it may have seen one of his female relatives laboriously whipping eggs with a fork, and whether to relieve her of the tedium of the work or to garner riches in abundance, he invented the egg beater. Millions of these handy little devices have been sold, and if the inventor received his just deserts, his reward should have been large. No mechanical difficulties stood in the way of the solution of this very simple problem; but the thought, the idea, was an inspiration. In the cases of Bell, Edison, Brush, and Marconi, also of McCormick, Whitney, Bessemer, and the Wrights—all had in mind a definite goal; a fixed purpose; something to be solved. They worked along the lines of their ideas for years, before anything of value was produced. They possessed, all of them, tenacity of purpose in a marked degree.

IT IS a peculiar circumstance that the efforts of inventors are not appreciated or recognized. On the other hand everything is deprecated and their Legion of Honor, is only bestowed after they have received their pecuniary reward, which must be in abundant measure if the inventor is to receive recognition as the producer of something of incalculable benefit to mankind.

We hear the cry from far and near, "this war will be won by airplanes!" but most of the readers of the *American Machinist* will recall the time when the Wright brothers went to the sand dunes of North Carolina to conduct their experiments. With no engine, but only the planes, they would throw themselves in the air, and in this way ascertained that the surface area of the planes exposed to the atmosphere was support for their weight, and that of the flying machine; the question of motor installation was then more or less an easy proposition. Be that as it may, the Wrights were looked upon as crazy followers of Mother Shipton, and were ridiculed on all sides. They were thought fit subjects for incarceration in the psychopathic ward of the most available public institution, and yet this invention is to win the war. Also with Jules Verne's "Twenty Thousand Leagues Under the Sea": This work of fiction was ideal reading for the youngsters, and for that matter for some of the grown ups, years ago. How many are there who ever thought it possible that a practical submersible vessel would ever be realized? And yet we are presented daily

with striking evidence of its efficiency, in fact deadliness, as a weapon or instrument of warfare.

It is true that the up-to-date manufacturer is keenly alive to the necessity of keeping in advance of the times if possible, otherwise at least to keep abreast of them. It is a fact, however, that an employer is not as keenly alive to the possibilities of an invention produced by one of his own men as would he be with one submitted by an outsider; then, too, the passing of a small check is in a great many instances, deemed entirely adequate compensation. It is not the easiest of propositions to induce an employer to take over an invention on a royalty basis, and it is almost unheard of to enter into a royalty contract until after the patent or patents shall have been granted, or rather issued, although an agreement having this in view, could properly be made contingent on issuance. Until the actual issue of a patent, an alleged inventor has no more actual rights than he possessed prior to the filing of his application for patent, and there is no possible grant that can be given except on the basis of understanding that the rights will be conveyed "as and when the patent is issued."

A QUITCLAIM deed to a piece of realty can be given by a party who has never had even one copper invested in the property, while a warranty deed is a guarantee of ownership (or at least supposed ownership) if everything be regular.

The contract set forth may be a fair one for the employee, but how about the employer? He is compelled to name the device according to the inventor's whim or dictation. The contract as stated in the editor's footnote should be corrected, as the validity of a patent is never judicially brought to the attention of the courts until after the commencement of infringement proceedings. If the contract is amended to read "if the patent is deemed to be infringed," it shall be incumbent on the party of the first part to bring an action for infringement. In an infringement action the defense might be non-infringement, and the question of validity not entered in any way as a defense. The writer has had this personal experience. In one instance a patent was sued under, and after trial the patent declared valid by the court of last resort. The infringing concern was closed, and considerable damages collected from the infringing users. Another concern entered the field with a somewhat differently constructed device. Suit for infringement was brought, and the defendants set up as a defense non-infringement, and after a thorough and exhaustive trial of the case, their contention was sustained, and we were thrown out of court. In the one case the patent was declared valid, and infringed, but in the second instance through a change in construction infringement was avoided, and non-validity could not be pleaded, as the highest court had already passed favorably on this question.

IN THE agreement presented, the clause (f) is one to which an employer might make strenuous objection, if only for personal reasons; that is, the undesirability of the inventor as a stockholder.

Another very serious objection is that permitting the party of the first part to "at all times during business hours visit and inspect the offices and shops of the party of the second part, to inspect the work being done under this agreement and to examine the original books and records on which the statements as to the total of the headlights manufactured are based." As a broad proposition, the writer would not sign an agreement containing the quoted provision with the inventor of the best device that ever bore patent protection. Stated times for the examination of books, say quarterly, is sufficient for all necessary purposes, and as to plant examination and interference with work in progress these would not be tolerated in the slightest degree by one shop in a thousand. Some crank of an inventor, or we will call him an over-enthusiast, would continually be under foot and around snooping, and the suspicious inventor would be as bad if not worse. There is no manufacturer in possession of his faculties who would consent to the proposed arrangement as outlined.

IN REGARD to the examination of the books; the contract calls for a minimum of royalities, so in reality the patentee must rest content if this minmum be lived up to by the party of the second part.

It is not every concern that would care to place an inventor and patentee in charge of the production of even his own invention. The reasons might be many and well founded. His ability or rather lack of it, might be brought into question and prove a serious obstacle to his engagement in the capacity mentioned. Personal habits or characteristics of temperament might also prove detrimental to an engagement of the character proposed.

An inventor in dealing with a reputable manufacturer would naturally be thoroughly conversant with his standing and ability satisfactorily to produce the article in question; otherwise it would be discretionate to cease negotiations; in fact, never to begin them.

ONE clause which might be added, and with advantage to the party of the first part is: to make provision that the party of the second part shall not become interested in any manner in a competing invention or do anything that might prove antagonistic to the interests of the party of the first part. As a matter of fact it should be made incumbent on the party of the second part in all ways to promote the introduction of the device as generally as possible. Mr. Pilkington's friend is wished every success in the production of a meritorious and highly profitable invention, but even after he has produced something that is of value, the question arises as to whether or not he is at liberty to proceed with its manufacture and sale, in view of prior patents.

The Berliner microphone transmitter, which is in universal use today, and which has served to make speech distinct on the telephone, was an invention of the highest order; but in view of Bell's patent it possessed no value for independent use until the latter had expired. Fortunately though for Berliner, it was taken over by the Bell company at a highly remunerative figure. This might prove the case in the instance in discussion.

As to the royalty contract, I am of the opinion that in order to get a fair one the friend will have to perform hypnosis on his employer or call on the Genii, of Aladdin's Lamp; and, I am inclined to think that lamp will require a considerable amount of hard rubbing.

HOISTING MACHINERY that is Helping to Win the War

At the Marne

Docks at Archangel, Russia.

At an American Ship Yard

WE ARE accustomed to think only of guns and ammunition as means of winning the war, but there is hardly a class of machine which does not play its part. There are three types of cranes in use at three widely separated points of the globe: On the historic Marne, at the Arctic port of Archangel and in a shipyard at an American point, all helping in different ways to win the war.

The unloading of coal in a secluded spot with no sign of a dock, may play even a greater part than the handling of freight at the great docks at Archangel, since the collapse of the Russian resistance—even though it be as temporary as we hope—makes what is loaded or unloaded at that point of little immediate concern to us. The crane in the American shipyard may yet play the most important part of all; because the building of ships is to be one of the crucial tests of endurance and of constructive capacity in the months to come.

The American shipyard crane is known as a three-motor gantry crane, and has a 40-ft. span, lifts 30 tons and is equipped with independent electric motors for the hoisting, for the cross movement of the crane and for its supporting car, as well as for swinging the crane to any desired position; it also has its independent motor for moving the whole gantry with its total load, along the track in the yard to any desired point. These illustrations show the great importance of the problem of handling materials of all kinds, in the shop as well as outside and in far corners of the earth. Improvements in the handling of the machine-shop work will play an important part in overcoming the labor shortage which is sure to be felt during the coming year.

After-War Prospects for American Machine Tools in France

By C. E. CARPENTER
President of the Allied Machinery Company of France

One of the questions most frequently asked by those familiar with the tremendous growth that has taken place during the past three years in the French production of war material, concerns the use to which machine tools purchased by France during the war will be put after peace is declared.

MANY persons in more or less close touch with the French industrial situation, have expressed the belief that France will have imported during the period of the war such large quantities of machine tools that not only will machinery be a drug on the market immediately after war, but that for many years the importation of such goods will practically cease. At first blush it is easy to accept this view, since it seems incredible that such vast numbers of machine tools, created purely for war purposes, can be absorbed by the industries of peace times and at the same time leave the door open for continued importations. If, however, the effects of the war on the economic conditions of France are taken into consideration, there will seem to be good grounds for belief that French industries shall have small difficulty in converting to peaceful uses the equipment now used for producing munitions; and that instead of the present equipment meeting the country's requirements for years to come, it will need to be greatly extended when the war is finished. Those who subscribe to this, base their opinions not on the transitory demand for machines for restoring the industries of northern France, but on the certain rapid development of the metal-working industries throughout the country that will be brought about by the complete exhaustion of stocks of all kinds of commodities, the high freight rates on imports, the necessity for utilizing home resources to the utmost, the exchange situation, and last but not least, by the great spirit of industrial enterprise awakened throughout France by the tasks laid upon the nation's engineers and manufacturers, as a result of the ceaseless growth in the demand for munitions.

The Accomplishments of Manufacturers

The extent to which this spirit of enterprise has developed can only be appreciated by those who have been privileged to witness at close range the accomplishments of manufacturers, who before the war were either unknown outside of their respective industries, or whose success could not to any appreciable extent, be considered as conspicuous. Before the war, the number of French metal-working industries that deserved recognition by reason of the state of their development, was very limited. Outside of France, practically the only well-known French industry in the metal line was the manufacture of automobiles. French motor cars were to be found in all parts of the world from Fifth Avenue to the Sahara Desert, and they carried with them the hall-mark of French engineering and mechanical skill. In like manner, French artillery was known and used by practically all the armies of the world, and French-built ships were to be found in all ports.

Apart from these and a few similar industries however, French manufacturers and builders had not attracted special attention, and the French market was a profitable field for the exporters of Germany, Great Britain, Belgium and Switzerland. The Germans, in particular, assiduously catered to French needs. French steel mills were equipped with German machinery; locomotives, cars, motors and steam engines were built with German machine tools, and scarcely an industry existed that did not operate with a considerable amount of German-made equipment. Swiss and Belgian locomotives operated on French railway lines; textiles were manufactured on British looms; automobiles turned on German and Swedish bearings; factories were driven by German, Swiss and Belgian Diesel motors; in short, France offered to other European industrial countries the richest opportunities for exploitation.

A Direct Effect of the War

One of the direct effects of the war has been to bring home to French manufacturers and business men the extent to which they were dependent upon the rest of the world for their most needed equipment and supplies; and already signs are becoming noticeable that indicate they are laying the foundations of a manufacturing campaign which will tend ultimately to make them independent of foreign manufactures. Independent to a very large extent at least, for those lines which can be produced in sufficient quantities to warrant the creation of modern factories. There is no doubt that a multitude of metal products, from tool steel to agricultural machinery, formerly imported from Germany, Belgium, Great Britain, Switzerland and the United States, can successfully be manufactured in France; and that a sufficiently wide home market exists to attract the necessary capital and initiative. Consequently, if the problems of home production of necessities are undertaken by French manufacturers and engineers with the same spirit and courage they have shown in the production of war material, there is every reason to believe that little difficulty will be experienced in keeping fully occupied in peace time the equipment now being utilized for making munitions.

In fact, it is no secret that some of the most prominent makers of war material have already created in their organizations what are known as *bureaux d'étude*, for the purpose of investigating the needs of the French market and for determining the adaptability of their equipment for the manufacture of the products selected. In some cases these *bureaux d'étude* have been expanded to the point of sending investigators into foreign countries to make thorough studies of foreign

practice and production methods. In considering the large number of machine tools which have been imported into France since the beginning of the war, it should not be overlooked that prior to the war, France in respect of mechanical equipment was what might be termed tool-poor. The automobile industry was probably the only industry which was equipped throughout with strictly modern machinery. In other industries, factories were handicapped by a vast amount of antiquated machine-tool equipment of greatly inferior productiveness, but which its owners could not be prevailed upon to consign to the scrap heap, because the need for such action had not been brought home to them with sufficient emphasis. When new equipment was required the majority of machine-tool buyers could be made to see only with great difficulty that price was not the most important point to be considered.

Since the beginning of the war, however, and under the stress of necessity, the most modern types of American and British machine tools have found their way to the farthest corners of France, and manufacturers of all grades have had an opportunity of drawing comparisons betwen the old and the new. As a result, it can be confidently stated that the lessons learned during the war will not be forgotten when peace returns and competition resumes its place. On the contrary, it is reasonably certain that after the war much of the old equipment now being used for munition work because substitutes are not now available, will be discarded in favor of modern machinery, and that the new equipment which will replace it will be the best that America can produce.

The Manufacturer of Agricultural Machinery

In speculating upon the direction in which French metal-working industries will expand after the war, it is not difficult to hit upon a number of likely leads. No doubt one of the first industries to receive attention will be the manufacture of agricultural machinery, particularly the building of gasoline tractors. The pressing necessity for increasing the food supply, and the certain scarcity of farm labor, are two factors which are bound to receive the immediate attention not only of the government, but of manufacturers engaged in this branch before the war, and others who have not heretofore paid particular attention to this industry. Already certain well-known engineers have begun work upon the designing of gasoline tractors, and as they have at their command a large amount of practical information on the subject, acquired through the exhaustive tests which the Ministry of Agriculture has conducted, it is fair to assume they will be successful in their projects. When it is borne in mind that tractors are among the most costly commodities to transport long distances by water, a home industry in this line should find substantial encouragement. It would, furthermore, be well within the province of the government to foster an industry of this nature by means of a protective tariff.

From tractors it is a short step to stationary gasoline, petroleum and crude-oil engines, which, although made to a certain extent in France before the war, were also imported in considerable quantities from other European countries. There is little or no reason why the entire demands of the market should not be filled by home industries.

Another industry which after the war should attain a high state of development, is the manufacture of ball bearings. While several small plants in this line existed before the war, large quantities of the bearings were imported from other countries. Steps have already been taken on a large scale to develop this industry, and France will be independent of foreign supplies in this line.

It is also evident that much will be done as soon as the opportunity warrants, to develop the production in France of railway material of all kinds: ships, hoisting and conveying machinery, materials and machinery required by the building trades, rolling-mill machinery, equipment for the glass and earthenware trades, for coal mines, sugar mills, furniture factories, and by a very large number of other industries too numerous to mention.

A Scarcity of Every Known Commodity

When it is realized that not alone in France, but in practically all the countries of the world, stocks have been reduced until there is a scarcity of every known commodity, it is clear that when the war is over superhuman efforts will be necessary to meet the demands that will be made upon the industries, and that there will be unlimited encouragement to new enterprise in every field.

With these conditions prevailing, it is far more likely that the machine tools imported into France for war purposes during the past three years will be considered as a great national asset, than as a drug on the market.

This coming industrial development will bring with it many features which are well worth the attention of American manufacturers. A large number of commodities in the United States have been developed to a very efficient degree. Many of these commodities cannot be exported on an extensive scale, first because of the higher labor costs prevailing in America, and second, because of prohibitive freights and import duties. They could, however, be manufactured in France for European sale, with very profitable returns. This fact has already been proven by several American companies which established branch factories in France before the war. In other lines of industry, particularly in the manufacture of the commoner factory and mill supplies, which in the United States have been developed into standardized articles, France offers a virgin field for American enterprise, and those manufacturers who will take the trouble to investigate the conditions thoroughly will find every inducement to extend their activities to his country.

Heretofore American manufacturers in general have been loath to create branch factories in foreign countries, partly no doubt because the rapid growth of the home market absorbed their attention and capital, and partly because they have hesitated to risk their capital in enterprises so far removed from their immediate supervision. They have, however, only to look at what has been done in this respect by their competitors of other countries as well as by a number of their own countrymen, to appreciate that distance should offer no real obstacle to initiative in this direction. The Germans for many years have consistently made it a practice to establish branch factories in foreign countries when such action was considered necessary, to meet

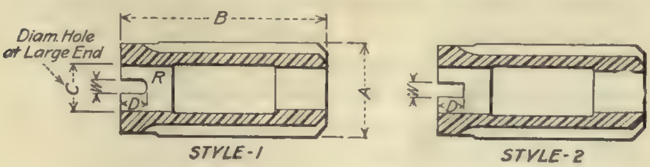
tariff difficulties or to give them greater hold on a market. Their practice in this respect was particularly noticeable in regard to France during the last few years that preceded the war, and if they found it profitable there is no doubt that many of our American manufacturers will find it worth their while to give serious attention to its possibilities.

The manufacture of many types of American products in France with American equipment, and on lines of American factory practice, can not only be carried on successfully as regards the local market, but can be made the means of developing markets which the same products, if made in the United States, could never succeed in entering on a large scale. It is therefore to be hoped that our manufacturers will not be slow to grasp the opportunities which the industrial development of France will offer them.

Taper Holes in Shell Reamers

We are informed that certain departments of the Government service have asked manufacturers of shell reamers to change their standards for tapers in the holes and all to conform to the taper of ⅛ in. per foot. Although this appears innocent enough on the face of it, it seems unwise from any point of view to comply with such a request.

The standardization of machines and tools on a logical basis is the ideal of every engineer; and he is perfectly



Diameter of Reamer, A	Length, B	Style	Nominal Diameter	Actual Diameter	Taper per Foot for Hole	No. of Taper Hole in Reamer	Width of Slot, W	Depth of Slot, D	Radii, R
½ – 11/16	2	1	¼	0.25	0.1368	3	⅛	7/32	1/16
⅝ – 27/32	2¼	1	⅜	0.369	0.13488	4	5/32	17/64	5/64
¾ – 31/32	2½	1	½	0.500	0.13824	5	3/16	11/32	3/32
1 – 1 3/16	2¾	1	⅝	0.625	0.13663	6	3/16	11/32	3/32
1 5/16 – 1 23/32	3	1	¾	0.750	0.13435	7	¼	7/16	⅛
1 11/16 – 2	3½	1	1	1.00	0.1406	8	¼	17/32	⅛
2 1/16 – 2½	3¾	1	1¼	1.249	0.13576	9	5/16	15/32	5/32
2 9/16 – 3	4	1	1½	1.507	0.13716	10	5/16	17/32	5/32
3 1/16 – 3½	4½	2	1¾	1.75	0.1426	11	⅜	9/16	..
3 9/16 – 4	5	2	2	2.00	0.1252	12	½	⅝	..
4 1/16 – 4½	5½	2	2¼	2.2498	0.1222	13	½	⅝	..
4 9/16 – 5½	6	2	2½	2.4998	0.1225	14	⅝	11/16	..

STANDARD SHELL REAMER DIMENSIONS

justified in objecting seriously to the illogical dimensions found in many standards now in use. He naturally objects to the dimensions of the well-known standard tapers, both the Brown & Sharpe and the Morse tapers being arbitrary and without any special basis; but the fact that thousands upon thousands of them are now in use, makes it unwise to advocate any changes at this late day.

The same criticism as to lack of a logical basis can be charged against the taper holes in shell reamers. Here the original taper was planned to be ⅛ in. to the foot; but either through unsatisfactory methods of measuring tapers or a failure to realize the importance of preserving a logical standard, the tapers now vary on different sizes, as may be seen from the table.

These tapers vary from 0.1222 in. to 0.1426 in. per foot of length, and there is a great temptation to change them all to some one logical standard; but when we realize the great number of reamers now in use, and the confusion that would arise from making the change now, it seems to be a case of letting well enough alone. Several attempts have been made to change the tapers in the shell reamers, but in most cases the attempt was abandoned and the tapers shown in the table were adopted as being considered the most practical. The tapers shown in the table were secured by carefully measuring the original plugs of the Morse Twist Drill Co., and are being employed in the great majority of shell reamers now in use. With such a precedent, it seems far wiser to continue to use these tapers even if they do not entirely accord with our sense of logic, than to attempt a change which would cause endless confusion.

Wooden Blocks for Shop Flooring

There are various discussions from time to time as to the best flooring for machine shops, and there seems to be a tendency to get away from the concrete floor in many cases. Inquiry in some of the large shops which use the wooden-block type of flooring very similar to that used in street paving, discloses that these wooden blocks are proving satisfactory in some cases at least.

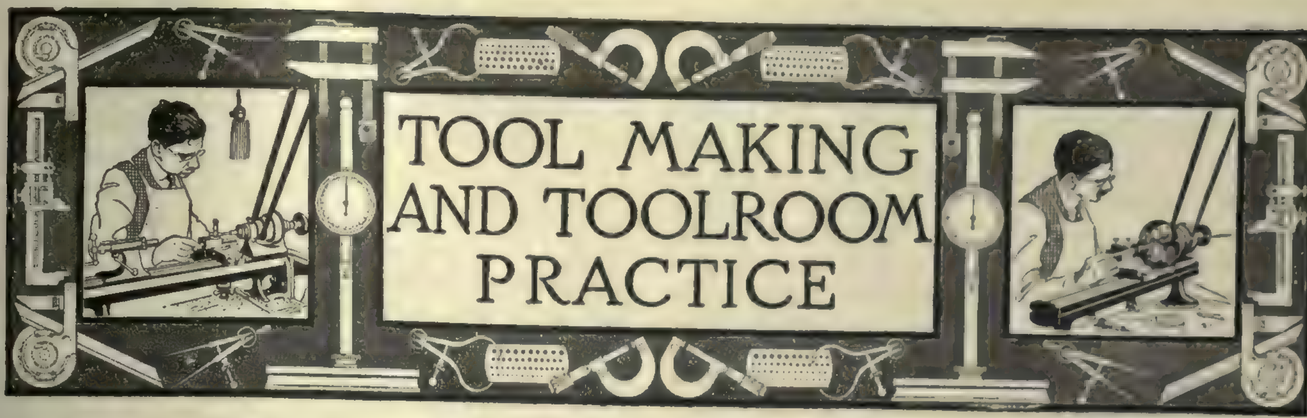
The opinion in these factories seems to be that for factory floors these wooden blocks are far preferable either to concrete, composition or planking. They last for a long time, in some shops where they have been used extensively; and all worn-out planking and concrete floors are being replaced with wooden blocks, with satisfactory results. Two important items quoted in their favor are a saving of wear and tear of equipment and a lessened breakage on account of any material falling on the floor.

Flooring of this kind can be used either indoors or out, but to secure complete satisfaction it should be carefully laid. Some of the classifications require a concrete foundation, struck (or covered) with pitch, but without any sand cushion. The blocks are to be laid after the pitch has become set, so that a bounding action takes place between the creosote in the blocks and the pitch of the foundation. The blocks are laid on end.

The only objections noted, are that they are a trifle harder to keep clean than other floors; also they require more power in pulling trucks over the floor on account of greater friction between the pavement and the wheels.

Course in Management of Personnel

It is interesting to note how the importance of the personnel of organizations is becoming recognized more and more each year. This is made evident by the establishment of a course in the problems of personnel-management at Columbia University, New York, under the instruction of Ordway Tead, Industrial Counselor. This course is designed especially for those who are either training for, or engaged in the work of dealing with employees in factories or other business establishments. It deals primarily with the problems that center about the maintenance of an efficient and willing working force, includes labor turnover and methods of recording and analyzing turnover costs. It is an extremely important subject, particularly at this time, and seems destined to interest many shop managers and others.



Elements of Gagemaking—IV*

BY C. A. MACREADY

Slender arbors and gages are apt to warp in hardening. Methods are given for straightening and truing such work. The grinding of slender gages, the use of temporary plugs, the distortions caused by excessive lapping and some special types of laps are also fully covered.

IT HAS been mentioned that the outboard end of an arbor, that is, the end supported by the tail center on which bushings are ground, must be made to run true before the body of the arbor is ground. This is also necessary with some classes of plug gages and will be made plain by referring to Figs. 61 and 62. It is obvious that if the center *A* of the arbor *B*, Fig. 61, is normal as shown by the dotted lines, and is sprung down and held by the tail center in line with the axis of the lathe spindle, it will spring out of true again when the tailstock center is released. When the lathe spindle is rotated this will apparently show a really straight hole to be curved, and will also seemingly prove that two holes which are in perfect alignment, as *A* and *B* Fig. 62, are out of line. A curved hole in one of the bushings will show this same effect when the test, Fig. 62, is made with a straight arbor, the curved hole bending the arbor out of true.

Arbors and plug gages of small diameter are made from drill rod about 0.015 in. larger than finished size. The size and length determine whether male or female centers should be used. Generally speaking, diameters below 0.125 in. work better if they are turned on the end to a 60-deg. included angle. Sizes above 0.125 in., if their length will allow it, are centered in the usual way by drilling and countersinking.

Plug gages that are strong enough to be ground in large cylindrical grinding machines will not be described, as they are not usually affected by the warping effects caused by grinding and lapping. However, when long slender plug gages are ground and lapped these effects which cause distortion must be taken into consideration. It may be mentioned that the style of lap used for small work can often be employed to advantage on large.

The process of hardening and straightening small arbors is the same as that used when making plug gages, except that arbors for supporting bushings while being ground are finished to size with an oilstone, while gages are lapped. This will be taken up later together with the making of plug gages.

There are several things to be considered in grinding out distortions: the way the work (arbor or plug gage) is held while being ground, the accuracy required at its end, and whether or not it is steadied by the tail center. It is evident that the shorter the work the less chance for vibration during the grinding operation. The most accurate way of making the outside of a bushing concentric with its hole is to remove all elements liable to cause errors. For this reason grinding arbors, used for holding and driving accurate bushings, should be held in a spring chuck without any support from the tailstock center, and they should not be removed from the chuck until the bushings are completely finished. The only class of arbor that requires the outboard end and center to run accurately before grinding the body, is that used to test a hole for curvature. The straightening of this type of arbor will, therefore, be used to show the method taken for straightening hardened plug gages, arbors, etc., which are distorted.

WARPING OF SMALL PARTS

Small arbors, plug gages, etc., as they come from the hardening are very likely to be warped as illustrated at *A* in Fig. 63. The wear on such a piece when used as a gage comes at the end and gradually decreases to nothing at about $\frac{3}{4}$ of the measuring length from the end *B*.

An assembled plug gage and handle are illustrated in Fig. 64. *D* is a cross-section of the knurled soft-steel handle with a plug gage *E* in place. At *C* a neck should be sunk in after grinding. The hardening only extends to the neck which is left soft and is therefore a help when straightening. Enough heat should, if necessary, be applied between *C* and *A* to show a light straw-color. To make the end run true the work is bent at *C*.

Generally these small plug gages can be straightened to within the allowance necessary for grinding with the combination shown in Fig. 65. At *A* is a cross-section of a piece of drill rod with a hole drilled in it, large enough to clear the plug gage freely, and deep enough to take the full length of the hardened part of the gage.

*Prepared for the author's forthcoming book on gagemaking.

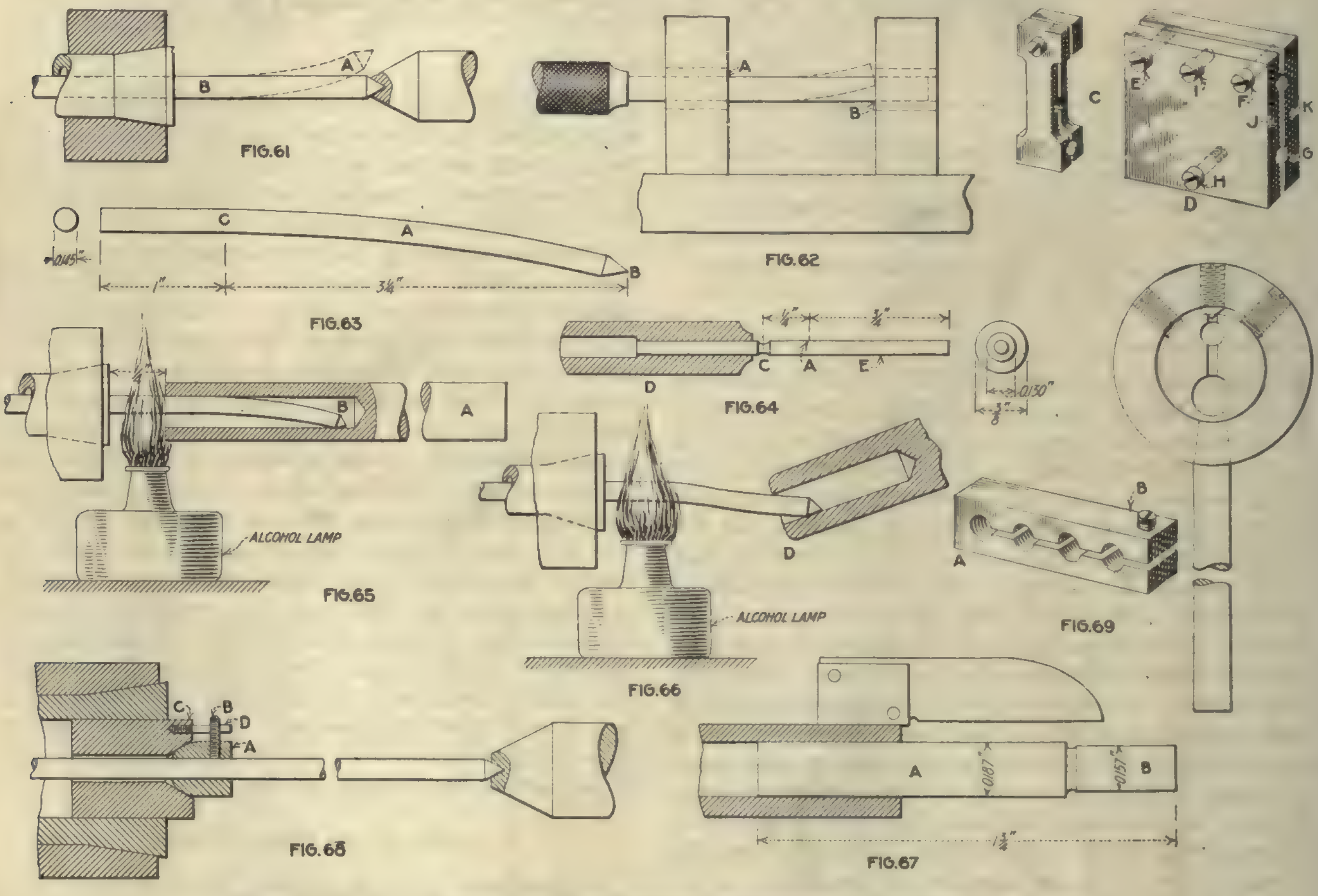
An alcohol lamp is used as shown to heat the work before bending.

It has been mentioned that the heat required to produce a light straw color is an advantage. The hotter a piece is, the easier it will take a permanent set, when bent, but care should be taken not to heat so hot that the work is softened. Heat to a large extent duplicates what is called "seasoning"—that is, that condition of permanency at which hard steel arrives after a period of time. This is a condition of stability caused by the stresses in the steel having adjusted or equalized themselves.

The work is held in a spring chuck and the full length of the hardened part, if it runs out of true, is allowed to extend beyond the chuck. Otherwise the true running

A curve that is similar to the one illustrated in Fig. 66 will cause the work to bend at the point wanted if the pressure is applied at the right place. But there is no hard-and-fast rule to determine exactly where and how to bend, this will have to come with practice.

After the work is straightened to within the grinding limits it is placed in the chuck at the point where the "neck" *C*, Fig. 64, should come, as at this point it is intended to be soft, and if not soft should be made so. An indicator is placed at the end of the work, and the work can be bent at this soft place with a pair of pliers applied close to the chuck, until the end runs true. If the end shows out of "round" it should be ground cylindrical. To grind the end, the work is pushed into the spring chuck so that it will only protrude a short dis-



FIGS. 61 TO 69. ARBORS, STRAIGHTENING METHODS AND EXTERNAL LAPS

part should extend out about a quarter of an inch. The spindle is turned to bring the "runout" *down* as shown at *B*, Fig. 65. The straightener *A* is smeared with oil on the outside, and encloses the work up to about a quarter of an inch from the spring chuck. This allows the heat from the alcohol lamp to be communicated to the work at this point, and run by conduction into the part held in the spring chuck. In the meantime the straightener *A* is also being heated. The heat is radiated from the straightener to the work and when the oil on the straightener begins to smoke the enclosed work is generally warm enough to bend without breaking. The place where the stress is exerted to bend the work should be where a gradual curve will end at the mouth of the spring chuck. If the work is hardened at that point never make a sharp bend at the mouth of the spring chuck unless a "temper" color shows.

tance. Grinding the end will often balance a short kink at the end where it would be hard to bend into place, beside making it what it should be to produce "round work."

There are several other conditions beside the "runout" at the end that will cause errors to develop in long slender work; the tailstock center not in line with the spindle axis, the effects of heat when dry grinding, too much stock left to finish to size by lapping causing aggravation if a narrow lap is used.

Plug gages having more than one gaging diameter, like *A* in Fig. 67, are often ground without centering as the different diameters in order to be concentric should be ground at one setting. The plug gage should be first rough ground all over close to size, and the part *A* should then be finished ground leaving the part *B* to be finished last.

The apex of the cone of the female center (if distorted in hardening on the taper shank that fits the tailstock) will not be in line with the axis of the live spindle. If in doubt as to the alignment of the tailstock center, test it at the end of the work with an indicator. Watch for a movement of the pointer when the center is made to bear on the end of the work. Indicate on the top and one side of the work when making this test.

In Fig. 68 centers are shown that will obviate these defects, and also allow the work to be as short between centers for grinding as it is possible to have it. The piece *A* is of drill rod, drilled a free fit for the work to be ground. A small setscrew *B* attaches *A* to the work, and also acts as a dog to drive it. A female center *C* is made from a piece of drill rod large enough to have a female cone turned in it. It also has a clearance hole for the work drilled through it. A pin *D* is fitted in *C* to drive the work. The piece *C* is finally held in a spring chuck and the 60-deg. included angle is turned in it so that it will run absolutely true. It is used, and, if taken out of the chuck, it should be retrued after chucking and before using again.

It will be noticed that the end of the piece *A* that bears in *C* is rounded enough for it to adjust itself to the conical seat in *C*. This allows *A* to seat like a ball and socket and corrects any evil effect due to lack of alignment. The piece *A* should be hardened.

Should there be a short kink in the work, it can be taken advantage of by placing the work in *A* so that the kink will be at the opposite side from the setscrew *B* in *A*. All hardened gages should be heated until soft solder will melt when in contact with them, with half and half solder the temperature would be about 400 deg. F. The use of solder has not been mentioned in connection with straightening hardened work but will be explained later.

The amount that should be left for lapping is governed by the fineness of the finish left by the grinding wheel. On large stiff work about 0.0003 in. will be sufficient, but on these small slender plugs much more than this amount will be required as on account of the heat and vibration of the work the wheel will not grind the work so smooth and round. It is desirable to keep the lapping allowance as small as possible, and it will be good practice to make a trial surface and measure the diameter before and after lapping to a finish and thus determine the amount of metal to leave on the work for finishing to size.

Temporary Plug Gages for Assembling Gages

The plug gage that goes with the finished ring gage should be a true cylinder. Plug gages used when making certain female gages have to be made so they will not take the objectional "set" mentioned in the first article. It is very evident that if a female gage is assembled upon one or more plugs and they become set it would be impossible not to disturb the temporary assembly if the plugs have to be withdrawn. This can be overcome by making the temporary plugs with spaces to contain vaseline or mutton tallow, the lubricants used. If a piece of drill rod or tool steel is turned to the size of the finished female gage, then knurled, hardened, ground and lapped it will be found to make an excellent assembly gage. It can be lapped to a size that in a continuous surface would take a set requiring the use of a hammer to separate it. The knurling, after being partially ground and lapped, leaves a series of narrow oil and air grooves, and the plug and ring are efficiently lubricated by the oil in these grooves. As the ability to take a set is something very desirable in some cases the amount of set can in this manner, be regulated to suit the conditions required.

If an arbor is oilstoned after lapping it will be found that there are spaces for the lubricant. With an oilstoned arbor a bushing can be located tight enough to drive it, but not so tight as to cause a displacement of the arbor when it is taken off.

Laps for Plug Gages

Several different styles of external cylindrical laps are illustrated in Fig. 69. They will be found to work satisfactorily and are cheap to make. At *A* is a step lap that is a rapid rougher and duplicator of size. It is made of cast iron, all the holes being drilled and reamed to the size required. The number of holes will be determined by the size and the number of plugs to be lapped. The holes are used consecutively. No. 1 is used until it has worn too large, then No. 2 is used and so on. The holes will be slightly different in size when worn, but the adjusting screw *B* can be tightened to take up the wear; the same process being repeated until the desired finished size is obtained.

When lapping cylindrical work the laps must be given a quick lengthwise movement to avoid lapping rings in the surface of the plug gages. These rings will be readily discovered, when nearing the finished size, by stopping rotary motion and pushing the lap lengthwise of the gage, at the same time revolving the spindle slowly by hand. There should be left for this final finish about 0.00005 in. which is removed with a lap that has not been used for a rougher, merely using the oil in the abrasive dish after the relatively coarse abrasive has settled to the bottom.

A lap will wear "bellmouth," which will leave an oversize diameter on the plug gage close to a shoulder. This can be reduced with a narrow lap like *C*, Fig. 69.

Distortion Caused by Excessive Lapping

As the size of the work is reduced, it will not so readily resist the localized effects that tend to cause distortion. Where there is great length as compared to diameter there is a tendency for the distortion to be excessive. For such work a long lap like the one shown at *D* is ideal as it covers a large part of the work and its action is not liable to result in these local distortions.

If one will consider the pressure required to compel the abrasive to remove the hard surface of the work, even though the amount removed is very small, the reason for the distortion will be readily understood. The more uniform the cause, the more uniform will be the effect. For this reason the extreme length of the lap *D*, in comparison to its diameter, results in a more uniform distribution of the lapping pressure over a larger area, and a consequent reduction in lapping pressure on any given unit of surface.

It will be noticed that there are three screws in a line in lap *D*. The middle screw *I* is tapped into the upper part *J* and its point impinges on *K*. It acts as a stop, and also as a fulcrum, so the end screws *F* and *E* can

close the hole in the lap at the ends. This overcomes bellmouthing. These laps are made in two pieces *J* and *K*, retained in position by the locating wire *G* and screw *H*.

In the large grinding machines the effects of the heat from the wheel are neutralized by cooling solutions, but as it is impracticable to use solutions on a small bench lathe the errors which result from heat are allowed to take place and are corrected afterward.

(*To be continued*)

Development of Air Hoists

Special Correspondence

Compressed-air hoists, which are now so extensively used in machine shops, foundries, boiler shops, locomotive shops, railroad repair shops, and in fact, whereever it is necessary to lift any considerable load, were devised in the shops of the Chicago Bridge and Iron Works, South Chicago, in about 1891.

In constructing the hoist a piece of cast-iron pipe was utilized. This was threaded on each end, and caps or heads were affixed: the one at the lower end having a stuffing box through which passed a rod connected to a piston, and designed to be connected by a chain to the object to be raised; while the head on the upper end was provided with means for its attachment to a wheel adapted to move on a track. The air hose was connected to a three-way cock located at the bottom of the cylinder, thus permitting air to be admitted to and exhausted from the latter, or its supply thereto entirely cut off.

A large number of these hoists in varying sizes were used and found to be of great benefit in lifting, and carrying loads to different points. However the workmanship was crude and the escape of air prevented the load from being held for any considerable length of time in its suspended position. Further than this, the piston was permitted unimpeded upward movement, and in consequence, when a light load was being raised and the air turned on too suddenly, the piston would strike and break the upper head. The Chicago Bridge and Iron Works, made no attempt to market this device, but did manufacture a considerable number on special order for those who had seen the hoist in operation.

One of the first concerns to adopt the hoist was the Ames Iron Works, Oswego, N. Y. This was in 1892. The initial introduction was that of a single hoist in their machine shop, and it proved so convenient and valuable as a time- and labor-saver, their shops were soon fully equipped. Hoists were later installed in the boiler shop.

The attention of the Pedrick & Ayer Co., Philadelphia, builders of machine tools, being directed to the compressed-air hoist, and they appreciating its merit and the possibility of an extensive sale, began the refinement and manufacture of the hoist on a commercial scale. The cylinders of the hoists for those of the light class were of seamless brass tubing with the bore accurately machined to prevent air leakage. The larger sizes were of the cast-iron pipe construction employed by the Chicago Bridge and Iron Works; but in both instances the workmanship was that of a high-grade machine shop. The Pedrick & Ayer Co. also designed and manufactured belted air compressors, and thus were in a position to supply a complete hoisting outfit. Their connection with machinery dealers and with the railroads was wide, and the pneumatic hoist was quickly taken up by those to whom it was presented. The business of the Pedrick & Ayer Co. was soon discontinued owing to financial difficulties, and the hoist branch taken over by the Q. & C. Co., of Chicago. By it, the hoist was in no way featured, and was sold only as an adjunct to a number of specialties principally used by the railroads.

The first concern to direct its efforts seriously to the perfection of the compressed-air hoist, and to go into the matter in a whole-hearted manner was the Curtis & Co., Mfg. Co., St. Louis, who started the manufacture of hoists in 1893. They established a separate branch in their manufacturing establishment devoted solely to the development, improvement, and manufacture of the hoist, and made rapid strides in its introduction.

The single-acting hoist heretofore described as being crude, is still manufactured, but it is only put to the simplest of uses: for in addition to the liability of fracture of the top head it has the further fault of requiring external force to lower the piston rod after the load has been released.

Positive Control

Where positive control is required, the balanced pressure hoist is by far preferable to the simple hoist. In this construction of hoist, the under or lifting surface of the piston is at all times subject to air pressure, and the upper surface subject to full or no air pressure, as may be desired. As the area of the piston rod passing through the stuffing box makes the effective area of the two sides of the piston unequal, the tendency is to force the latter to the lower end of the cylinder by a force proportionate to the area of the piston rod; therefore on air being exhausted from the upper end of the cylinder, the piston rod with its load is caused to rise with a speed depending on the rapidity with which the air is withdrawn from the upper end of the cylinder. The speed regulation in a hoist of this description is particularly refined, and it is surprising how accurately the load can be raised to almost the slightest fraction of an inch, making it particularly adaptable for machine-shop use. A load can be sustained for as long a period as thirty minutes without any appreciable drop.

The uses of the compressed-air hoist in vertical and horizontal form are many and varied.

Motor hoists are also extensively employed, and particularly where there is a lack of headroom. In the case of the motor hoist the well-known drilling- and reaming-machine motor is utilized, and is geared to the hoisting drum. These hoists are absolutely dependable, but the motor construction makes them entirely too expensive for general adoption, and the straight-line hoist has the preference.

As the quick and economical handling of materials is of vital importance, lifting is now generally performed by the compressed-air hoist instead of by hand. Floor space otherwise congested is kept clear for new work. The time of passing a job from one stage to another is reduced, and a general all-around saving effected.

Automotives in the Great War

By COKER F. CLARKSON
General Manager of the Society of Automotive Engineers

THE following statement was made by the officer in charge of the transportation division of the Quartermaster's Department concerning the work of members of the Society of Automotive Engineers on standardized designs of United States war truck: "Of those who are now pressing forward and contributing their services for the purpose of ending the war, none has given greater or more patriotic service than this body of highly trained, highly educated, and high-minded motor-truck specialists."

During the year 1916 this officer had maintained close relations with the Society of Automotive Engineers, and in conjunction with a committee of the society prepared a draft of military truck specifications for the department. The Truck Standards Division of the S. A. E. entered earnestly into coöperation with the Quartermaster's Department and with representatives of other bureaus of the War Department, with a view to providing suitable specifications for military trucks. The society called officials of the National Automobile Chamber of Commerce into conference, and asked representative truck-manufacturing companies to send their chief engineers to a meeting to consider the military-truck needs of the Government. This resulted in a convention of fifty or more engineers and others. The action taken was the appointment of a committee which later became the Truck Standards Division of the S. A. E., composed of the engineers of five companies which manufacture trucks, five companies which assemble trucks, the engineer of a truck factory not making the type of truck being deliberated upon, and the truck engineer of the Quartermaster General's office. After joint meetings of this committee with the War Department Motor Transport Board, a revised set of military-truck specifications was issued last April.

Conference of Engineers

Later, a conference was held of engineers of companies engaged in the production of various units entering into the construction of the trucks, including the engine, transmission, axles, springs, universal joints, frame, radiator and fan. The purpose was not to modify the War Department's specifications but to bring about such interpretation of them as would result in the production of parts as well as of complete trucks, in sufficient number to supply the army adequately with trucks of proper type, the assembly units to be interchangeable so far as possible. To a limited extent the parts of units of different make were to be interchangeable. The manner in which truck- and parts-manufacturers coöperated in this work was most gratifying and afforded additional manifestation of patriotism in a matter of vital importance to military operations.

In July the Government announced that it had decided, as a matter of military exigency, to standardize complete designs of war trucks, practically all the component parts thereof being interchangeable although made at widely scattered points. Committees, constituted in very large part of members of the Society of Automotive Engineers, were promptly put to work. Early in October samples of the U. S. heavy-duty war truck (Class B, rated by the Government at 3 tons, but of practically 5 tons commercial capacity) were on the road; several samples of the U. S. medium-duty war truck (Class A, Government-rated $1\frac{1}{2}$ tons, but substantially a 2-ton commercial truck) have been in operation for some weeks, and by the middle of this month samples of the light-duty war truck (Class AA, $\frac{3}{4}$ ton) will be under test. These models are new, specially designed from the ground up in almost every respect. The broadest experience of the best specialists and experts has been drawn upon; and the detail belongs to the best which experience has been able to approve.

The public does not appreciate fully the value of the scientific and technical organizations back of the factory engineers. While all automotive engineers are competitors in a selling way, a close and confidential scientific basis underlies their work as a group and individually. Obviously this coöperation has had a commercial effect on the motor car, the motor truck, the motor boat, the airplane, the farm tractor and other automotive products. It has much to do with progress through engineers toward ideals sought by all.

The Efficiency of the Motor Car

A great part of the efficiency of the motor car and of the motor truck of today is due to the splendid manner in which the proceedings of the Society of Automotive Engineers have been conducted by its members. If each of the manufacturers had worked solely on the knowledge of the engineers employed by him, we would not yet have seen cars of such perfection as has been attained, or cars sold at the relatively low prices.

The nontechnical mind does not really appreciate the vital importance of standardization. To the average layman standardization frequently means that each and every car has an engine, clutch, transmission, frame, springs and axles of approximately the same general or identical makeup. Fundamentally in the commercial sense it is none of these big units that causes trouble to the automobile engineer or builder, or needs standardizing. The comparatively small things, different merely because they are different and for no good reason, are the things that keep purchasing departments in hot water, delay production and increase cost, not to speak of delayed and increased work of designers.

The tube mills reported to an S. A. E. investigating committee some years ago, that not less than 1600 different sizes of tubing were being called for by the motor-car trade. Few, if any, standard sizes could be stocked because of the minute though immaterial difference in the specifications of each individual case. Before commercial standardization was established by the Society of Automotive Engineers, there were innumerable special dies, gages and jigs. Over 600 distinct lock-washer designs were specified between the bolt sizes of $\frac{5}{16}$ and $\frac{5}{8}$ in., whereas three dozen were more than sufficient. Metals and metal alloys of every conceivable analysis were being ordered.

These are merely surface examples indicating how

the lack of standardization complicated engineering and purchasing and manufacturing problems—to say nothing of the enormously increased cost of the finished product, due to lack of uniform manufacturing limits and patterns.

The Liberty airplane engine and the war trucks are not examples of standardization in the commercial sense, but of military designs dictated by war needs. The standardization by the Government of the necessary designs of all kinds of self-propelled vehicles operable on land or sea, or in the air, is one of the chief factors in determining the outcome of the great war. A very large number of war-emergency machines are now being manufactured after designs submitted by automotive engineers working in coöperation with army officers. The term "automotive" includes the automobile, aëronautic, tractor, motorcycle, marine and stationary gas-engine fields; in fact it includes every type of self-propelled vehicle. The design, production, operation and upkeep of these classes of apparatus are of the utmost importance in time of peace. During a period of war the problems become multiplied many times because of their magnitude and the pressing importance of speed in their solution.

In the last analysis war as fought today is substantially the matching of great engineering enterprises. In the long run the side with the best engineering genius (including productive and organizing ability) will win the contest. The ramifications of engineering accomplishments are infinite. They include the automotive, mechanical, civil, mining, electrical, chemical, sanitary, marine and railway fields, not to mention others of scarcely less importance. All these are inter-related and interdependent.

An Organization of Motor-Transport Service

The organization of the motor-transport service required by modern armies, is a problem worthy of the best engineering talent, and one in which the automotive engineer has done splendid work. The unusually severe service conditions make the problems to be met in keeping a fleet of army trucks in operation, far more serious than those encountered in normal peace service. As a result of years of preparation and experience on the part of the S. A. E., along standardization lines, the Government now has in production war trucks which are not only rugged and finished as designs, but capable of being produced rapidly; and they are simple and easy to repair, the parts being made with a view to easy renewal and absolute interchangeability. For many years the society has been carrying on an extensive program of standardization. In every possible case the standards created by the society have been made use of in the design of these war trucks, and what is quite as important is the fact that an S. A. E. organization accustomed to producing standardization work was already in existence and proceeding smoothly.

The work of the society's members has not by any means ended with the completion of the designs. The Government organizations by which such matters as the production, inspection and operation of automotive apparatus will be handled, are made up largely of automotive engineers, a surprising percentage of whom are members of the S. A. E. who have entered the service. The engineer corps will use a large number of trucks for the handling of materials. Doubtless these will be for the most part of the types designed by the Quartermaster Corps in coöperation with members of the S. A. E. Light, high-speed trucks to act as airplane tenders will be employed by the Signal Corps. The medical department will use the same chassis, the Class AA ¾-ton truck designed by the Quartermaster Corps organization. The Marine Corps and the Navy Department also will use this truck in considerable numbers. Incidentally, it will be put into service in quantity in this country, by the Post Office Department. The first Government-owned, motor-vehicle, postal service was established in Washington in October, 1914. This service has been extended to Boston, Buffalo, Chicago, Detroit, Indianapolis, Nashville, Philadelphia, Pittsburgh and St. Louis; and according to schedule was to supersede contract service in Brooklyn and New York the first of this year. As an indication of the efficiency of this service, it can be stated that in one of the cities where it was in operation during one year, the motor trucks engaged in the transportation of mail between the depot and the post office were scheduled to make 384,526 trips, and there were only 132 failures, or one failure to every 2913 trips. Government-owned, motor-vehicle service will be extended as fast as conditions permit. Experience has demonstrated, the Postmaster General reports, that trucks of the same size should be of a single type for the reason learn to operate a truck of single type. It is, theresary to keep in stock repair parts for each type. When chauffeurs are compelled to familiarize themselves with the operation of trucks of different kinds, they render less efficient service than when they are required to learn to operate a truck of a single type. It is, therefore, argued that the department should adopt a standard truck for use throughout the service. This can be accomplished in either of two ways: by adopting one of the standard makes of truck best suited to the needs of the service, or, by adopting a Government design of truck. The first plan is not believed advisable because it would give one company a monopoly of the business and stifle competition. For that reason it is thought by the department that the second plan should be followed.

An Economical Form of Mail Service

The operation of motor routes not only represents a more economical form of mail service to the rural communities, but also permits of the establishment of a wider postal zone from the larger and more important trading and postal centers. This means a better supervision of the service and the extension of the local-zone rate on parcel post from the larger towns to a vastly greater number of families, giving them improved facilities for trading and at the same time increasing the utility of the parcel-post feature of postal activity. These are considerations that demand the most careful attention in these times of excessive costs for foodstuffs and other necessaries of life.

A considerable number of contracts have been awarded, requiring the use of motor vehicles in the transportation of mails in the star route service, resulting in material reductions in schedule running time. By this means mail is not only delivered to a large number of post offices of considerable importance located on branch lines of railroad where trains do not arrive early in the

day, or at points more or less remote from the railroad, considerably earlier than would otherwise be possible; but where rural delivery routes emanate from such offices the expedited schedules on the star routes has had the effect of causing the mail from surrounding cities to be delivered on such rural delivery routes 24 or 48 hours earlier than formerly, with equivalent advances in the dispatch of outgoing mail.

In the Ordnance Department the necessity for greater speed and tractive effort, as well as the increasing scarcity of horses, have made necessary extensive motorization of equipment. Accordingly another group of automotive engineers, S. A. E. members for the most part, familiar with the design of tractors, has been working on the problem. Heavy ordnance, which heretofore it would have been inpracticable to move successfully, is now drawn over ground almost impassable otherwise than by means of this modern motive power. In addition to the tractors used by the Ordnance Department, a large number of four-wheel-drive trucks are provided for the handling of ammunition. The accomplishments made possible by the use of the so-called tanks, form one of the most interesting chapters of the great war. The troops of this country will be provided with equipment of this character second to none in use by the Allies. It may be noted with just pride that the work involved has been in the hands of competent automotive engineers, many of them being representative S. A. E. members.

The Motorcycle for War Purposes

The motorcycle as now used for war purposes is made in two- and three-wheel vehicles for dispatch work and for transporting machine guns. Here again the society has rendered effective assistance to the Government in the standardization of parts, the Secretary of War having delegated officers of the Quartermaster Corps to confer with a society committee on problems relating to the development, standardization and use of the motorcycle. The work of the society's committee on this subject compares favorably with that of other committees and individual members already mentioned.

The automotive engineers have had a most important part in the conduct of the Government aircraft program. It is well known that the development of the Liberty engine is properly credited to engineers who are members of the Society of Automotive Engineers and whose work has been greatly facilitated by the present and past activities of the society. Due credit must, of course, be given to the Allied Governments for data furnished to our engineers who designed the Liberty engine, but it should not be forgotten that this engine is strictly an American product, having been designed for rapid production, standardization and interchangeability of parts, factors not realized to the same extent in other designs. The benefit which this will have in increasing the effectiveness of our fighting contingents at the front can scarcely be overestimated. The aviation engine is, of course, a high-strung piece of apparatus, one that must develop great power with minimum weight. The engine operates under full load and at high temperature practically all the time, so that its depreciation is relatively rapid. This in turn greatly increases the service problem and new parts must be supplied frequently in order to keep the maximum number of machines in operation. Here again we realize the importance of standardization and the necessity for absolute interchangeability: factors long appreciated by automotive engineers and practiced especially in the automobile industry in this country. The society is justly proud of the work its members have done in connection with the production, inspection and upkeep of aëronautic apparatus. There is no more important work than theirs. In addition, the possibilities for development in the aëronautic field following the war are almost unlimited. A careful study is being made in connection with the National Advisory Committee for Aëronautics, looking to the development of a practical type of airplane for carrying mails, and the details are being worked out for the establishment of a number of airplane routes between several of the commercial centers which are to be put into operation as speedily as satisfactory machines can be obtained for the purpose.

The Submarine Problem

The submarine problem may possibly be solved by the adoption of one of the designs of large seaplanes now being perfected. The development of such types of aircraft is rapidly progressing and their activities are expected to have an important bearing upon the outcome of the war. The flying-boat no longer is a matter of speculation. It has proved possible to build a machine with the seaworthy qualities of a small yacht and at the same time able to take the air, for the purpose of locating and destroying submarines. The seaplane is not, however, the only type of craft for marine use in attacking the submarine, which has been developed by the automotive engineers. The submarine chaser is another of their war products. The design and construction of engines used in many of these submarine chasers constitute another of the problems that automotive engineers have handled with marked success. The production of the boats by standardized processes has been a very great achievement.

The development of small stationary or semi-portable units for the operation of the wireless set, the searchlight, pumps, isolated electric lighting plants, and machine tools in portable repair shops, is another achievement of automotive engineers. The machines mentioned perform highly important functions in the great military organizations of modern times, and those responsible for their design and operation deserve equal credit with those who have contributed to the more spectacular forms of modern warfare.

The development and production of the farm tractor constitute a branch of automotive engineering of equal importance with that having to do with any direct military activities. The farm tractor is playing a tremendous part in the production of food. It is well recognized by all who have investigated the subject, that the total production of food in this and other countries can be further increased enormously by the application of the farm tractor in many forms, small as well as large.

S. A. E. members are performing valuable service in the prosecution of the war in innumerable ways. In any branch of the service whether here or with our men in France, where automotive apparatus is made or used, there will be found the automotive engineer striving to do his part, always willing to coöperate with his fellow men, and always looking for more work to do.

Interchangeability, Tolerances and Finish

BY J. P. BROPHY
Vice President and General Manager, Cleveland Automatic Machine Co.

In times when it is highly desirable that all sorts of tools and parts be produced with the greatest possible speed, the questions of interchangeability, tolerance and finish become very important. This article presents the ideas of one member of a firm manufacturing machine tools.

THE word interchangeability, is not seriously enough considered in thousands of instances on the drawing board.

When designing a piece of machinery where the parts are large or small and the mechanism intricate, it seems to be the thought of a great many that because some of the parts have to be a close duplicate of one another, the drawings in general must necessarily all be figured for close tolerances.

There are parts of machines that must be furnished to replace broken or worn parts of like character, and while these parts must be interchangeable there is no use in going to extremes and calling for limits of 0.0005 in. when 0.002 in. will answer the purpose. This would result in greatly increasing the cost of production.

The writer would venture to say that there are thousands of instances where the cost of manufacture is increased from 50 to 200 per cent. through foolish notions of some men in power. Inventors of different kinds of mechanism naturally take great pride in having the article well made, but in many instances this particular machine or whatever it may be, will be just as serviceable, and perhaps more so, if the parts that in the inventor's opinion had to be exact with a slight tolerance, were made with an abundance of tolerance, especially if they are not the working parts. The man to determine this, however, should be strong mechanically.

Interchangeability Should Be Considered

Tolerances marked on drawings should be given as much study as the design of the particular thing under consideration. It takes but a few seconds to place on a tracing three or four figures, which may mean several hours of unnecessary work. That's why the word interchangeability should be considered along the lines of abundant tolerances as well as where only close tolerance is allowed.

There is some confusion about what the word interchangeable means, and a great many are under the impression that when you use this word, everything called for must be extremely close to size.

An ordinary plow can be made interchangeable with $\frac{1}{16}$-in. to $\frac{1}{8}$-in. tolerance all around, whereas if this same plow were considered on the basis of 0.020-in. limits, it would go up in price perhaps 100 to 200 per cent. The same applies to the most delicate piece of mechanism.

Many surfaces on machinery of all kinds should be accurate and one piece practically the same as the other, because of alignments that are necessary and because of the fit between centers, etc. All good mechanics understand this quite thoroughly. There are many pieces that fit on shafts and spindles that do require close workmanship, but extremes in many cases show high costs from the minute your blueprint reaches your toolroom, throughout your factory, in the manufacturing end of the business.

Gages and cutting tools of all kinds, if the tolerance and finish must be extremely high class, are very expensive to make; when we remember that cutting edges must be sharp and always kept that way, in case great accuracies and finish are called for, we know the output will be greatly lessened and the final result, high-priced parts. In many instances, thousands of dollars would be saved and outputs expedited, if such contingencies were considered.

Inspectors Play an Important Part

In relation to interchangeability: inspectors play an important part. Especially on Government work they are given great power, and this being the case, they should be given implicit instructions to avoid recklessness in condemning material that without question is urgently needed.

Suppose a gage is made maximum and minimum sizes for diameters, lengths and shapes; and suppose the piece is a few thousandths over the maximum or under the minimum, and not the exact shape; and suppose a great number of these pieces have been produced—and this increase or decrease in length, shape and diameter, makes no particular difference! The inspector ought to be aware of this and not be too hasty in condemning; he should regard the amount of labor already expended on the parts and the vast amount of work necessary to reproduce these pieces.

The loss is great to the manufacturer who is doing his utmost, and the loss is certainly great to our Government, because these pieces are needed to complete something demanded in this particular war.

The inspector has but one thing in mind; there is nothing flexible about his judgment; he has been sent out as an inspector and he knows nothing but the gage and micrometer, whereas if he were given some discretion by those in power, he could often pass work that he must otherwise reject.

To carry this matter farther: in Government work where two surfaces fit together, they must be absolutely smooth, according to present standards. If the tool should tear the surface in the slightest, the piece is condemned. The same requirement applies to threads of various kinds. Perhaps they are right for size and pitch, but there may be a rough spot on some of the threads which has not the slightest effect on the application of these pieces to what they are intended for. They are good enough in every particular, and if used on ammunition it means they are never used but once. They are not like parts of a machine that has got to be constantly in use for years.

An inspector should be allowed to use discretion in such cases, while at present he feels that should he not condemn, even when he knows the articles to be

practical, he will be reprimanded and perhaps dismissed. Common sense should govern the inspector's decision, especially at this time when every pound of finished war material has a value unprecedented.

Another very important thing to those bidding on Government work, is the realization that rigid inspection on account of the tolerances and finish, must be reckoned in figuring the job. This means the Government always pays high prices for what is made from its drawings.

If the finished article at a cost of $10 would ordinarily be a good enough job for anyone, the chances are that the man who figures will add 25 or 50 per cent. for safety. What does all this mean? Nothing short of costs mounting away beyond a sensible figure. Another result of captious requirements is a tendency to slow up the production of an article. It may be a part of a gun; it may be ammunition; it may be a part of an airplane; it can be part of almost anything that the Government requires in this war.

Machine-tool builders who read this article can easily comprehend what the writer is explaining.

Money Expended Foolishly

There is no question but what machine tools are made close enough as far as accuracy is concerned, but if the closeness were carried to extremes, the price would advance rapidly while the work produced would not be any better nor the life of the tool lengthened. It would mean simply a vast amount of money expended foolishly because of impractical exactions; whereas the machine tools of today are just as good as though the accuracies were extremely fine on every piece of the machine.

There is no end to the protest that might be made when discussing the matter of finish.

If a piece does not require to be ground, do away with this operation. If a piece has got to be hardened, harden it, but if it will work as well without hardening, do away with that extra expense. If a piece is just as good after being turned in the lathe, what is the necessity of placing even a file on it?

Burnished surfaces called for in many instances, are perfectly useless and excessively expensive.

A vast amount of thought must be given to the manufacturing of anything, to keep down the expense of the finished product.

Take, for instance, the springs on an automobile: some of the engineer-martinets are liable to mark the drawing for a spring that should be ½ in., 0.510 in. Now, the ½ in. is a commercial proposition whereas the 0.510 in. is a special size. This practice is common and should be prevented when possible.

A man, strong theoretically but with only a very limited amount of practical experience coupled with some inventive genius, may design something; but the money necessary to build the article is not furnished by him. It is in such circumstances that elaborate drawings, costly shapes and unthinkable accuracies are called for. What difference does it make to the designer who perhaps has a fad for close mechanical tolerances? Perhaps he knows no better. If not curbed, the business will probably be a failure.

Extravagant notions are very prevalent in the mind of such a man who is not experienced in manufacturing. He does not seem to know, nor yet to care, how much the thing is going to cost—a very important matter that should be uppermost in his mind. Those who have been struggling with this tolerance problem for years, fully realize how cautious we must be to not attempt to produce articles almost down to the point of no-tolerance, simply because there is a gratification in saying, "that's the way our product is made!"

There is much more gratification in producing an article that is entirely satisfactory while, at the same time being able to say at the end of the year that your bank account has honestly increased.

In steam engine building, a man's reputation for skill might be excellent; but to build a steam engine as accurately as a machine tool for instance, would be a calamity. This occurred and the results spelled dismal failure. Expansion and contraction never entered the brain of the great mechanic who made some no-tolerance engines. When the steam was applied, those engines slowly came to a stop and were badly damaged—which was one illustration of what going to extremes may mean.

Sewing machines, typewriters, talking machines, and many other common and useful things are interchangeable, but not along nonsensical, no-tolerance lines. If they were they would not be good commercial propositions. That is why the prices for such things are not ridiculously high.

Be careful and not ask for needless duplication. If you do, who pays the excess? Not the man that does the work.

It would be well seriously to think of keeping down the manufacturing costs. Tolerances to suit your fancy but not essential, are money-wasters. Who is the sufferer? Not the man who obtained the contract. You pay for what you ask for and obtain. How about a little more simplicity in the asking!

Finish is important. Do not overdo it. Every minute wasted on fine finished surfaces, round or flat, that are not necessary, may be deemed superfluous.

The Automatic Control and Measurement of High Temperatures*

By R. P. Brown

Probably no employee has caused the average works manager so many sleepless nights as has the furnace man on whose shoulders rests the responsibility for the accurate heat treatment of the steel and the uniformity of the product.

A great amount of study has been given, not only to the perfection of pyrometers, but also to the automatic control of temperature. It has however, been only recently that helpful results have been accomplished in automatic temperature control. First of all it was necessary to perfect the temperature-measuring instruments so they could be relied upon uniformly to indicate the actual furnace temperature. It was then necessary to apply to the pyrometers, attachments to throw the switches on the electric furnaces, or to open or close the valves on gas or oil furnaces. My experience in the United States has shown, that for industrial service,

*Extracts from a paper presented before the Faraday Society of London, Eng., Nov. 7, 1917.

an instrument actuated by the expansion of nitrogen gas is the most satisfactory for temperature measurements up to 800 deg. F. or 425 deg. C. The gas-expansion instrument consists of a bulb of copper which is inserted in the heat, and this bulb is connected by capillary tubing to an indicating or recording gage containing a helical expansive spring.

For use at moderate temperatures where the measuring instrument must be placed at a considerable distance, and for temperatures above the range of the gas-expansion instrument, the thermo-electric pyrometer has been almost universally adopted in the United States. A thermocouple of base metals, usually formed of one wire of nickel 90%, chromium 10%, and the other wire 98% nickel and 2% aluminum, is preferred for temperatures to 1800 deg. F. or 1000 deg. C. For temperatures above this, and as high as 2800 deg. F. or 1500 deg. C., thermo-electric pyrometers using a platinum-rhodium thermocouple, are the most satisfactory. For higher temperatures still, a radiation type of pyrometer is available, consisting of a thermocouple in the focus of a reflector at the rear end of the tube, which is pointed at the door or some other opening of the furnace.

Measuring the Voltage

For measuring the voltage produced by a thermo couple, whether of base metal, platinum-rhodium, or the radiation type, high resistance millivoltmeters are available. Such millivoltmeters are produced by us in the United States, of some 1000 ohms or more. This remarkably high resistance is naturally desirable, practically to eliminate the errors due to changes in the resistance of the line or wiring which connects the thermocouples and the instrument; also to nullify the effects of any changes in the resistance of the thermocouples, due to heating.

Changes in resistance may be due to actual changes in length or changes in atmospheric temperature, which in turn affect the resistance of the line or wiring. We have been able to secure this exceedingly high resistance by reducing the weight of the moving element to a minimum.

The total weight of the moving element in our high-resistance pyrometer, including pointer and springs, is 526 mg. This extreme lightness is secured by the use of an aluminum alloy wire, which we have succeeded in enameling. The enamel coating is much thinner than the silk insulation formerly used, and more turns can be secured on a coil of a given width. Likewise by the use of the aluminum wire, the weight has been reduced 66⅔ per cent. as compared with copper wire which was formerly used for these moving elements. The aluminum wire is 0.003 in. in diameter, and drawing this wire has been quite a mechanical problem.

For even greater precision in temperature measurements than is secured with the high resistance millivoltmeter, I have developed a new instrument, which we call the Brown Heat Meter. This instrument is suitable for either temperature measurement or automatic control of temperature, and a brief description of this new instrument might be of interest.

Briefly, its operation is as follows:

With our standard millivoltmeter of high resistance, we supply an ordinary dry cell about 1¼ in. in diameter by 2½ in. in length, and furnish suitable rheostats to reduce the voltage of the dry cell from approximately 1½ volts to a range from 0 to 60 millivolts—the voltage produced as a maximum by the thermocouples. In our first operation, we oppose the voltage developed by the thermocouple to the reduced voltage of the dry cell; and when the pointer stands on zero, it indicates that the voltages from the two sources are equal. In operation No. 2, we cut out with a switch the voltage of the thermocouple and read the voltage of the dry-cell circuit by direct deflection. This eliminates the line resistance entirely, as in a potentiometer. This gives us a deflection, indicating the actual temperature developed by the thermocouple at the moment of reading the instrument, but fluctuations in temperature of the thermocouple will not be indicated, as we are reading the voltage from the dry cell. We have, however, incorporated other operations in this meter.

In operation No. 3, we connect the thermocouple to the meter instead of the dry-cell circuit, and note whether the indications are the same. By switching back and forth quickly, the voltage from the thermocouple circuit or from the dry-cell circuit can be noted. If excessive line resistance has caused the indications of the millivoltmeter to be lowered, as compared with the dry-cell circuit, a rheostat is operated to bring up the indications of the thermocouple circuit to that shown when we are reading the voltage of the dry-cell circuit. We now leave the instrument indicating on the thermocouple circuit, and the errors if any, which might be due to line resistance or changes in temperature of the line, have been eliminated, and we have a direct reading millivoltmeter, indicating the correct temperatures.

We have eliminated the temperature coefficient of the meter by furnishing a copper resistor in the meter, equivalent to the copper or aluminum of the coil; hence in balancing the voltage from the dry cell against that of the thermocouple, we also automatically eliminate errors due to the temperature coefficient of the meter itself. There are now left only certain possible sources of error: the change in the actual indications of the meter due to sticking of the pointer, abuse of the instrument, spring fatigue, etc. To obviate these chances we can supply with the instrument a standard cell with suitable resistors; and by the same test of the meter by the potentiometer method, the millivoltmeter may be checked. We supply three resistors; for example, where a meter is calibrated for 60 millivolts, we furnish resistors equivalent to a deflection of 20, 40 or 60 millivolts on the scale; and after balancing the standard cell against a part of the voltage of the dry cell we can note through these suitable resistors whether the pointer swings to 20, 40 and 60 millivolts respectively on the scale. If it does not, the error can be noted and the actual error in calibration is detected.

Automatic Temperature Control

Another type of automatic-control pyrometer operates in the following manner: A thermocouple formed of a nickel-chromium alloy is installed in the electric furnace, the temperature of which is being controlled. The thermocouple actuates a high-resistance millivoltmeter. Below the pointer and adjustable throughout the whole scale range, is a table carrying two contact

pieces, separated by a thin piece of insulating material $\frac{1}{32}$ in. thick. The depressor arm driven by a small electric motor or by a clock if preferred, depresses the pointer at regular intervals, usually every ten seconds, and in doing so the pointer forces together the two contact pieces below. The switch connecting the furnace in the line is closed, and the pointer slowly rises across the scale as the temperature of the furnace rises. As the switch is already closed when the pointer is depressed on the low contact, the switch continues to remain closed, and no change occurs until the pointer passes over the neutral insulating piece and is depressed on the high contact. The switch indirectly operated by a solenoid and relay is now instantly actuated and the circuit opened. The temperature of the furnace begins slowly to fall, and when the pointer is again depressed on the low contact, the circuit is again closed. This operation continues as long as the furnace is to be operated.

When the switch opens and closes the main circuit, the current in consequence is either full on or off, and the fluctuations are continuous within narrow limits of some 10 deg. to 20 deg. F. These continuous risings and fallings of temperature can be largely reduced, and closer control can be procured by the use of two rheostats in the furnace line. The solenoid-operated, automatic switch is then used simply to cut in and out of circuit, the second rheostat. Assuming it is desirable continually to maintain 1400 deg. F. in the electric furnace, irrespective of fluctuations of voltage, the two rheostats are set so that with only one rheostat in the circuit the temperature will rise to approximately 1500 deg. F. With the second rheostat in the circuit the temperature drops to 1300 deg. F.

When we now use the solenoid-operated switch to cut in and out the second rheostat, we naturally control the temperature only between 1500 and 1300 deg. F., and we do not have the rapid surges, or ups and downs in temperature, and maximum control is secured. It is realized that the same form of switch can be used to operate a valve to control a gas or oil furnace. We have found it desirable to use an automatic valve in a by-pass so as to control a portion of the gas or oil supply, and in the same manner as in the electric furnace control, eliminate the maximum fluctuations caused by the complete opening and closing of the switch or valve.

In addition to an instrument automatically to control furnace temperatures, there has been a demand for an instrument automatically to signal by lights whether the temperature is too high, correct, or too low in any particular furnace. We have been able to develop an instrument automatically to signal by means of lights whether the temperature is correct or not, and in this way the services of the operator at the instrument are eliminated. The same form of instrument is used for this purpose as we use automatically to control the furnace temperatures, and the pointer is depressed at intervals of every ten seconds on contacts corresponding to the red, white and green lights.

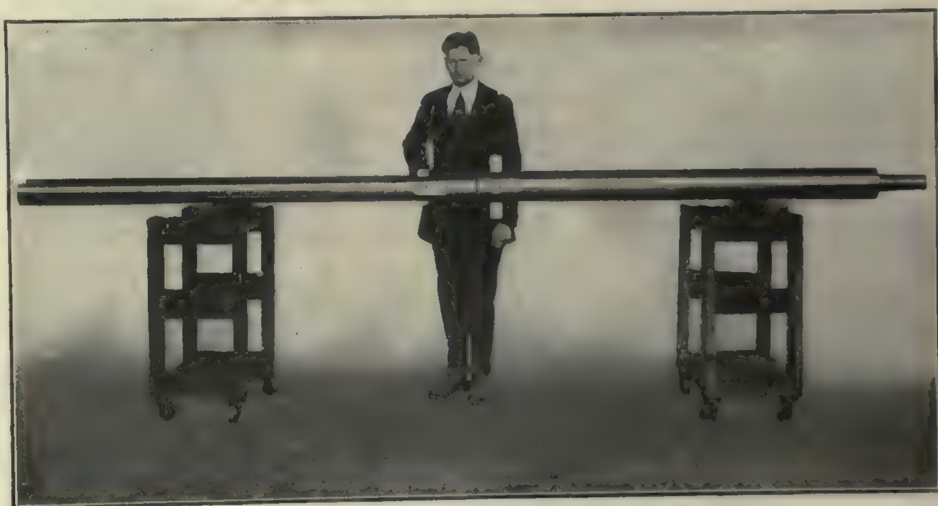
The extensive use of pyrometers to measure or record high temperatures, will serve (1) to eliminate guesswork as to the temperature; (2) reduce fuel consumption through the maintenance of the correct temperature and not excessively high temperatures; (3) reduce time for heating of the product due to the maintenance of the correct temperature; (4) increase efficiency in operating a plant through the savings outlined above.

Instruments automatically to control the temperature, when properly constructed and applied, will eliminate entirely the personal element. The maintenance of the correct temperature in the furnace is automatic; this is one step further, and in consequence an improvement over temperature control through pyrometers.

A Giant Boring Attachment

What is believed to be a record breaker in the boring-bar line has been recently completed by the Davis Boring Tool Co., of St. Louis.

It is made of solid tool steel, 14 ft. 7½ in. in length, and 6 in. in body diameter, with a pilot-body diameter of 5 in. The completed tool weighs 1167 lb. The high-speed steel cutters bore 6¾ in. on the pilot, and 11½ in. on the body. The adjustment in each of these cutters is 1¼ in. controlled by what is practically a micrometer. The tool was designed for boring gun-carriage pinions, and is successfully doing its bit "somewhere in the United States."



THE COMPLETED BAR

National Foreign Trade Convention Postponed

The Executive Committee of the National Foreign Trade Council announces that "owing to the railroad congestion and the desire of the Council to coöperate with the Government in the relief of the situation due to the war," the dates of the Fifth National Foreign Trade Convention to be held at Cincinnati, Ohio, have been changed from Feb. 7, 8 and 9, to Apr. 18, 19 and 20, 1918.

The Davie Gaging Machine for Fine Inspection Work

SPECIAL CORRESPONDENCE

This gaging machine has a wide field of usefulness in the toolroom or inspection department, combining as it does a range from ordinary to extreme accuracy of measurement suited to the work in hand.

THE Davie gaging machine, shown in Fig. 1, is made by the Davie Tool Co., Cleveland, Ohio. It was designed to be used in the toolroom or inspection department instead of snap gages or micrometers.

The advantage of a gaging device in which the measurements are visually indicated, is plain to every mechanic. The "feel" of a snap gage or a micrometer may vary with different workmen or even with the same workmen at different times.

The machine gives three different readings: thousandths, tenths of thousandths and hundredths of thousandths. These different readings are obtained by means of compound levers mounted in a lever box carried on an adjustable column.

These levers which have a 60-deg. angle bearing, are balanced by weights which are adjustable. The balance bearings are of the best-quality tool steel hardened, ground and lapped. One of the principal features of this machine is that the multiplying end of the lever is

FIG. 1. DAVIE GAGING MACHINE

adjustable, thus compensating for any inaccuracy in the fulcrum. In Fig. 2 *A* is the lever for loosening the column *C*. The gaging table *D* is made from high-grade tool steel hardened to 100 deg., scleroscope test, ground and lapped with diamond dust to insure a perfectly flat, hard surface. At *B* is shown the handle which operates the pinion and rack for the approximate adjustment of the table. The lever *F* is for operating the eccentric clamp used in securing the column of the lever box *E* in any desired position. This column has a 15-deg. taper to insure rigid clamping and a free movement when unclamped.

As shown, the machine is set to read 0.00001 in. By removing the screw *K* and placing the indicator unit on

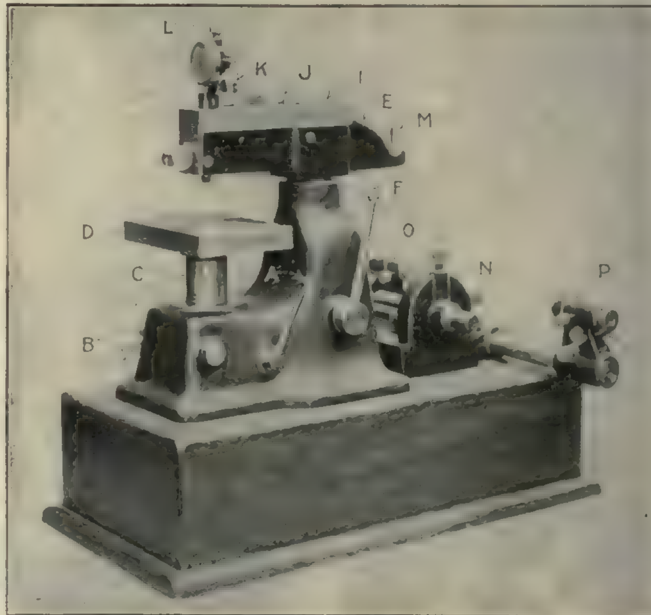


FIG. 2. MACHINE WITH PARTS INDICATED

Specifications—Distance from center of gaging spindle to back of throat, 4½ in.; maximum distance from top of table to end of gaging spindle, 4 in.; size of table, 5 x 6 in.; height adjustment of table, 0 to 4 in.; height adjustment of gage bracket, ½ in.; largest diameter of milling and form cutters, or disks and bushings that can be gaged for concentricity, 4 in.; greatest distance between centers on center test attachment, 13 in.; largest diameter that will swing between centers, 4 in.; maximum height of machine, 18 in.; length, 15 in.; width, 9 in.; total weight of machine, 68 lb.; with attachments, 96 lb.; with hardwood stand, 109 lb.; dimensions of hardwood stand, 7 x 13 x 27 in.

the base *I* so that the indicator spindle comes in contact with the lifter *J*, readings in 0.0001 are obtained. This is the most desirable position for commercial work where limits of 0.0005 to 0.005 in. plus or minus are allowed. Should it be desirable to read only to 0.001, the indicator may be removed by turning the fine adjustment screw *L* which will disengage the indicator which can now be placed on the stud *M* which is tapped to receive the adjustment screw. However, the principal advantage on fine work is the ability to read 0.00001 in. and thus detect the most minute inaccuracy.

At *N* is an attachment for testing concentricity of formed milling cutters, gear-teeth cutters, bushings, disks, etc. At *O* and *P* are test centers which are adjustable on a bar of chrome nickel steel and are guided by a 29-deg. spline for alignment.

These two attachments together with the gaging table *D* have No. 12 Jarno taper shanks, and are interchangeable. The top of column *C* is threaded at the nose and is provided with a backing-off nut used only when a change from the gaging table to one of the attachments is desired or vice versa.

Sidelights

EDITED BY D. BACON

On Aug. 3, 1917, the commandeering order affecting ships in the building and to be built, went into effect. On that day there were already 3,056,000 tons dead weight, under construction; since then 5,617,000 more have been contracted for, and the figures cover ships of steel, wood and composite.

These figures represent 4,402,100 more tons under contract than for any previous year in the history of this country, and we once had a merchant marine at that. What foolish legislation in the past, and laws like that fathered by La Follette have destroyed for us, let us hope the war of the world will restore. With the order for a fleet came the building of plants where it could be made. Thirty-six such plants existed one year ago, Jan. 1. Seventy-four have been created since that day. The first ship was launched 78 days after its building was begun. This ship was an 8000-ton standardized, steel merchantman with a speed of 11 knots an hour: not very great, but it required 450 freight cars to handle the freight. Three weeks later this plant turned out on private contract 13 other ships. It showed what can be done when time and necessity press.

On Mar. 1, the fleet corporation expects to have turned out 1,000,000 tons of shipping. As an item of statistics it is interesting to know that the "shipping board is larger than the steel trust, which represents $1,000,000,000." It is worth twice as much as the Pennsylvania railroad, and Congress permits it to spend $1,800,000,000. On the Pacific coast hulls have been made in 64 days. Meantime, since the order came, plants have had to be erected, homes or at least possible dwelling places created for men, where none at all existed, and spring will see the fleet in the making, for the preliminaries are over.

This thing of war will belong to peace, for there is hardly a manufacturing activity of this war that will not have its convertability into peace-product manufacture. Nothing of the war is so dead-certain to continue as a great peace-time necessity, as this shipbuilding industry. Not a thing that floats will be hauled from the water for decades to come, save for repairs or replacement. All this present and future has come about in five months.

Doubtless it could have been done quicker, but doubtless it never was.

What the Figures Really Mean

The immense demands of the present war have accustomed us to speaking in terms of immense quantities and we speak of millions as glibly as we formerly talked of thousands. Very few of us, however, have any conception of what this really means and, as a means of bringing home some idea of the immense quantity of shells which have been manufactured and used, we are pleased to quote from the remarks of Brigadier General Sir Alexander Bertram, of Canada, in a recent address, in which he tells what Canada alone has done during the past three years.

He says: "We have shipped in shells a sufficient tonnage to build 19 bridges across the St. Lawrence River, each bridge equal in size to that of the new Quebec Bridge. We talked a few years ago of contributing three battleships to the British Navy. Our tonnage in shells shipped to the Empire would build 66 battleships of 18,000 tons each."

Comparisons of this kind, with objects which are familiar to us, make it much easier clearly to understand what these large quantities really mean.

What Has Been Done in "No Time"

A few months ago the Government made an appropriation of $640,000,000 for the manufacture of airplanes, and the vanguard of such an air fleet is at the front, manned and ready to do the business of war. In the spring there were less than 200 planes; today, 22,000 are in the works. When war was declared by us we had 75 aviators; today we have 10,000 in training. The making of $640,000,000 worth of airplanes implies the creation of another new industry: one as unfamiliar to us as the new shipbuilding industry, while unlike the latter, it has no precedent in our country. The sporadic making of planes before war was declared might, speaking metaphorically, have been done in the woodshed; when this new industry began there were only two companies doing business. The industry has been created and permanently established. The Liberty motor was evolved in a week as a result of the intensive getting together of 20 inventors. With our own fabricating operations going strong, there has not been the slightest diminution of our export to the allies of raw materials for airplane manufacture.

Our new business is five months old.

Wings to be Insured

Every sort of insurance conceivable has been thought to exist: Lloyd's insures against Providence itself! Now the insurance of wings has come. The National Advisory Committee for Aëronautics has perceived the need of this insurance, has met for its discussion and the insurance companies have acted with the conviction that the whole world means to take to the air. This way of transportation is not always to be a war exigency, a semi-official proposition; but a commercial fact. As automobiles have revolutionized roads and road laws and society and health, so the dustless route now takes its place among the sure things. When insurance companies get busy we have a sign of the times.

Much Labor: Little System

Secretary Baker said recently: "If all the women in America were to stop doing the things that they are doing, we should have to withdraw from the war," and he was not referring to the sentiment women have brought to the situation, but to their work.

Women have been added to the volume of men laborers, yet shortage is talked of. There is no labor shortage.

There are men who do not know how to place themselves and there are those who have a sort of replacement fever that should be abated by a proper, labor-distribution supervision. It is human to err, and in this difficult moment it will be almost Divine if labor distribution becomes properly systematized. The entrance of women into labor ranks has presented only the most superficial problem: the main point has been proved: they can and will do the business required of them by the times. There are plenty of men and plenty of women to turn out the enormous amount of work to be done, yet the number of unemployed today is matched only by the misemployed.

New Industries in Japan

Twenty new companies have been formed in Japan and they operate 28 new factories. These new factories mostly produce sulphate of ammonia, potassium chloride, caustic soda, bleaching powder, niter, sulphate of potash, potassium carbonate, sodium sulphide, sodium chloride, sodium peroxide, iodine, fatty and stearic acids, nitric acid, disinfectants, phosphorus and other products.

Before the war Japan had use for but half her iron products. Today new companies are being formed to handle all she mines, and new mines are being worked. Three new steel companies have been formed of late. They are producing steamer shafts, railway wheels and tires. Japan is dealing with China and India. One of the new companies will devote all of its commercial operations to an export trade. Five new companies are operating works for the treatment of Japanese zinc; this also is an export medium. An electrolytic process is to be used for aluminum, and aluminum is a product of a certain Japanese clay. Very considerable preparations are being made for this. Galvanized-iron wire has become a manufacturing factor, and the company that formerly engaged in it has increased its capitalization more than 100 per cent. It is an exporter. Companies for the manufacture of machinery are being formed, and companies for manufacturing electrical supplies. New works for the manufacture of textiles exist and more are under construction.

Industrial Centers and the Workman

From Washington comes a statement that homes and proper living conditions are being created for the multitude of women that has gone thither to serve the Government. We shall call these women staff officers. The Committee of Public Information has given the report. The work is being done under specialized forces. The need is present; it is recognized and it is being met.

One of the foremost activities of the wartime has been that of the Y. M. C. A. which sent forth an army of its own to make living conditions for the man soldier. Thus ahead of the army, for the first time in history, went the homemaker. Formerly there went behind, the camp follower. The latter is cut off. First the man soldier and then the woman soldier has been cared for in rational ways. The industrial soldier must now have his day. His need of right living conditions must be recognized and met. Shipbuilding is a newly created industry in this country, and at great shipbuilding plants the home conditions have been almost nil. In every industrial center, henceforth, proper living conditions must be planned and provided for the soldier-in-industry who must stay at home to serve his country best. If eventually, why not now!

Government Coal in Alaskan Mines

The Government has offered for lease, coal mines in Alaska. There were 30 days left from Jan. 1, in which those who desire to rent, may apply for leases. The original period covered 30 days between Dec. 1 and Jan. 1, and that period is extended. There are 760 acres of mining properties that may be acquired, and railroads have already been constructed from mines to main railway lines, or to ports or central places, that the coal may be got out. The Government would like to supply the entire Pacific Coast and the Navy from this Alaskan source, for thus the transportation problem would be considerably simplified. The vast cross-country carriage of coal for the coast would be done away with and the distribution for the Navy be altogether by sea, which would relieve the land-transportation force. Large amounts of machinery and equipment are already being taken in by lessees, for the development of their holdings, and the Commissioner of the General Land Office, Washington, D. C., will give to those interested further information in regard to this enterprise.

The International Parcels Post

Parcels Post service between the United States and Chile ceased to exist by agreement between the two countries on Dec. 25, 1917. The notification reads: "Parcels mailed in Chile before Dec. 25, 1917, which are received at post offices of address in this country after Dec. 25, should be delivered to addresses subject to the usual formalities. Parcels for Chile mailed in the United States subsequent to Dec. 25 and prior to the receipt by postmasters of this notice, will be allowed to go forward to destination." Apropos of postal affairs which are of great import to all just now: all wooden boxes that reached port of embarkation after Dec. 5 will be returned to the senders, if the proper amount of postage for return is remitted to the post office. On Oct. 27 the department announced that wooden-boxed goods for the members of the expeditionary force must reach the port of embarkation on or before the date of Dec. 5 and must weigh not more than seven pounds.

How the Householder Contributes to Manufacture

As long ago as July, 1917, when our war was but three months old, a war report on the municipal garbage can was made. When war was declared an appeal was made to householders to stint the can and spare the country. There had been no systematic saving; no organized, federalized work, yet at the end of three months it was stated that the garbage can had fallen off 48 per cent. If these figures were correct they presented a rather extraordinary commentary on human possibilities at a pinch—and extravagance in former days. Now comes a systematized appeal to spare the can, but all the system in the world cannot produce the great results that human kindness and good will can produce, and when the householder knows that his garbage can averages 4 per cent. or more of useful grease: grease that will help to make the defenses of our country if properly conserved, delivered and applied, it is likely the householder will turn ammunitions maker by saving the grease.

Keys Through Thin Bushings

By Albert F. Guyler

On page 121, Vol. 47, Mr. McCray tells of his difficulty in keying on cutters when a thin bushing is necessary to make the cutters suit the arbors. Some time ago, I had to use a pair of 8 x 1-in. cutters with $1\frac{1}{4}$-in. holes. I found that only 1-in. arbors were to be had,

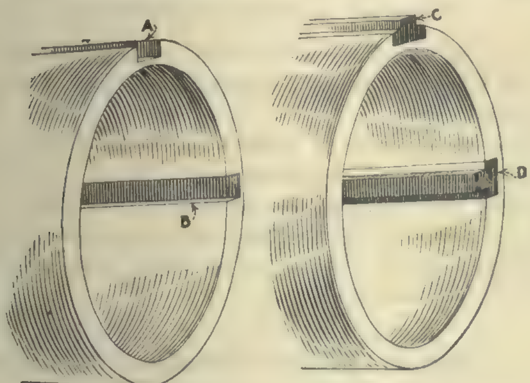


FIG. 1 FIG. 2

FIGS. 1 AND 2. TWO WAYS OF KEYING BUSHINGS

therefore, two bushings were made as shown in Fig. 1. The keyways *A* on the outside and *B* on the inside were made $\frac{5}{64}$ in. deep, and placed at 90 deg. as shown. These bushings were in use for several weeks and are still in good condition, no trouble whatever being experienced. Perhaps had the keys been made as shown at *C* and *D* in Fig. 2, the job would have been stronger but the additional labor was not found necessary.

A Hand Tapping Device

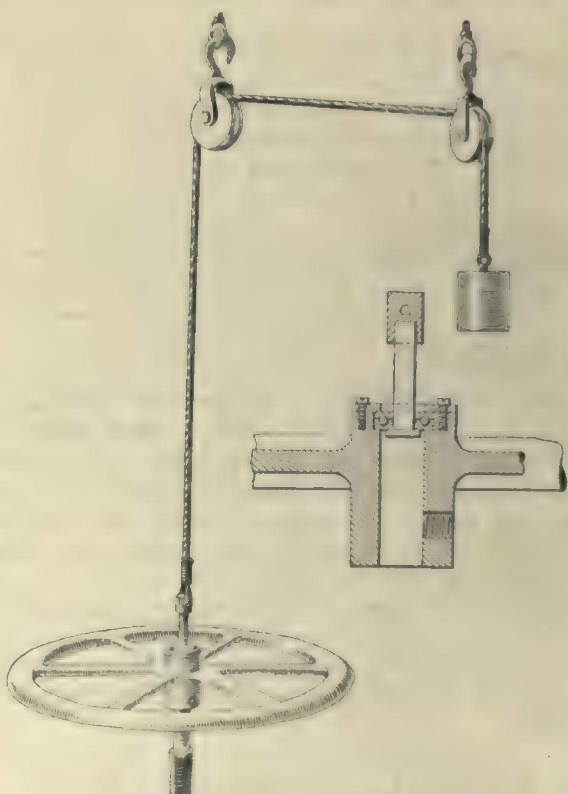
By H. Jaynes

On account of the accuracy required in many tapped holes for such ordnance work as the primer hole in cartridge cases, the socket hole in 4.5-in. shells, the bottom, closing-screw hole in fuses, etc., it has been necessary to do a more than the usual amount of hand tapping. Many tapping devices and machines were tried, but the quantities of scrap accumulated until hand tapping was resorted to. More often than not the operator of such machines as were employed, was to blame for careless starting of the thread. Sometimes the machines were not lined up properly, or in tapping brasswork the taps would rough up the threads.

The lead of the tap is an important item, as is also the size to which the hole is bored.

The illustration shows a cast-iron handwheel about 15 in. in diameter with a $\frac{7}{8}$-in. rim. One end of the hub is recessed to take a ball-thrust bearing that is held in place by a cover plate. Through the thrust bearing there is a swivel, the upper end of which is fastened to an ordinary clothesline that runs over two pulleys. The other end of this line has a counterbalance weight attached to it so that when the tap is lifted it remains at whatever distance it is placed and the weight of the wheel does not tire the operator.

The use of this arrangement increased the output on fuses 25 per cent. and was a considerable saving on the operator's strength. As girls were employed on this work, it was necessary to make things as easy as possible.



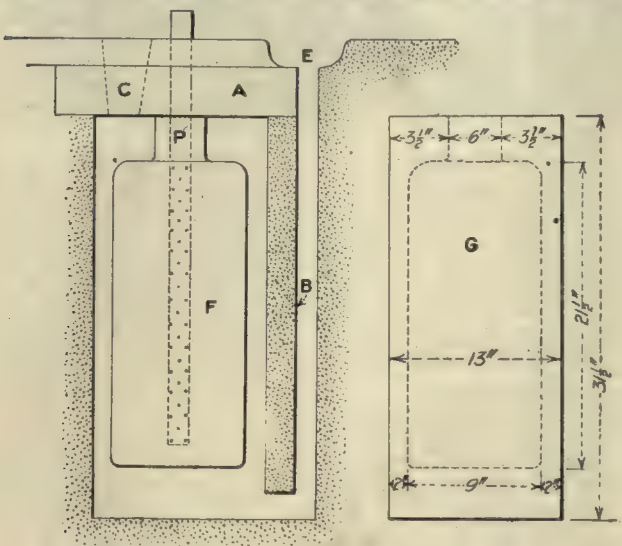
HAND TAPPING DEVICE

The weight of the rim would carry the tap around two revolutions if a swing were given it, and if there were no more than 0.004 in. to be retapped out. By swinging, the tap would run itself out $5\frac{1}{2}$ threads with only one movement of the operator. The capacity of this arrangement is 1500 per day of 10 hours, when retapping the bottom-closing screw in fuse bodies.

How Would You Make This Casting?

By H. Maplethorpe

In reply to the query of Mr. Duggan, page 164, Vol. 47, I offer a few notes upon securing good sound castings of the type shown at *G*. Considering the bulk and thickness of metal there must be a liberal way provided for the gases to escape freely, therefore, it is necessary to provide a good coke bed under the mold and vent it



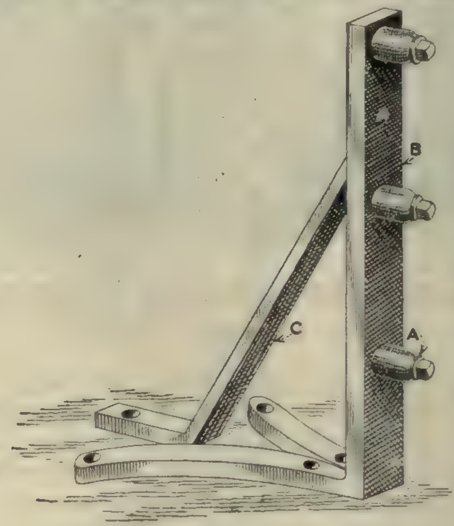
METHOD OF MAKING A SOUND CASTING

with a piece of 2-in. pipe, otherwise an explosion may occur. In addition, a 1½-in. gas pipe *P* as shown in the illustration, should be inserted in the core *F*, and a number of small holes should be drilled in the tube as shown by the dots. To secure a clean casting it will be necessary to provide a method for the escape of any rubbish or dross which may rise. This is accomplished by means of the riser *C*, which is formed in the top part of the core *A*, and as shown it is somewhat tapered, the narrow end being nearest the casting. To prevent any dross getting down the gate *B*, a sprue *E* should be provided which is about 8 in. in diameter, and this must be kept well filled during the pouring operations to insure the core being kept central. Better results will be obtained by admitting the hot metal only at the bottom as shown. The walls being thick, that is 2 in., the metal will keep in its molten condition some time, and will rise freely in the mold, and all impurities will float upon the top, and rise through the opening *C*. This opening will also allow all air to escape thus guaranteeing a sound casting. In concluding I may say that several castings of a similar character and weight have been made successfully by following the method described.

A Chuck and Faceplate Rack

By Edward N. Moor, Jr.

The illustration shows a chuck and faceplate rack I recently designed and made for use in the school shop here. The idea might prove useful to some readers who want a rack to keep chucks and faceplates off the floor and the threads free from chips, which is not likely to occur if these articles are allowed to lie around under the lathe. The forging *B* is made of ½ x 2 in. machine steel, split as shown and with 4 screw holes in the base for fastening to the floor. The brace *C* is ¼ x 1¼ in. steel riveted at its upper end to the forging, and provided with a screw hole for attaching to the floor. The plugs *A* are of hardwood, a bolt with a washer under



A CHUCK AND FACEPLATE RACK

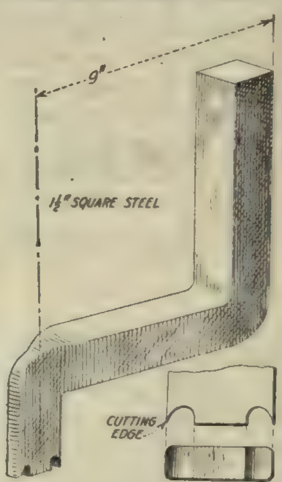
the head secures them to the rack. The center distance for the plugs is spaced to accommodate the chucks and faceplates used.

These plugs being of wood protect the threads from being burred when the chucks are slid on. I find that by using this stand at the head end of the lathe it is very convenient as the operator merely stoops over, picks up the chuck, and puts it on the lathe without moving out of his tracks.

Double-Edged Slotting Tool

By Jerome G. Peppers

Some time ago I had to machine a link for the valve motion of a small engine. Its radius was 37 in. and the radius of our slotting-machine table was only 14 in.



DOUBLE-EDGED OFFSET SLOTTING TOOL

After I put an extension on the table, setting the radius of the link with trams from the center of the table, and after putting an extension head on the ram of the slotting machine, I still needed about 9 in. I made up a bent tool as shown in the illustration, with a double cutting edge, but narrow enough to cut one edge at a time. This did the job satisfactorily.

Co-ordination of Government Departments

On Jan. 12, Secretary Baker explained in considerable detail to the Senate Committee on Military Affairs the reasons for his personal objection at this time to the creation of a Director of Munitions to supervise all purchases of supplies for war purposes in this country. These reasons may be summarized briefly by the statement that the present reorganization of the War Department and the War Industries Board will provide an entirely suitable agency for the prompt and efficient performance of such work, and should be tried before this organization, now in process of remolding in the light of the experience of the administration in war work up to date, is thrown into inevitable confusion by drastic changes.

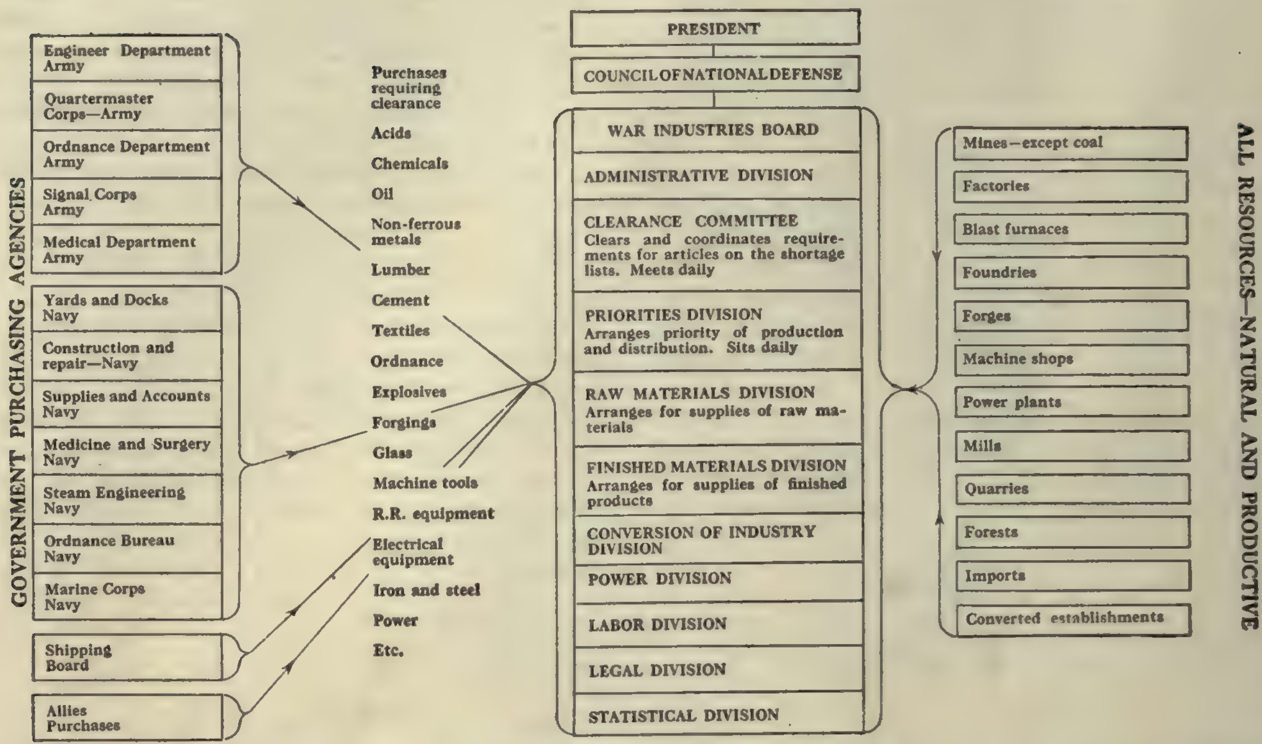
It was necessary at the commencement of American participation in the war to begin training immediately a great number of men to carry on the administrative and technical details of the Department's work. No matter how these were ultimately grouped, they had to become familiar with their duties and with government methods of work before they could render effective service. While this training was going on, the reorganization of the Department was being studied; and as army ordnance was in great demand this branch of the service was first changed. It is a purely technical branch; Secretary Baker characterized it as a "manufacturing" branch, and the scheme of reorganization was developed with the help of men who have made efficiency in manufacture a specialty. Formerly the work of the ordnance branch was subdivided according to products, such as small arms; but under the new system it is subdivided by functions, that one branch may have charge of the technical details of design, another of purchase, another of inspection, and another of supplying the equipment when and where needed. This functionizing of the ordnance branch is in harmony with the methods of organization now favored by a large number of the leading manufacturing corporations in the country. The men working under the old system of organization are having little difficulty in shifting into the new system without interruption to their labors.

The Quartermaster Corps is now being reorganized in the same manner, and the high positions in it are being filled—as in the case of the ordnance branch—by civilians who hold leading positions in the callings they have to carry on for the army.

Under the old scheme of organization, there was an immense amount of detail which went from each branch of the Department to the Secretary's office. Under the new organization a very large part of this detail which has to do with correlating the requirements for supplies for the different branches, goes directly to a central office. The ordnance, quartermaster, engineering, medical and aviation branches will purchase their supplies, as they have in the past; except that before contracts are signed they must have the approval of this central office, which will so regulate conditions that one branch

THE GENERAL ORGANIZATION

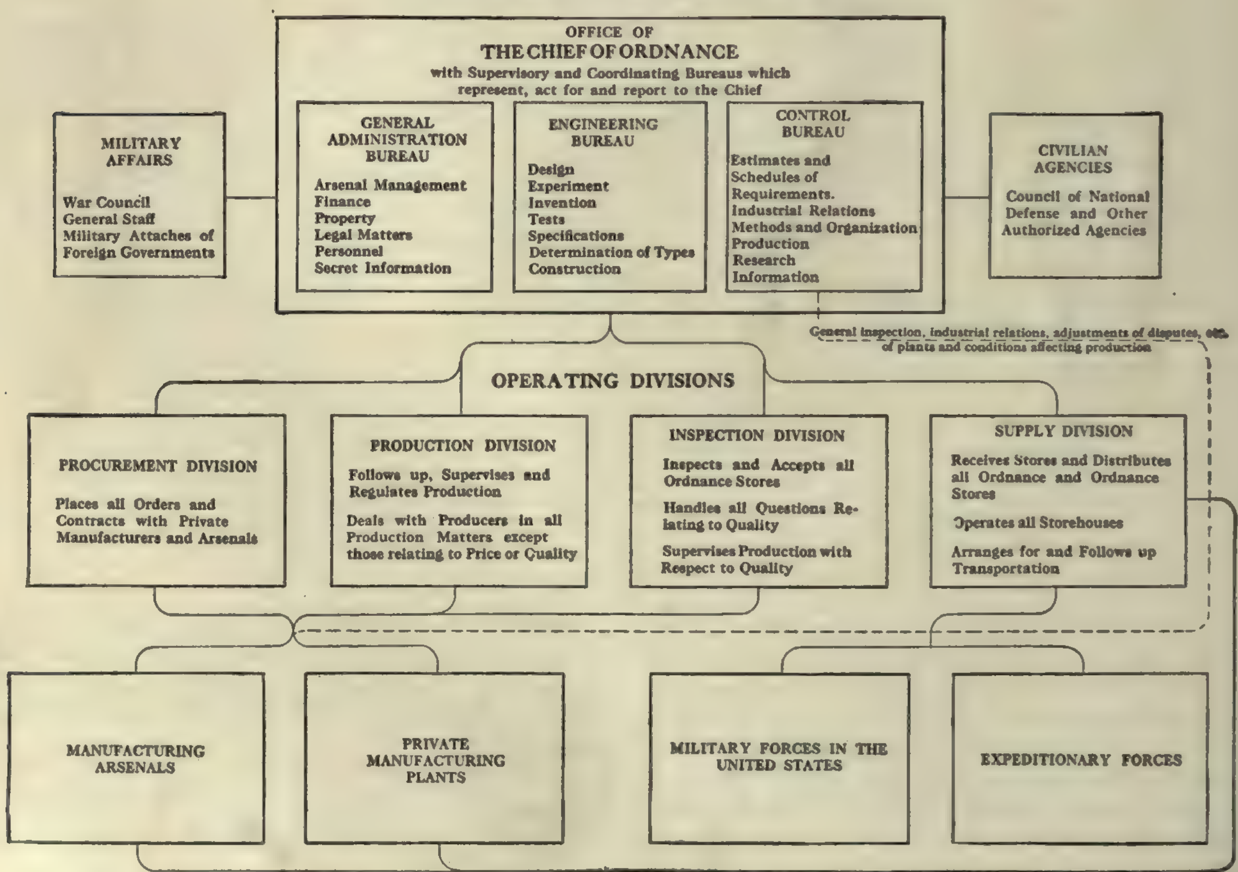
ORGANIZATION AND FUNCTIONS OF WAR INDUSTRIES BOARD



NOTE: A "war industry" is construed to mean any industry which cannot meet the war-time needs without abnormal expansion or conversion of facilities

Washington, D. C.
January 9, 1918.

ORGANIZATION OF THE ORDNANCE DEPARTMENT



shall not needlessly hinder the operations of another in the market.

The War Department is not alone in making great drafts on the industries of the country. The Allies' Purchasing Board, the Navy Department and the Shipping Board are similarly straining the resources of our manufacturers, and no legal remedy for this condition has been provided by Congress. But the four great purchasing agencies have agreed to joint action through the War Industries Board, which has been reorganized in order that it might do for all American munitions manufacturers what the Central bureau of the War Department does for its five great purchasing branches. The requirements of the four agencies are reported to a Central committee. If its decisions are questioned, the appeal is made to the War Industries Board, which thus becomes arbiter of manufacturing priority in this country in every industry furnishing supplies for military purposes.

The committee has a further very important function which was explained by Secretary Baker as follows: Assume that General Pershing cables a requirement for 1000 guns. As his requisitions are not questioned, a copy of the order would be sent at once to the ordnance branch of the War Department and another to the Central committee of the War Industries Board. While the ordnance officials were preparing the plans and specifications, the committee would ascertain what sources of raw material could be used with the least interference to the manufacture of other necessary supplies; what forge shops could be utilized and what plants were available for producing the other parts of this order. As soon as word was received that the ordnance department was ready to buy these guns, the committee would notify the procurement division of the ordnance corps what parties should be invited to bid.

Approval of Industrial Leaders

Secretary Baker assured the Senate Committee on Military Affairs that this system of handling the Government war purchases in coöperation with those of the Allies is not only the best that careful study has been able to suggest, but it has met with the approval of the industrial leaders to which it has been submitted. In his opinion, it disorganizes none of the existing machinery, and interferes as little as possible with meeting civilian demands. This system is the equivalent, he believes, of having a special director of munitions. Any functions which such a director would possess, would be possessed by Daniel Willard, chairman and executive officer of the War Industries Board. The chairman did not have legal authority to enforce his decisions; but as each of the four great war purchasing agencies had agreed to recognize his decisions as binding, it had not seemed necessary to ask congressional action to confer legal powers upon him.

The essence of the organization, according to Secretary Baker, is that each of the four great purchasers: the Allies' Committee, the War and Navy Departments and the Shipping Board, have their own organization for acquiring supplies in the desired order; while the War Industries Board has these orders filled in a sequence to meet the war needs, and manufacturing facilities and civilian requirements are served in the best possible manner. Such is apparently the Administration's answer to the criticism that Washington had no logical plan for mobilizing the nation's resources. Acccording to Secretary Baker, it is the most complete plan for the purpose that has been advanced in this country or Great Britain. It manifestly created a deep impression upon members of the Senate Committee who have indicated their disapproval of many features of the work of the War Department since the United States entered upon the war.

The arrangement of the various divisions is graphically indicated in the accompanying charts.

Measuring Morse Tapers

By P. S. Smith

The use of the sine bar and Swedish blocks for measuring Morse tapers per foot, is no doubt the best practice, but unfortunately every shop is not so equipped, and it is therefore necessary to resort to other methods. The writer recently had occasion to measure some No. 4 Morse taper plug gages, and being without special tools of any kind, performed the work in the following manner which has proved very satisfactory:

Make a short shaft, say 2-in. diameter and 12 in. long, care being taken to have it perfectly straight. Put this on good lathe centers and with dial test indicator, test centers for parallelism, making any necessary adjustments to get them in perfect alignment. When this is done remove the test bar and put taper plug gage on centers, clamp a parallel strip across the lathe ways on operating side of machine and bring carriage squarely up against it; now put a dial test indicator in toolpost and set the contact point to bear on tapered part of plug gage; also set needle at zero. Move carriage away from the clamped parallel strip until an ordinary 2-in. micrometer test plug can be inserted. In this way the length is accurately measured. Now note reading of indicator dial, which on a correct No. 4 Morse taper should read nearly 0.052 in. This is half the amount of taper for 2 in. Multiplying this by 2 we have 0.104 in., this being the total amount of taper for 2 in. Now multiply 0.104 in. by 6 in., the product of which will be 0.624 in., the correct No. 4 Morse taper.

Cutting Quick Pitches Without Danger to Change Gears

By A. Rebelski

The writer has an 11-in. swing foot lathe about 20 years old. It is very frail and the change gears are only 20-pitch. By the method here described the operator has cut screws of a quick pitch that would not be attempted in a lathe with four-pitch change gears.

This old lathe is provided with arrangements for compounding the change gears and has a range of from 120 threads per in. to 1 thread in 4½ in. By taking the belt off the cone pulley and using a crank on the lead screw for a drive, threads have been cut having a lead of 1 to 3½ inches.

It is apparent that the quicker the pitch to be cut, the safer are the change gears when the lead screw is used to drive the lathe, providing the depth of cut is kept within reasonable limits.

John Riddell

John Riddell, mechanical superintendent of the Schenectady works of the General Electric Co., died in Schenectady, Dec. 31, 1917, leaving behind him a host of friends in the business world as well as among those who knew him in personal life. Mr. Riddell, born in Ireland in 1852, was conspicuously a self-made man. At the age of 12 or 13 years, he started as an apprentice in a jobbing machine shop owned by Nicholas B. Cushing in Jersey City, who made elevators and repaired machinery, especially marine engines. This work brought him in contact with marine circles and he spent the next two years as second engineer on trading steamers plying between the West Indies, Central America and New York.

His first association with the electrical business was with the Daft Electrical Co. where he did experimental work, especially in the railway field. In 1887 he entered the employ of the Thomson-Houston Electric Co., Lynn, Mass.; in 1888 he became foreman of the railway motor shop and was recognized as one of the leading mechanical experts at the time the General Electric Co. was formed in 1892.

The Mechanical Business

Mr. Riddell moved to Schenectady in 1895, and shortly after his arrival was appointed mechanical superintendent. In this important position he designed special machine tools for increasing the production of the machine shops and also for carrying on the many special processes involved in the manufacture of mechanical tools. Many of these machines were built by the General Electric Co. under his direction; and for such tools as were purchased outside, Mr. Riddell not only prepared the specifications, but actually purchased the machines, he being the company's trusted representative. He was consulted in regard to all automatic machinery and his resourceful genius was called in when a solution was sought for different mechanical problems that baffled the average expert.

In the sense that Mr. Riddell could obtain large outputs from machine shops with a minimum cost, he might well be termed a manufacturing economist. He was responsible for the location of machines and machine tools, and his advice and opinion were sought in regard to such manufacturing problems as the routing of the materials from the time the raw materials were received until the finished product was ready for shipment.

Notable Achievement

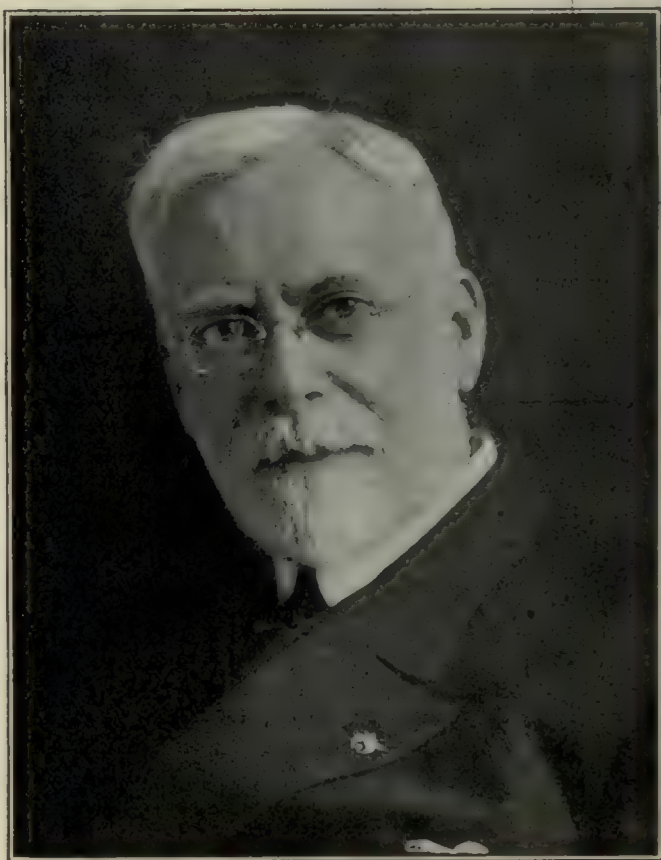
Among the notable achievements of Mr. Riddell in the various works of the General Electric Co. is a boring mill—the largest in the world at the time—which was built from his design and which has a 60-ft. swing. This was so successful for machining the large wheels for the rotors and stators of water-wheel-driven generators that he designed a 40-ft. boring mill embodying the same principles as the large one, and used for turbine work. These mills have operated night and day for over 10 years without the loss of a single hour.

Another one of his interesting machines was the bucket-cutting machine for large steam turbines, which he developed in 1902. It was at this time that the General Electric Co. was building the first 5000-kw. steam turbine ever constructed, and this labor- and time-saving device which Mr. Riddell designed became an important factor in the development of the steam-turbine industry, when the steam engine was preëminent in the largest power plants in the world.

Field-Coil Winding Machine

Almost automatic was the field-coil winding machine which he built and which was adopted both in Lynn and Schenectady. It was a labor saver and a time saver, and in the opinion of his confreres, there was no single achievement of Mr. Riddell's which advanced the electrical industry more than this winding machine.

He was a member of the American Society of Mechanical Engineers, the Engineers' Club of New York, the Society of Engineers of Eastern New York, the Mohawk Club and the General Electric Quarter Century Club, and he delivered several papers on engineering subjects before various associations and societies. Mr. Riddell belonged to all Masonic bodies in Schenectady, to the Oriental Shrine and the Albany Consistory, and was also a member of the Elks.



JOHN RIDDELL

Those who knew him loved him because of his generous heart and unselfish nature. He was not only willing but anxious to give credit to those who assisted him, and afforded encouragement to those who were striving to improve themselves.

Mr. Riddell leaves his wife, Mary; his daughter, Mrs. William Newcomb; a granddaughter, Madge Riddell; two sisters, Mrs. Mary O'Hare and Mrs. Anne Whitten, both of Jersey City.

EDITORIALS

Have You Sent that Telegram?

Unless you have already responded to the appeal for large machine tools with which to build heavy artillery, now is the time to act.

EVERY DAY'S DELAY will take its toll in human life. If not your boy, then that of a neighbor's or friend's.

Only heavy artillery can win our victory with a minimum loss of life. This requires hundreds of heavy machine tools.

These can be secured only from such as already have them in use; there is no time to have them built. It is up to you who have them, to give them up freely; and above all promptly.

THIS IS WHAT IT MEANS!

When 100,000 boys go "over the top" in the great drive to come, the casualty list may be either 5000 or 60,000, depending on whether or not they have enough heavy artillery.

The size of the casualty list depends directly on the response you make to the Government's appeal for these heavy machine tools. No sacrifice you can make is too great to keep the list down to the minimum. *You and you only can do it—and we know you will.*

THE Government at Washington realizes what a sacrifice this means to you. But it also knows that the men of the machine-building industry are loyal and patriotic enough to make any sacrifice which will shorten the war and save the lives of thousands of our boys in France. It must have these machines at once, you must give them up in order that our boys may have the heavy artillery they need.

MACHINES NEEDED

60 x 60 x 20-ft. planing machines.
48 x 48 x 20-ft. planing machines.
36 x 36 x 14-ft. planing machines.
Nos. 4 and 5 plain milling machines.
Nos. 4 and 5 vertical milling machines.
30-in x 20-ft. engine lathes.
36-in x 20-ft. engine lathes.
4- and 5-ft. radial drilling machines.
18 x 130-in. cylindrical grinding machines.
10-ft. vertical boring mills.
5-ft. vertical boring mills.
6-in. floor type, horizontal boring and milling machines.
4-in. floor type, horizontal boring and milling machines.

THERE IS no time to lose. Your great opportunity is now. No work you may have is as important as this. Look over the list of machines needed, and make up your mind to spare some of yours.

Look over your equipment. Which tools are not working to full capacity? What work are you doing on heavy tools which can be done on smaller ones that are not as efficient perhaps but—

What rearrangement can you make in your equipment that will release one or more big tools? Do it now! Then—

Write or wire the MACHINE TOOL SECTION *of the*
WAR INDUSTRIES BOARD, COUNCIL OF NATIONAL DEFENSE
Washington, D. C.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Tompson Electric Spout-Welding Machine

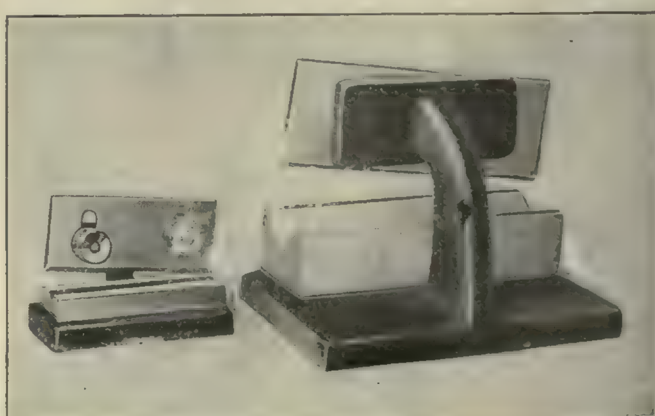
The Thomson Electric Welding Co., Lynn, Mass., is now marketing the machine illustrated, which is used for electrically welding spouts that are stamped in halves and assembled with the abutting edges projecting slightly. The device is known as the No. 26 spout-welding machine. The halves of the work are placed together and clamped in a specially constructed copper die which allows the projections of the spout to extend beyond the edge of the seam. This die is then placed upon the top of the machine, which is a copper table, and the projecting edges of the spout are brought into contact with a revolving vertical die extending through an opening in the top of the table and the current is turned on by means of pressing a foot treadle. The current travels through the top plate of the machine, through the copper die, through the projecting edges of the spout, into the revolving vertical die, and the circuit is completed through the secondary winding of the transformer enclosed within the base of the machine. The projecting edges of the spout are quickly heated at the point of contact with the revolving die, and a slight pressure serves to press them down practically flush with the contour of the spout and weld them together. The die is pushed by hand until the whole length of the seam has been welded. The revolving die or electrode is power-driven. For operation, alternating current at 110, 220 or 440 volts, and 60 cycles, single-phase, is used. The machine is equipped with a voltage regulator and the welding current can be adjusted in five steps to take care of all conditions. The operating switch is of the solenoid type, and is controlled by the means of a push button switch mounted upon the floor at a convenient point for the operator to touch with his foot.

SPOUT-WELDING MACHINE

Maximum current consumption, 5 kw.. or 7½ k.v.a.; pulley dimensions, 6 x 1¾ in.; speed, 200 r.p.m.; floor space, 24 x 33 in.; height, 41 in.; table dimensions, 15¼ x 26 in.; weight, 850 lb.

Davie Taper Gage

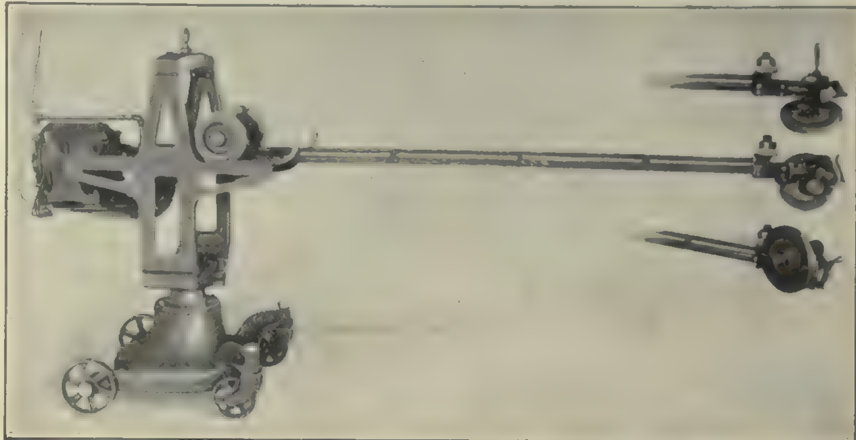
The Davie Tool Co., Cleveland, Ohio, is making the type of taper gage shown. This is made in various sizes and is also made with stops to indicate the proper length of the tapered work. From the small view it will be seen that the moving member may be quickly adjusted to any position, within its range, by means of two knurled nuts.



DAVIE TAPER GAGE

Mummert-Dixon Portable Radial Grinding Machine

The Mummert-Duxon Co., Hanover, Penn., is now marketing the 8-in. portable, radial grinding machine shown in the illustration. It is intended for general light buffing and grinding and is entirely self-contained. The grinding wheel is driven by an electric motor mounted at the rear end of the tubular arm. The motor is direct-connected to a shaft running through the arm, the shaft in turn, transmitting its motion to the wheel spindle through a set of hardened-steel spiral gears, which are inclosed in an oil-tight case and packed in grease. Ball bearings are used in the head. The head, arm and motor are carried on a two-wheeled, ball-bearing trolley which rolls on a steel track, being kept in alignment by racks and gears at each side of the carrying frame. The motor balances the head and holds the whole in equilibrium when the workman releases his hold. The bolster of the trolley-carrying frame is mounted on the top end of a trunnion which turns in the base. This construction allows the arm and head to be turned around the base through the entire circumference. A lockpin is provided to prevent any movement in case a rigid machine is desired. This feature is also convenient when the machine is being moved about the floor on its own wheels. The trolley can also be locked in central position. The head can be turned to any angle on the arm, thus making it possible to grind on the top, sides or underside of a piece of work. The machine may be moved about on its own wheels, but a ring is provided at the top in case it is more convenient to use a crane. All moving parts except the lower half of the grinding wheel are completely inclosed. The switch is located close to the head and the wires run along the top of the arm in steel conduit.



PORTABLE RADIAL GRINDING MACHINE

Grinding wheel, 8 in. in diameter, 1-in. face, $\frac{5}{8}$-in. hole; speed of wheel arbor, 2800 r.p.m.; motor, 1 hp., 1800 r.p.m.; length of arm from trolley to head, 7 ft.; travel of trolley, 30 in.; annular working area, 30 in. wide with a mean radius of 6 to 7 ft.; vertical movement of head, from floor to as high as a man can reach; height over all, 4 ft. 6 in.; length over all, 9 ft.; floor space, 30 x 30 in.; net weight, 700 lb.

Persons-Arter Magnetic Chuck

The Persons-Arter Machine Co., Worcester, Mass., has recently completed what is believed to be the largest and most powerful magnetic chuck ever built.

Fig. 1 shows the finished chuck ready for mounting on the machine. It measures 100 x 25 x 5 in., and an idea of its size may be gathered by comparison with the yard stick shown with it. It has a holding capacity approaching 250 lb. per sq.in. and is magnetically alive all over its face, making every square inch available for holding work. Four standard-size, individual chucks were used in the construction, each individual one being constructed of standard units as shown in Fig. 2. These are a polar shell, a polar core and a magnetizing coil. Each of the four sections is composed of one shell, four cores and four coils, all interchangeable and replaceable. It is claimed that the construction used for the coils and pole pieces gives a good distribution of the magnetic force without sacrificing electrical efficiency. This construction also makes it possible to caulk the spaces between the shells and the cores, to make the whole assembly waterproof. All parts of the chuck comprising the magnetic circuit are made of soft steel. The bottom plate is made in one piece and is fastened to the body by means of hexagon-head bolts. The assembled chuck rests on a number of nonmagnetic supporting feet, which insulate it from the bed of the machine, provide a clear path beneath for the flow of cutting compound and make it an easy matter to true up the face. The chuck is claimed to be both waterproof and heatproof.

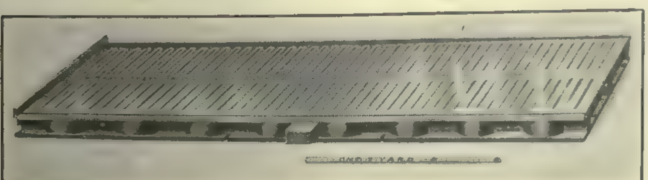


FIG. 1. LARGE MAGNETIC CHUCK

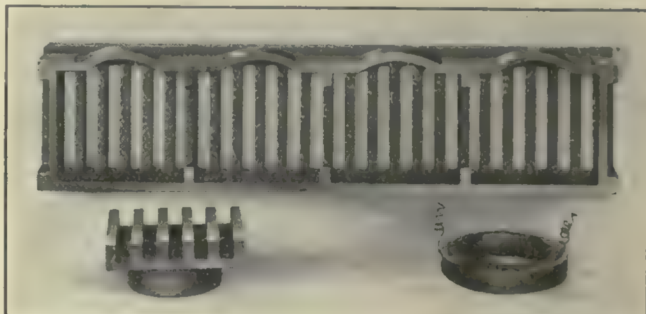
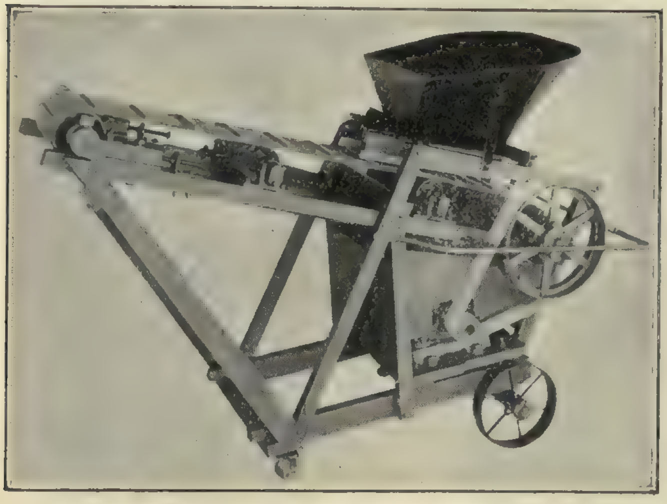


FIG. 2. THE INDIVIDUAL PARTS OF A CHUCK UNIT

Link-Belt "BX" Loader

The device shown in the illustration is for the purpose of loading any kind of fine material into box cars. It is the product of the Link-Belt Co., Nicetown, Philadelphia, Penn., and is known as their "BX" loader. When in use, the material being loaded is shoveled into the hopper, from where it is carried out on the flat belt and dumped at some distance from the hopper. The

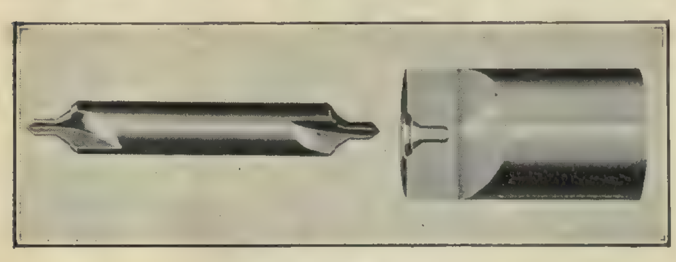
machine is portable, being mounted on wheels, and may be arranged to be driven either by a gasoline engine or by an electric motor. The belt is supported on four rollers, the one at the outer end being mounted on sliding bearings equipped with adjusting screws. This feature allows any slack in the belt to be quickly taken up.



LINK-BELT "BX" LOADER

Apex Center Drill

The illustration shows a combined center drill and countersink that has recently been placed on the market by the Apex Drill Co., 2455 W. McMicken Ave., Cincinnati, Ohio. The auxiliary countersunk hole allows the work to be faced up to the hole without the use of half centers or other schemes for accomplishing the same result. A further advantage claimed is that the center is protected from injury due to accident or to pressing or driving the piece into other parts. The drill is made in the usual range of center-drill sizes.



APEX CENTER DRILL

A Novel Electric Welding Process

BY T. M. R. VON KELER

J. Sauer, in the *Electrotechnischen Zeitschrift* describes a new German process of electric welding which is said to be particularly useful in the case of broken T-rails, Z-shaped steel and iron, wheel felloes and similar metallic pieces of irregular cross-section. When such objects are heated to welding temperatures, it is usually found that the thinner parts are burned away before the thicker reach welding temperature.

To overcome this difficulty and at the same time to obtain a very complete weld, Sauer uses a welding machine in which the two pieces are gradually brought nearer and nearer, until sparks form an arc between the surfaces to be welded. The heating proceeds gradually until the melting point is reached, when the pieces are forced against each other. The ridge of metal formed at the junction must be removed with a chisel, while the weld is still red hot. If the welder attempts to forge the ridge flat by hammering, parts of the metal are pressed into the welded joint and the strength of the weld is greatly impaired. Welds made by this process have been found to have 98 per cent. of the tensile strength of the metal itself.

The process has been adopted by some of the large toolmakers for welding tool-steel tips to shanks of a lower grade of metal, and has been greatly improved by the addition of an artificial "breaking" of the weld before it cools. The two pieces of metal are welded as described above, but while the weld is still red hot, it is pulled apart, the current being shut off temporarily and again welded under pressure and heat. Steel tools made by this method have given satisfactory service, and the scarcity of tool steel in Europe renders the process of special interest.

Adjustable Drilling Jig for Cotter-Pin Holes

BY H. C. CARD

The jig here shown, for drilling cotter-pin holes in small shafts of varying lengths, was designed by the writer in 1907. It has proved so handy and useful that it is seldom to be found in the tool crib in working hours.

It consists of two cast-iron V-blocks free to slide on two round cold-rolled steel rods which have a flat surface milled their entire length, to provide a seating surface for the setscrews. At one end, a swinging plate secured by a collar-head screw, carries a gagescrew and checknut to provide a locating point for the end of the shaft being drilled. Two pack-hardened, cold-rolled steel plates are screwed and dowelled to the top of the V-blocks, and are drilled and tapped for binder screws and bored for slip bushings. The jig as made, was for small work and will drill cotter-pin holes in both ends at one setting, in shafts from $\frac{1}{4}$ to 1 in. in diameter, and from 4 to 14 in. in length. Shafts from $1\frac{1}{4}$ to 4 in. may be drilled one end at a time, in one of the V-blocks. Larger shafts also may be drilled one end at a time, if a support is provided for the outer end of the work. The very simplicity of the jig tends to make it a most valuable addition to a toolroom equipment.

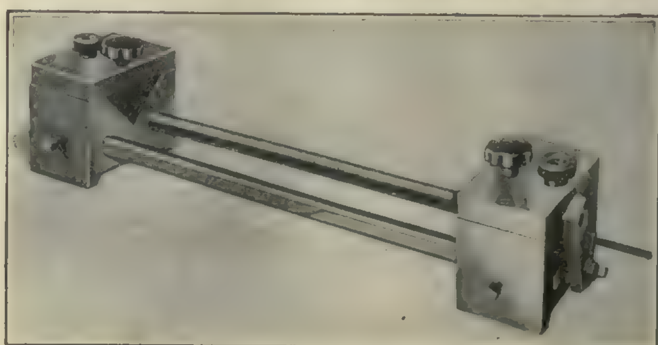


FIG. 1. ADJUSTABLE DRILLING JIG FOR COTTER-PIN HOLES

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Jan. 19, 1918—One interesting development of the reorganization of the Ordnance Department is the selecting of men, by General Wheeler, who handle the business of the organization. Several men have already been selected, these being Samuel McRoberts, formerly executive manager of the National City Bank of New York, Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric and Manufacturing Co., E. N. Black, who was formerly a member of the engineering firm of Ford, Bacon & Davis, and Ralph Crews, a well-known Chicago lawyer.

* * *

Some idea of the immense task which confronts the Ordnance Department may be had from the statement that its appropriations for the present year are $3,200,000,000; some idea of what this really means may be deduced from the fact that in the year 1914 the total value of all the iron and steel industries in the United States was given at only $900,000,000, or less than one-third the amount to be expended by the Ordnance Department this year. Contracts for over half this sum have already been placed, the amount being $1,677,000,000.

* * *

All of the men chosen in the interests of organization, have had some experience with munitions manufacture, and should prove of extreme value in the work to be done.

* * *

We are sure these men will meet with hearty coöperation from all manufacturers, and that they will be able to expedite production to a considerable extent.

* * *

The concentration of all inspection under one head, and the location of this head in New York City, is something of a departure in army circles. The plan has many possibilities, however, and although the change is too recent to have had any marked effect on the situation, there is, nevertheless, every indication that it will improve the administration of this very important department.

* * *

There seems to be more genuine misinformation floating about the country in regard to the Liberty motor than concerning any other item. One of the late reports has it that the Liberty motor has been abandoned for everything excepting scout duty, and winds up with the information that it has not proved nearly so satisfactory as was expected, and is consigned, as a consequence, to this comparatively unimportant duty.

* * *

This hardly agrees in any particular, with what seems to be the fact. In the first place, the scouting machines are of the most, if not the most, important items in the whole air program. These are the small fast machines which must do the scouting and much of the fighting, and a motor which can stand up under such service cannot have been found wanting in many particulars. As a fact, the Liberty motors are being used only in the 12-cylinder size instead of in the small scout machines. The 12-cylinder size develops something over 400 hp., and is entirely too large for any scouting machine yet built. According to the best information obtainable, the Liberty motor will be used in the large bombing machines and flying boats. From all accounts, it is making such an enviable record for itself that it is being specified by some of our allies on the other side.

* * *

There is no reason to expect perfection either in Liberty motors or anything else, but if our entire air program comes along as satisfactorily as the motors, we shall have little fear as to making a creditable showing in the fighting this year.

* * *

It must not be forgotten, however, that the Aircraft Production Board is not placing all its dependence upon the Liberty or any other one type of motor, but is building motors of several well-tried designs for use in the machines of various kinds. The Liberty motor seems to be one of the bright spots in our whole preparedness program.

* * *

In this same connection it may be well to point out that the designers of the Liberty motor have given us an excellent example of the utilization of unit parts so as to avoid unnecessary tools, fixtures and gages in manufacturing. With this idea in mind they designed a motor with a unit cylinder, which allows them to make the piston, piston pins, piston rings and connecting rods exactly alike, no matter whether two or twelve cylinders are used. This enables a very considerable saving in tools, fixtures and gages, and thus conserves the labor of skilled toolmakers, reduces the capital invested in the manufacturing equipment, as well as the amount tied up in spare parts. This in turn affects both the construction and upkeep of the motors as a whole, and is an example of the principle of economical designing which should be carefully studied in many other lines.

Personals

Lewis A. Larsen has been appointed assistant to the president of the Lima Locomotive Works, Inc., with headquarters at Lima, Ohio.

R. N. Nichols, formerly general foreman of the Central railroad of New Jersey at the Communipaw engine terminal, Jersey City, has been appointed assistant master mechanic.

Henry M. Shaw, for several years connected with the sales department of Sherritt & Stoer Co., Inc., is now associated with the Monarch Machinery Co., 300 N. Third St., Philadelphia.

Charles Spalding is now general manager of the Amalgamated Machinery Corporation, 72 W. Adams St., Chicago. Mr. Spalding was formerly with the Gisholt Machine Co., for 11 years.

J. O. Smith, for the past twelve years manager of the engraving and field photographic service of the McGraw-Hill Co., is now serving in a similar capacity with the Simmons, Boardman Co., New York City.

C. E. McAuliffe, formerly master mechanic of the Missouri Pacific railroad at Atchison, Kan., has been transferred to Wichita, Kan., succeeding **R. H. Tait**, transferred to Kansas City as master mechanic.

Robert L. Arms, for several years connected with the sales department of Manning, Maxwell & Moore and Sherritt & Stoer Co., Inc., has become sales manager for the Monarch Machinery Co., 300 N. Third St., Philadelphia.

Frank B. Smith, formerly employment manager of the Bullard Machine Tool Co., Bridgeport, Conn., has been appointed a member of their plant management committee, coöperating with the president and vice president in the duties of works manager.

P. C. Gunion has been made advertising manager of the industrial bearing division of the Hyatt Roller Bearing Co., Newark, N. J. Mr. Gunion has been with the Hyatt Company for two years. Previous to his appointment he was manager of the Pittsburgh office.

H. R. Warnock, formerly superintendent of motive power of the Western Maryland Railroad at Hagerstown, Md., has been appointed general superintendent of motive power of the Chicago, Milwaukee & St. Paul railroad with headquarters at Chicago, Ill., succeeding **A. E. Manchester**, deceased.

Milton Rupert was recently elected vice president and assistant treasurer of the R. D. Nuttall Co., Pittsburgh, Penn. Mr. Rupert has been with the Nuttall Company for the past twenty-five years and has held various positions. In his new position he will have charge of the sales and manufacturing activities of the company.

D. Gleisen has been appointed manager of the industrial bearings division of the Hyatt Roller Bearing Co., Newark, N. J. Mr. Gleisen is a mechanical engineer, a graduate of Stevens Institute, and has been connected with the company for six years. He has recently been assistant manager of the Hyatt company in charge of bushings sales.

Franklin T. Chapman, formerly assistant to the manager of the Olympian Motors Co., Pontiac, Mich., is now assistant general sales manager of the E. F. Houghton & Co., Third, Somerset and American Sts. Mr. Chapman succeeds **W. Burton Piersol**, who recently accepted a position as assistant general manager of the Bethlehem Shipbuilding Corporation.

J. W. White has been appointed manager of the power and railway divisions of the Detroit office of the Westinghose Electric & Mfg. Co. Mr. White was formerly connected with the Pittsburgh office of this company, subsequently becoming associated with the Allis-Chalmers Mfg. Co., and has now returned to the Westinghouse Co., assuming the position above noted.

D. O. Leary, master mechanic of the Pacific Coast railroad since 1893, also master mechanic of the Pacific Coast Steam Ship Co.'s repair works, has resigned to accept a position as machinery inspector with the United States Shipping Board Emergency Fleet Corporation. Mr. Leary is a member of the American Society of Mechanical Engineers, and the American Railway Master Mechanics' Association.

Herman Schneider, dean of the Engineering College, University of Cincinnati, has been appointed Director of the Industrial Section of the Ordnance Department, United States Army. He will make his headquarters in Washington, but will not sever his connection with the University of Cincinnati he will remain the directing head of the Engineering College, returning at intervals to supervise the work of the college. Dean Schneider will have charge of the statistical and legal divisions, supplying and distribution of labor, housing of Government employees, plant organization, labor adjustments and women in industrial labor.

Business Items

The Wagner Electric Mfg. Co., of St. Louis, has opened a service station in Seattle at 535 First Ave., South, to take care of service in the State of Washington and the Northwest.

The New Standard Hardware Works, Mt. Joy, Penn., has enlarged its plant and organization to take care of the increased quantities of hot tinning of grey iron, malleable iron, steel and brass stampings, etc.

The Simonds Mfg. Co., of Fitchburg, Mass., has appointed the T. P. Walls Tool and Supply Co., Inc., 75 and 77 Walker St., New York City, as its sales agents for the territory of Connecticut, New York and New Jersey.

The Amalgamated Machinery Corporation, Chicago, Ill., elected the following officers for the ensuing year at the annual meeting of the board of directors: T. K. Webster, president; L. I. Yeomans, vice president; Walter A. Strong, secretary; C. M. Moderwell, treasurer.

The Hydraulic Press Mfg. Co., of Mount Gilead, Ohio, is now occupying its extensive new buildings. The plant is again in operation to its full capacity. The new equipment represents the most advanced types of metal-working machinery available for the building of hydraulic presses, pumps, etc.

The Little Giant Truck Co., Little Giant Bldg., 1615 Michigan Ave., Chicago, took over the motor truck interests of the Chicago Pneumatic Tool Co., which has been in existence about nine years, on Jan. 1, 1918. The Little Giant Truck Co. is owned and controlled by the Chicago Pneumatic Tool Co., and the officers are the same: W. O. Duntley, president; W. B. Seelig, secretary; L. Beardsley, treasurer; W. J. Hudson, sales manager.

The U. S. Ball Bearing Mfg. Co. elected the following officers at the annual meeting of the board of directors: W. H. Strom, president and treasurer; E. N. Strom, vice president; G. A. Strom, secretary. The change in officers was brought about by the recent death of A. A. Strom, father of the three members of the present board. The change of name of the product of the U. S. Ball Bearing Mfg. Co. from "U. S. Ball Bearings" to "Strom Bearings" was decided by the active members of the company in commemoration of Mr. Strom's activities in the manufacturing world.

New Publications

United States Rifles and Machine Guns—By Fred H. Colvin and Ethan Viall, Associate Editors of the "American Machinist." Three hundred twenty-eight 11½ x 8½-in. pages, plus four pages of index. 2391 illustrations. Published by McGraw-Hill Book Co., Inc., 239 West 39th St., New York City. Price, $3.

No complicated manufacturing process has ever been covered in such detail as that of the United States service rifle, Model 1903, described in this book. This rifle is more commonly known as the Springfield rifle, and is considered by experts to be the best designed, best made and hardest shooting rifle produced by any government. The book begins with a chapter on the evolution of the American military rifle, in which the arm is traced from the earliest days to the present time. Following this is a treatise on the shop methods of the Springfield arsenal in the production of the Springfield rifle. The manufacturing process is given with the most minute detail; every part and how it is made, is gone into without a miss anywhere. The tools, machines and various fixtures used, are shown by halftones or line cuts in such a way that an engineer, draftsman or machinist can easily grasp the construction and principles involved. Hundreds of photographs were taken for this work; hundreds of blueprints were used, and months of time were consumed in gathering and arranging the material dealing with the Springfield rifle alone. An entirely new method of tabulating and arranging the data was evolved especially for work of this kind, with the result that an enormous amount of fact is contained in a comparatively small space.

Following the description of the manufacture of the Springfield rifle, are chapters on the Modified Enfield rifle, used by our expeditionary forces; the United States Automatic Rifle; the Lewis Machine gun, and the Vickers Machine gun. Beginning with the Modified Enfield rifle, these guns are described in detail as to their construction, action and handling.

As a reference book for public libraries, draftsmen, designers, engineers, army men and anyone interested in the latest types of rifles and machine guns used by the United States forces, this book should prove of great value.

Glossary of Aviation Terms—Compiled by Lieut. Victor W. Pagé and Lieut. Paul Montariol. Ninety-four pages, 5¼ x 7¾ in. Published by the Norman W. Henley Publishing Co., New York. Price, $1, net.

As the title implies, this is a glossary of terms used in aviation, and both English and French terms are given. It is divided into sections so as to make the selection easy. There are a few illustrations which indicate some of the important parts of the planes, thus making the terms more understandable to the student of aviation. The size seems a trifle large for a book of this kind, which would seem to be more conveniently made if easily carried in the pocket.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Lathe, Cone Head

National Lathe Co., Cincinnati, Ohio

"American Machinist," Jan. 10, 1918

Made in two sizes, 18 and 22 in.; swing over bed, 18½ in. and 23 in.; back-gear ratio, single back gear, 5⅓ to 1, double back gear, 3 to 1 and 9 to 1; 16 spindle speeds on single back-gear lathe, 15 to 370; 18 spindle speeds on double back-gear lathe, 15 to 360 r.p.m.; hole through spindle, 1⅜ in.; distance between centers, 6-ft. bed, 38 in.

Drilling Machine, 24-In., No. 3

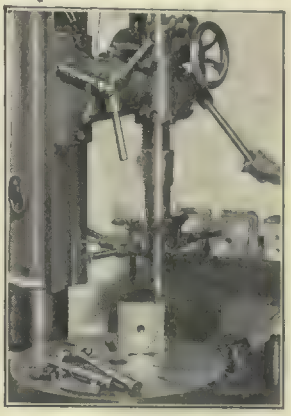
Defiance Machine Works, Defiance, Ohio

"American Machinist," Jan. 17, 1918

Capacity with high-speed drills in solid steel, 3 in.; length of power feed, 16 in.; diameter of spindle nose and drive, 3½ in.; taper in spindle, Morse No. 5; diameter of spindle sleeve, 3½ in.; width of helical gear for spindle drive, 2½ in.; maximum distance spindle nose to top of table, 32 in.; working surface of plain table, 20 x 22 in.; working surface of compound table, 17½ x 35 in.; longitudinal adjustment of compound table, 9 in.; vertical adjustment of table, 15 in.; feed changes, four, 0.007 to 0.046 in. per spindle revolution; spindle speeds, eight, 51, 81, 102, 128, 162, 204, 253 and 408 r.p.m.; driving pulley, 22 x 5½ in., 425 r.p.m.; horsepower required, 10; floor space, 38 x 66 in.; weight, 4570 lb.; floor space of motor-driven machine, 38 x 81 in.; weight of motor-driven machine, 5400 lb.

Drilling Head, Turret

Newman Manufacturing Co., 717-719 Sycamore St., Cincinnati, Ohio.

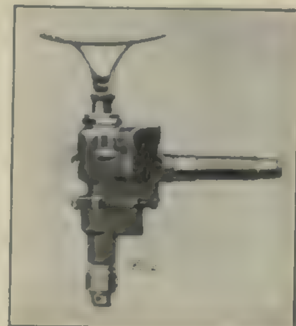


"American Machinist, Jan. 10, 1918

The attachment is arranged to be clamped to the sleeve, the drive being through a taper-shank fitting into the end of the spindle. The device is particularly useful where a number of different operations are required on a single piece of work. One tool may be substituted for another almost instantaneously, the tool in use being the only one in motion.

Drill, Pneumatic "Little David," No. 5

Ingersoll-Rand Co., 11 Broadway, New York City

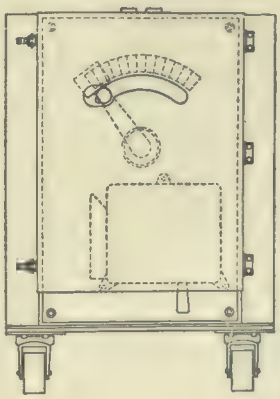


"American Machinist," Jan. 17, 1918

A lightweight, high-power, nonreversible pneumatic drill. Capacity on reaming work is up to ⅝ in. Weighs 15 lb. and develops a free-spindle speed of 1000 r.p.m. The motor has four pistons, and by the removal of five capscrews the entire crankshaft assembly may be withdrawn in its entirety. The valve is of the rotary type and is gear driven. Ball bearings are used on the crankshaft while those on the connecting rods are of the roller type. Furnished either with breast plate, spade handle or a telescoping feed screw

Welding Panels, Portable Electric

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

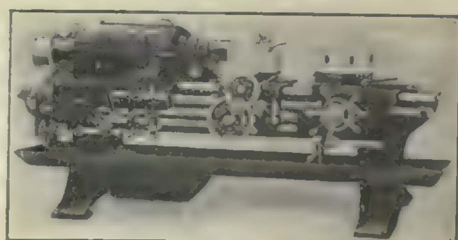


"American Machinist," Jan. 10, 1918

Made to obviate the necessity of installing a large number of welding panels. Is portable, being mounted on a truck and consists of a handle-trip, railway-type circuit-breaker, with an overload release, magnetic blowout, and a 13-point face-plate connected to resistors mounted in the rear of the panel. The face of the panel is protected by a metal cover through which the handles of the rheostat and circuit-breaker project

Lathe, Turret

W. K. Millholland Co., Indianapolis, Ind.



"American Machinist, Nov. 15, 1917

Designed for manufacturing work with an automatic chuck capacity up to 2½-in. rounds. Capacity of scroll chuck, 12 in.; hole through spindle, 2⅜ in.; swing over ways, 19½ in.; swing over carriage, 15 in.; spindle speeds, eight, 18 to 240 r.p.m.; weight, 5500 lb.; motor, constant speed, 5 hp.; taper attachment for tapers up to 1½ in. per ft. not exceeding 12 in. long

Balancing Machine, Dynamic

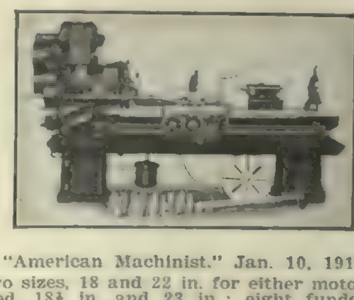
Fitz-Empire Double Pivot Last Co., Rochester, N. Y.

"American Machinist, Jan. 10, 1918

Designed for balancing parts weighing from 5 oz. to 75 lb. Machines of larger size will be made to order. The driving-head yoke is a single casting with two adjustable, self-oiling bearings. The shaft carries the cast-iron friction disk and tight and loose pulleys, and is provided with a ball thrust-bearing held by an adjustable spring tension. By means of this spring tension the pressure between the members of the friction drive may be adjusted to suit conditions. The friction disk is provided with a foot-operated brake for stopping the machine. Weight, 650 lb.

Lathe, Geared-Head

National Lathe Co., Cincinnati, Ohio



"American Machinist," Jan. 10, 1918

Made in two sizes, 18 and 22 in. for either motor or belt drive; swing over bed, 18½ in. and 23 in.; eight fundamental spindle speeds, 12 to 330; length of carriage bearing, 28 in.; greatest gear ratio, 28 to 1; hole through spindle, 1⅜ in.; distance between centers, 6-ft. bed, 38 in.; width, top of bed, 17 in.; net weight, 6-ft. bed, motor drive, 3800 lb.; net weight, 6-ft. bed, pulley drive, 3300 lb.; weight per extra foot of bed, 175 lb.

Patent Applied For

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Jan. 18, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$23.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia...............	33.75	33.75	30.00
*No. 2, Valley.....................	33.95	33.00	31.00
No. 2, Southern Cincinnati............	35.90	35.00	25.90
Basic, Eastern Pennsylvania..........	33.95	30.00	30.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Jan. 11, 1918	One Month Ago	One Year Ago	Jan. 18, 1918	One Year Ago	Jan. 18, 1918	One Year Ago
Structural shapes ...	$4.20	$4.20	$3.75	$4-4.04	$3.85	$4.20	$3.75
Soft steel bars......	4.10	4.10	3.75	4-4.04	3.85	4.10	3.85
Soft steel bar shapes.	4.10	4.10	3.75	4.14	3.85	4.10	3.75
Plats, ¼ to 1 in. thick	4.45	4.45	4.75	4.39	4.50	4.45	4.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Jan. 18, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York...................	4.70	3.75
Warehouse, Cleveland	3.98½	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Jan. 18, 1918	One Month Ago	One Year Ago	Jan. 18, 1918	One Year Ago	Jan. 18, 1918	One Year Ago
*No. 28 black......	5.00	6.45	6.45	5.50	6.45	5.50	6.45	5.00
*No. 26 black......	4.90	6.35	6.35	5.40	6.35	5.40	6.35	4.90
*Nos. 22 and 24 black	4.85	6.30	6.30	5.35	6.30	5.35	6.30	4.85
Nos. 18 and 26 black	4.80	6.25	6.25	5.30	6.25	5.30	6.25	4.80
No. 16 blue annealed.	4.45	5.65	5.65	4.85	5.65	4.95	5.65	4.70
No. 14 blue annealed.	4.35	5.55	5.55	4.75	5.55	4.85	5.55	4.60
No. 10 blue annealed.	4.25	5.45	5.45	4.65	5.45	4.75	5.45	4.50
*No. 28 galvanized..	6.25	7.70	7.70	7.50	7.70	7.00	7.70	7.25
*No. 26 galvannzed..	5.95	7.40	7.40	7.20	7.40	6.70	7.40	6.95
No. 24 galvanized...	5.80	7.25	7.25	7.05	7.25	6.55	7.25	6.80

*For painted corrugated sheets add 25c. per 100 lb.; for galvanized corrugated add 5c.

COLD DRAWN STEEL SHAFTING—From wârehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Jan.18, 1918	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Jan. 18, 1918	One Year Ago
New York	$15.00	$8.00
Cleveland	15.30	7.50
Chicago	15.00	6.00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*	
¾, 11/32, 5/16, ¼, 7/32, 9/16, No. 8, 3/32 and No. 10, ⅛ ..., No. 12 ..., 3/32, No. 14 and 1/16.., No. 18 ..., No. 20 ...	21.00@30.00

Cast-Iron Welding Rods	
3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire	
⅛	33.00
5/32	30.00
3/16	38.00

' Very scarce.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Jan. 18, 1918	Cleveland Jan. 18, 1918	Chicago Jan. 18, 1918
Tire	4.10	5.00	4.10
Toe calk	5.70	5.50	4.35
Openhearth spring steel...	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	14.00	11.25	12.00
Coppered bessemer rods....	9.00	....	7.00
Hoop steel	4.95	....	4.95
Cold-rolled strip steel.....	9.00	....	8.50
Floor plates	6.19½	....	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4......	29%	17%
4½ to 6......	44%	32½%	4½ to 6......	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Jan. 11, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	30.00
Tin, in 5-ton lots.................	85.00	86.00	42.88
Lead	6.75	6.50	7.50
Spelter	8.00	7.75	7.50

*Government price.

ST. LOUIS

Lead	6.70	6.37½	7.33
Spelter	7.75	7.50	9.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Jan. 18, 1918	One Month Ago	One Year Ago	Jan. 18, 1918	One Year Ago	Jan. 18, 1918	One Year Ago
Copper sheets, base.	31.00–33.50	35–37	41.00	32.50	44.00	32–33	42.00
Copper wire (carload lots)	32.00	36.00	36.00	28.50	44.00	31.50	36.50
Brass pipe, base...	36.50	38.50	47.50	38.00	52.00	38.00	46.50
Brass sheets	30.75	35.75	45.50	30.00	47.	30.50-31	44.00
Solder ½ and ½ (case lots)	48.00	40.50	27.50	43.25	28.25	44–45	28.25

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

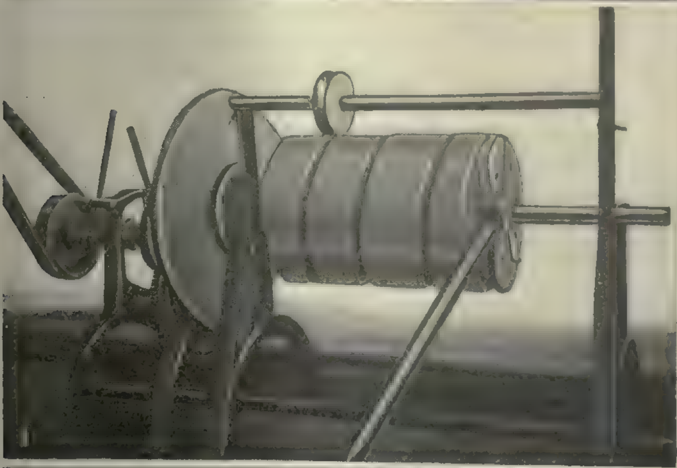
	Jan. 18, 1918	One Year Ago
Mill	$25.00	$42.00
New York	30.00	45.50
Cleveland	34.00	42.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:
Carload lots f.o.b. mill.. 19.00

	In Casks		Broken Lots	
	Jan. 11, 1918	One Year Ago	Jan. 11, 1918	One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.00	22.50	22.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Jan. 18, 1918	One Year Ago
New York	14.75	15.00
Cleveland	17.00	16.75
Chicago	16.00	15.75



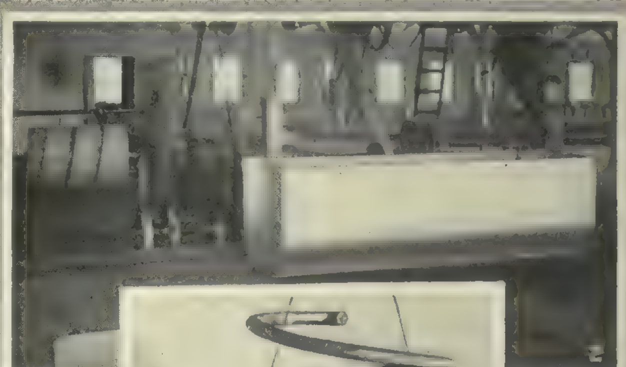
Operations in a CREAMERY MACHINERY PLANT

By Frank A. Stanley

The work described includes the coiling of copper pipe by means of a machine using a wooden bending drum, the machining of brass valves and plugs, and the finishing of pump parts.

IN THE Oakland, California, plant of the Jensen Creamery Machinery Company, there are numerous operations of interest, particularly in the line of pipe bending and forming, valve and pump work, and so on.

In connection with the production of coils from copper pipe, some unusual apparatus is employed which is well worthy of consideration in these columns. These pipe coils are made of copper tubing and are used in milk pasteurizers and coolers which are an important part of the product of this concern. The coils are of various diameters and lengths ranging from fairly small units up to diameters of five feet or more, and lengths up to 10 or 12 ft., according to the capacity of the tanks in which they are used. Like the interior of the milk receptacles, the copper coils are heavily coated with block tin, this coating operation being accomplished as a final process in the preparation of the pipe by cleaning the coil thoroughly with muriatic acid and dipping in troughs containing the melted metal.



FIGS. 2 AND 6. VIEWS IN THE PLANT

Fig. 2—The machine drive and drum.
Fig. 6—Melting the resin in the coil

The copper tubing from which the coils are formed is 2 in. in diameter and $\frac{1}{16}$ in. thick through the walls, the same size and gage tubing being used for all sizes and classes of coils.

The machine which has been constructed for forming these coils is shown in Figs. 1 and 2 and consists of a long spindle or main shaft for operating the coiling drums, and a power-driving mechanism comprising spur-gear trains, through the medium of which the coiling drum is rotated at a very slow rate of speed. The gearing through which motion is transmitted from the driving pulley to the drumshaft is seen clearly in the front and rear views referred to above.

The most interesting feature of the machine is the drum around which the copper pipe is bent to form a coil of the desired outside diameter and necessary helix. The lead of this helix, or the advance from turn to turn in the coil, is determined by the semicircular groove cut in the periphery of the drum, and the diameter of the coil is, of course, established by the pitch diameter of the drum itself. The drums are of sugar pine and are built up as shown in Fig. 3, which is reproduced from a rough sketch covering the drum construction, and shows the method of securing the copper tube at the end preparatory to forming the coil.

As stated above, the drums are made in various diameters and lengths, and in all cases whether large or small, the outside is formed by lagging the wooden center with 2 x 4-in. lengths secured in edgewise position across the whole length of the drum. The ends of these 2 x 4-in. strips are shown in Fig. 3, and as there indicated, they are planed up slightly wedge-shaped, so that their joining faces are on radial lines from the center of the drum, the entire series fitting snugly together around the drum body.

The helical groove around the surface of the drum is thus formed in the edges of the lagging strips, and for this reason the drum may be used indefinitely without showing appreciable wear from contact with the copper tubing. The groove is worked out by hand tools much the same as a job of patternmaking would be handled, the workmen following closely a center line

laid out around the drum to the required lead. This helical line for locating the center of the guide groove may be laid out in various ways. One of the simplest methods however is to make a templet of heavy paper or sheet tin and wrap this around the drum to provide a guide for scribing the helix, as indicated by the diagram, Fig. 4. Here the templet is shown developed for one turn around the drum, the base of the templet at *A* representing the lead of the helix; the vertical height or length of the templet *B*, being equal to the diameter of the drum multiplied by 3.1416, and the hypothenuse *C*, then represents the proper helix for a center line.

With this center line marked around the work, parallel lines may be laid off on either side to give the correct width of groove, and the workman can then cut out the winding channel to the correct depth, using a gage or depth templet to check the cut at all points.

How the Machine Is Used

Fig. 5 shows a number of drums of different sizes as required for certain types of coils. The one in the foreground is about 3 ft. in diameter, but is by no means the largest regularly used in the machine. This view by the way, shows distinctly the method of building up the parallel strips on the outside of the drum body and also shows the method of securing the strips by embedded screws at the ends.

The drum in the machine, Fig. 1, is about 30-in. outside diameter, and in this view a length of copper pipe in seen set in position for coiling. The end of the tube is secured for the start as indicated by Fig. 3. The tube end rests against the shaft and is gripped by driving the wooden block *F* in between the wooden jaws *G* and *H*. The coil is started to wind out from the center, and the guide block *G* around which the first part of the first turn is formed carries the bend outward to meet the outside of the drum where the remainder of the coil is wound along the helical groove.

Before coiling operations are started, the copper tube is filled from end to end to prevent wrinkling and collapsing; the practice here being to use resin as a filling medium. The resin being melted and poured into the

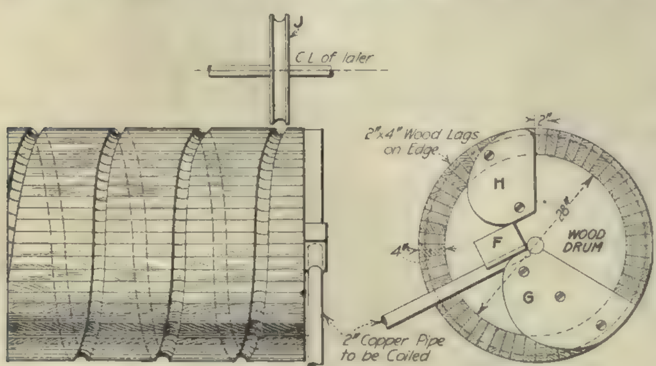


FIG. 3. DETAILS OF THE DRUM

tubing and allowed to cool thoroughly. After the machine is started the pipe is held snugly to the drum by a grooved idler pulley *J*, Fig. 3. This pulley is also shown in the illustration, Fig. 1, where it is seen mounted upon a long shaft held by uprights in a position parallel to the drumshaft. The pulley is free to slide along its shaft, and in operation it is caused to travel from one end of the drum to the other by the coiling of the pipe in the drum groove.

The shaft which carries the idler pulley is so adjusted for center distance from the drumshaft, that the pulley will hold the pipe snugly in the groove in the drum but will not create sufficient pressure on the copper to cause flattening at any point.

After a number of pipes have been coiled the resin is melted out as shown in Fig. 6. For this operation the coil is suspended by means of a sling with unequal arms which hold the coils from opposite sides in approximately vertical position, with the lower end of the pipe

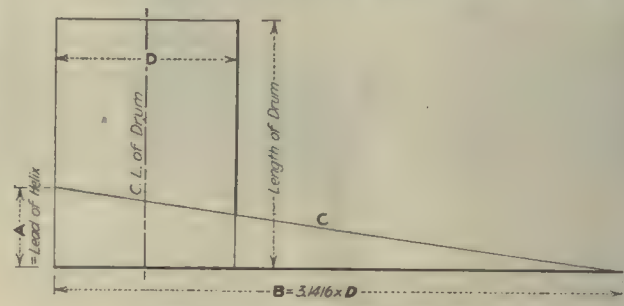


FIG. 4. LAYOUT OF HELIX

resting over a metal tank. A blowtorch is then applied as illustrated and the resin melted out. In applying the heat to the pipe it is necessary, of course, to warm the entire length of the coil, but care must be exercised to start the melting at the bottom and to work gradually toward the top without heating unduly at any intermediate portion of the pipe. Once the resin has started to flow it requires but a few moments' attention to free the remainder of the core so that it will drop out in semiplastic condition.

The coils are built up in various forms; some rotate in their tanks while suspended from a vertical shaft hung on ball bearings, others are carried horizontally in longitudinal vessels. They are commonly made of return-tube type with a hollow-shaft connection to permit of continuous flow of liquid, and a characteristic coil, one of many forms, is here shown by Fig. 7. This particular coil it should be noted, is attached to a vertical shaft by means of which it is revolved in an upright tank. The coils in Fig. 8 are long ones with a dozen or more turns. Usually when of this length or longer, they are made in two sections and brazed together to avoid the necessity for an inconveniently long drum in the coiling machine.

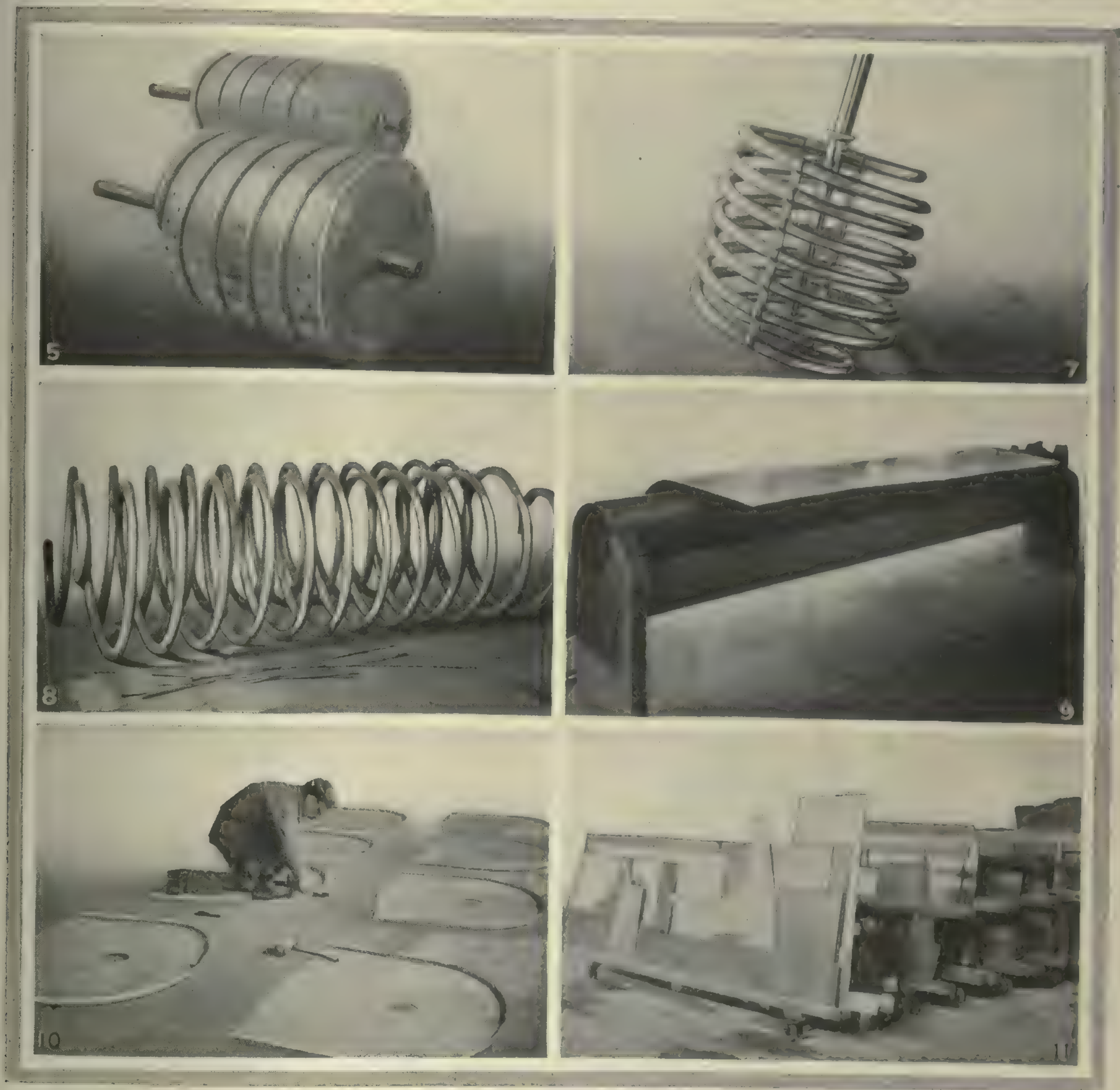
Tank Work

The long coils just referred to are used in longitudinal tanks like the one seen in the foreground of Fig. 2. These are built up of sheet metal in three pieces; the body of a single sheet, with two flanged end members.

For bending the long sheet a simple device is used in the manner illustrated by Fig. 9. It consists of a length of 12-in. pipe resting in wooden supports at the ends, while two 12-in. planks are secured to posts at the rear, leaving sufficient space to admit the sheet of metal between the face of the planks and the back of the pipe. With this simple apparatus the sheet-metal worker and his helper drop the sheet behind the pipe, and by merely drawing it over the top of the pipe to the front, bend it to the required curvature for the bottom of the tank.

The ends are flanged up on the floor as in Fig. 10. A

number of pieces, cut to suitable dimensions and allowing for the amount of material necessary for the flange joints, are laid out on the shop floor, and the tinsmith working to a line with a simple forked tool bends up the edge, then hammers out the wrinkles formed in the crimping process by placing a short anvil inside the lip and striking the outside of the work with his hammer.



FIGS. 5, 7, 8, 9, 10 AND 11. SOME OF THE APPARATUS USED IN THE CREAMERY MACHINERY PLANT

Fig. 5—A set of wooden drums. Fig. 7—A return coil with vertical shaft. Fig. 8—Long coils. Fig. 9—Apparatus for sheet bending. Fig. 10—Making sheet-metal heads. Fig. 11—Narrow trucks for holding sheet metal

In connection with this work a very convenient type of truck is used which could be employed to advantage in any shop handling sheet metal. Eight or ten of these trucks are illustrated in Fig. 11. They are long, narrow affairs with upright frames resting on the wooden bodies and slanting inward to an A-shape, so that the sheet metal rests on edge in the channeled body and slants back sufficiently to stay in place when the trucks are moved about the shop. This type of truck occupies but little floor space as compared with wide trucks which hold the metal in flat position, and with the material kept on edge as is shown, there is far less danger of its being bent or injured than when piled up flat.

Another class of work handled in this shop is illustrated by Fig. 12, which shows a small part of a considerable number of plug cocks or valves which also are finally coated with tin. Fig. 13 shows the method of boring the taper hole in the bodies. The work is a brass casting about 4 in. long with threaded connections at each side of the body, the taper seat being 2$\frac{5}{16}$ in. in diameter at the outer end. The taper is 1$\frac{1}{8}$ in. per ft.

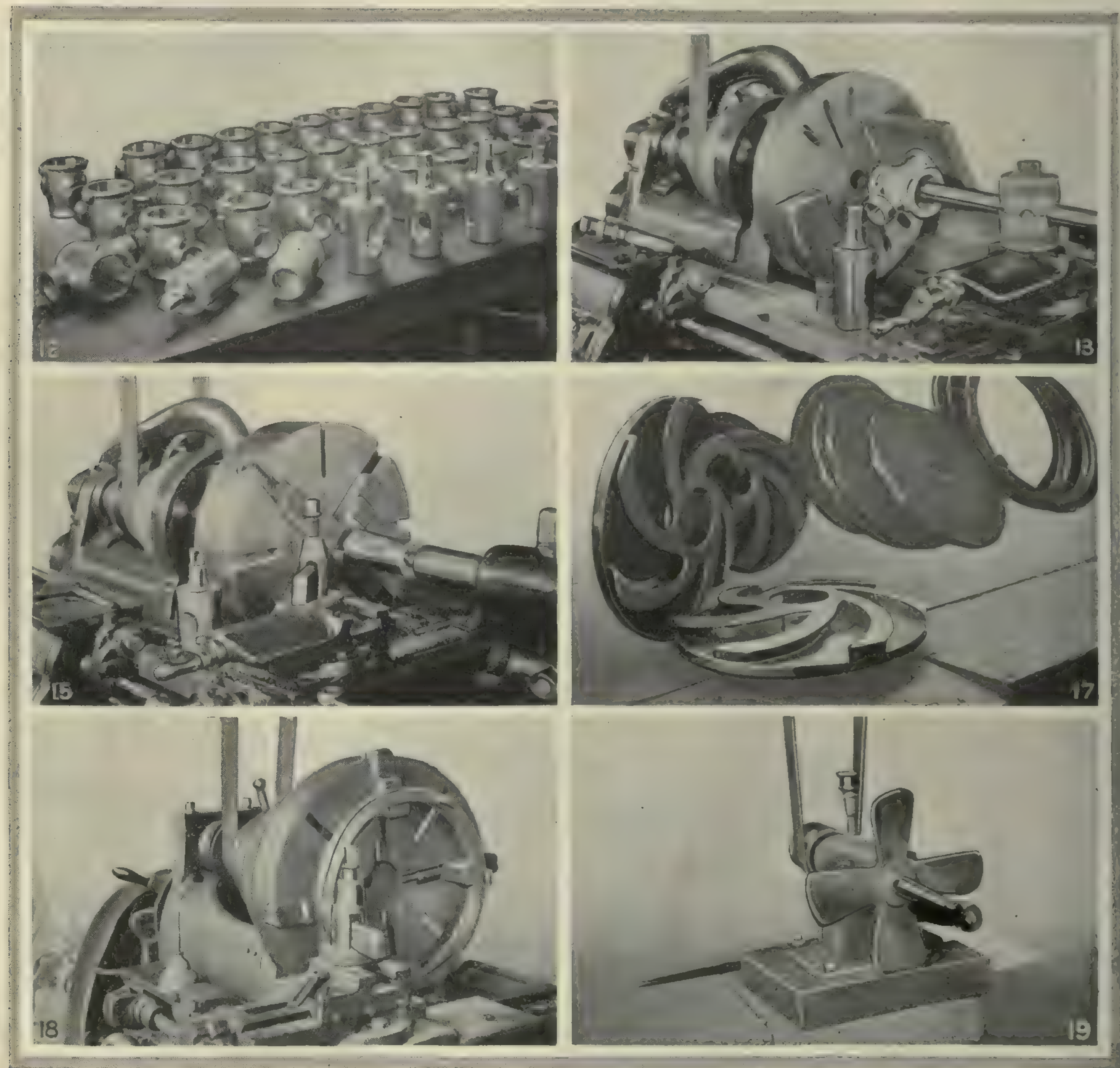
The lathe fixture for holding the brass casting is a simple angle iron balanced by a counterweight on the opposite side of the faceplate. The projecting leg of the angle iron is bored out and threaded as in Fig. 14 to 1$\frac{1}{2}$-in. pipe size to receive the connections on the work

which have already been threaded. A screw plug is provided in the top of the threaded hole in the angle plate to form a check for the work and prevent it from turning under the action of the cut.

The boring tool is applied as shown in Fig. 13, so that it cuts at the back of the hole, the tool being turned upside down—which has a tendency to do away with chatter. The taper of the hole is, of course, controlled by the regular taper attachment on the lathe. Three cuts are taken through the hole with the work running at high speed. The taper bar is set with accuracy and the hole is bored to exact dimensions without requiring a reamer for finishing. A taper plug is used to test the hole for correctness of taper and size at the large end.

The taper plugs for these valves are machined as in Fig. 15, with the square end of the shank held in the lathe chuck and the outer end carried on the tail center. Fig. 16 shows the small boss cast in the chamber at the outer end for centering and supporting the work during the turning of the taper and the facing of the ends.

An interesting form of pump is built by this company. The brass castings which make up this pump are of unusual form and require care in machining in order not to spring them at various points. Fig. 17 shows the pump impellers and casing backs and rings. These parts are held on the lathe chuck for the machining of various surfaces. Fig. 18 illustrates the method of chucking the ring for the turning of the outside, the boring of the seat inside and the facing of the outer edge. As illustrated, the ring is held from the inside by running out the chuck jaws, and owing to the light section the internal gripping must be done carefully, otherwise the ring will be distorted enough to prevent truth in the work when slipped off the chuck jaws. The faces of the



FIGS. 12, 13, 15, 17, 18 AND 19. SOME OF THE MACHINES USED IN THE PLANT

Fig. 12—Brass valve work. Fig. 13—Boring the taper in valve bodies. Fig. 15—Turning taper plugs. Fig. 17—Regular pump parts. Fig. 18—Finishing a light brass ring. Fig. 19—Bench grinding stand with dust fan

jaws are dressed off in a true plane so that the ring may be reversed and the back surface faced off parallel with the front.

Fig. 19 is an attachment for a bench grinding machine used with a small wheel for cleaning up iron and

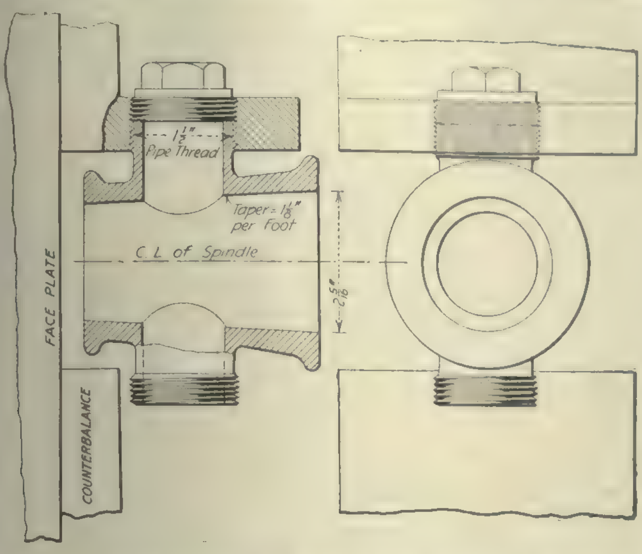


FIG. 14. FACE PLATE FEATURE FOR HOLDING VALVES

brass castings before they are bored out in the lathe. A four-bladed fan bent up from sheet metal is attached to the spindle for blowing out the scale and dust caused

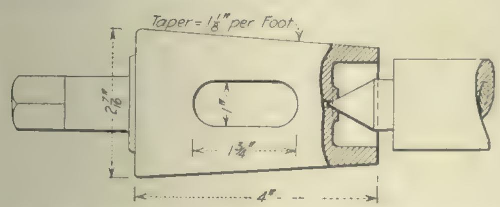


FIG. 16. METHOD OF SUPPORTING THE PLUG

by the process of grinding in the bore, thus keeping the wheel clear, also carrying the objectionable dust away from the operator.

Figuring the Cost of Work

By H. Johnson

In the last paragraph of an article on "Figuring the Cost of Work," on page 993, Vol. 47, a quotation reads: "I think I was a little hasty in what I said to the machine-shop people."

Shortly before, the writer had read the advertisement of a garage owner in which it was claimed that the management was able to effect good repairs cheaper than other shops because of expert help and complete equipment. His men did not experiment because they knew how to quickly diagnose and repair troubles. Now this garage owner is giving his customers a line of service which Mr. Forbes' friend did not receive. The machinist wasted both material and labor when he cut stock $1\frac{1}{2}$ in. longer than was needed. The bar should have been chucked and the piece completed ready for hardening before any cutting off was done. The firm was negligent when it provided unannealed bar stock for jobbing work. This sort of thing happens time after time in jobbing and contract shops both large and small.

A protest is recalled that was made against an excessive bill from a toolmaking firm. They had used $3\frac{1}{2}$-in. round stock to make a $2\frac{1}{4}$-in. job. Asked for an explanation, they simply said that $3\frac{1}{2}$-in. steel was the only size they had which was suitable for the job. What right had they to charge up wasted material and labor when the waste was caused by failure to carry a reasonably full line of bar steel, and this in what was claimed to be a general tool-building shop? Passing by the matter of right, it is surely poor business and a certain way to kill possible repeat orders.

From another firm, a large one too, a lot of equipment was purchased. The hangers for this equipment, being 2-in. pipe, were to be made by the purchaser. The hanger fittings were found to be tapped for 10 threads in place of the standard $11\frac{1}{2}$ threads per in. A telegram was sent requesting the loan of a die to cut the hanger threads, feeling that the builders ought to be willing to accommodate to that extent after "putting over" a freak job. They replied saying they had no die, but cut all their hanger threads in the engine lathe. Several dollars were expended in making a die to rectify the error. These manufacturers were not efficient in their methods, as engine-lathe operations on work of this class proves.

These instances could be piled up indefinitely. The man who has much contract work to do, soon discovers the careless firms and avoids them, but the occasional buyer seems doomed to disappointment from indifferent foremen and thoughtless workmen in shops superintended by men whose sense of fairness seems blunted.

Plaster of Paris for Sealing Holes

By Robert C. Morse

In the making of sectional gages, adjustable gages or various other mechanical devices, it is desirable to seal screw holes. The curiosity of man being always prevalent, it is wise also to seal the inspector's adjustment or the toolmaker's precision that they may not be tampered with.

Red sealing wax commonly used, suits the purpose, but it has been found from experience that sealing wax is difficult to apply to steel. It hardens too rapidly to get desired results, and often necessitates a second application. The idea of using plaster of paris came to the writer when several holes were to be sealed on some indicator gages; and as the holes were quite conspicuous, sealing wax was undesirable and did not properly fill them. Plaster of paris was tried and found superior to wax. The plaster dries rapidly and requires haste in applying.

The proper way of using plaster is to get all materials in readiness before mixing the desired amount; and if numerous holes are to be sealed, it is even better to mix a very little at a time, thereby eliminating unnecessary waste.

A small scale can be used for mixing and applying; if after filling a hole the plaster is rough on top, moisten the scale slightly and pass it over the plaster with enough pressure to make plaster flush with the top; scrape particles off and a neat appearance results.

Plaster is easily removed if need be, and moisture evaporates from it so rapidly, there is little danger of rust resulting from the water used in mixing.

Laminated Steel-Spring Proportions

BY H. H. KENNEDY

The easy-riding qualities of laminated steel springs as applied to motor cars and other vehicles, are due in a great measure to the relatively great length and volume of steel that can be conveniently used. In general, a long spring rides easier than a short one, and the work performed is proportional to the volume of steel used. While some long springs cause discomfort from violent rebound, this action is due more to certain proportions, other than the length, as this article explains.

IN THE selection of springs for a motor car, it is the practice of each designer to specify a certain degree of stiffness suitable for the size, weight and class of car under consideration. The stiffness factor is taken as the ratio of the pounds of load to inches of deflection produced by that load. Every designer must know from experience the correct value of this quantity to use for different conditions of spring suspension, car types, etc. It is this stiffness factor that determines how far a spring will act under a given road-shock, but does not in itself cover all the proportions necessary for easy riding.

With the stiffness factor once determined, the spring maker must know in addition the length and width desired in the spring. The width to use is generally standard for springs of a given load capacity, but may be given a rough calculation from spring formula by temporarily assuming a length and making the width greater than the calculated thickness at the center. This calculation can be checked again after the length is determined, it being necessary to see only that the width shall not be less than the thickness at the center.

The selection of spring length is of great importance, and is where most car designers make or mar the spring suspension. The stiffness factor already decided on, to some extent settles the minimum length of spring permissable, in order that the plates shall not be too thin nor too numerous, nor the stress too high in the plates. Beyond this the average designer refuses to go, working under the delusion that the greater the spring length the more the spring will weigh and cost. This is evidenced especially on low- and medium-priced cars.

It is generally admitted that relatively long springs are desirable providing that they are not too flexible on the one hand, nor too heavy and clumsy on the other. It can be shown that relatively long springs need be neither too flexible nor too heavy.

In the proportions of a leaf spring, which is nothing more than a laminated beam, it is possible to have a number of combinations that will meet a given specification of load and deflection. Contrary to the laws of a simple one-piece beam, it is possible, in the case of a spring, to vary the thickness and number of plates and the length, for a given stress, rigidity factor, width and load, and furthermore to do this in a manner such that the weight will remain practically constant.

These facts can be verified mathematically from the fundamental formula for leaf springs.

Taking the formula for semi-elliptic type of springs, and assuming all plates of equal thickness for the purpose of illustration, and where:

D = Deflection of spring at center;
L = One-half length center to center of eyes;
t = Thickness of plates;
n = Number of plates;
b = Width of plates;
P = Load at center;
E = Modulus of elasticity (30,000,000);
S = Stress, lb. per sq.in.

$$S = \frac{3LP}{nbt^2} \qquad (1)$$

$$D = \frac{3L^3P}{nbt^3E} \qquad (2)$$

To prove that S, D, P, b, E, may remain constant while L, n, t vary, we will assume values for the constants and substitute in equations (1) and (2). If the resulting two equations have common solutions that will satisfy both equations (1) and (2), the correctness of the assumption made is verified.

Assuming $S = 60{,}000$, $D = 2$ in., $P = 1000$, $b = 2$ in., $E = 30{,}000{,}000$ and collecting the variables on the same side of the equation;

$$\frac{L}{nt^2} = \frac{Sb}{3P} = \frac{60{,}000 \times 2}{3 \times 1000} = 40 \qquad (3)$$

$$\frac{L^3}{nt^3} = \frac{DbE}{3P} = \frac{2 \times 2 \times 30{,}000{,}000}{3 \times 1000} = 40{,}000 \qquad (4)$$

From equation (3)

$$L^3 = 64{,}000\ n^3t^6$$

From equation (4)

$$L^3 = 40{,}000\ nt^3$$

Hence,

$$64{,}000\ n^3t^6 = 40{,}000\ nt^3$$

$$n^2t^3 = \frac{40{,}000}{64{,}000} = 0.625$$

$$t = \sqrt[3]{\frac{0.625}{n^2}} \qquad (5)$$

Values of t and n that will satisfy equation (5), will satisfy both equations (3) and (4) hence (1) and (2), since equation (5) was derived from both equations (3) and (4).

However, to illustrate further; let $n = 10$, then from equation (5)

$$t = \sqrt[3]{\frac{0.625}{100}} = 0.184$$

From equation (3)

$$L = 40\ nt^2 = 40 \times 10 \times (0.184)^2 = 13.5$$

From equation (4)

$$L = \sqrt[3]{40{,}000nt^3} = \sqrt[3]{40{,}000 \times 10 \times 0.00625} = 13.5$$

It is shown therefore, that there are any number of values for nt and L that will satisfy the formula for leaf springs, while the stress, deflection, width and load remain constant.

To show that the weight of the spring will remain practically constant while stress, deflection, width and load are constant, and length, number and thickness of plates vary, it will only be necessary to prove the product of n, t and L constant, since the weight of the spring will be approximately proportional to this product of number of plates, thickness and length.

Two formulas for deflection involving all the factors are:

$$D = \frac{L^2 S}{tE} \tag{6}$$

$$D = \frac{3L^3 P}{Ent^3 b} \tag{7}$$

In which D, b, P, E and S are to be constant.

From equation (6)

$$\frac{L^2}{t} = \frac{ED}{S} = Q \text{ (a constant)}$$

$$\frac{L^4}{t^2} = Q^2$$

From equation (7)

$$\frac{L^3}{nt^3} = \frac{EbD}{3P} = K \text{ (a constant)}$$

$$nt^3 = \frac{L^3}{K}$$

$$nt = \frac{L^3}{Kt^2}$$

$$ntL = \frac{L^4}{t^2 K} = \frac{Q^2}{K}$$

Since Q and K are both constants, Q^2 divided by K is also constant. Hence ntL is constant. That is, the weight of the spring will remain constant for any variation in length, if the number and thickness of plates are so selected that the stress and deflection do not vary for a given load and width of plate.

It is therefore possible for the spring maker to furnish a long spring as well as a short one that will meet the same specifications as to flexibility, load and weight of spring, the only limitations being plates too thin and numerous on one hand and plates too thick on the other. However, there is considerable leeway in this respect, and there is considerable to be gained by the use of long springs, as regards good riding qualities, so long as the flexibility is not too great.

It happens that for a given stress, load and deflection, a relatively short spring requires numerous thin plates, which give a damping action that is desirable, while a long spring tends to the opposite. It is therefore necessary that a compromise be made. However, this point of compromise as regards spring length is usually greater than the lengths adopted by many car designers.

Harry's Uncle Looks Back

Not long ago I went to arrange for the admission of a young friend, Bob, to the apprentice school connected with a large manufacturing shop.

While Bob was obtaining certificates of birth, vaccination, school attendance, consent of parents and I know not what else, I visited the school where he was to be made into a machinist. This was no easy matter, as I was subjected to a questioning almost as thorough as that meted out to the boy. Finally I was admitted, probably because my calloused hands removed any fears that I might be a member of the I. W. W., and was treated with the greatest courtesy.

What I beheld was a revelation to an "oldster," and well worth all the trouble incident to gaining admission.

As I watched the quiet assembling of the young fellows, clad in their "glad raiment," books and papers in hand, I found it easy to believe the tale that an earlier visitor, also a machinist, asked whether the exercises were opened with hymns and prayer.

Hearing the pupils recite their arithmetic, algebra and trigonometry, I was soon convinced of the thoroughness of their training in those branches of erudition, and was somewhat impatient to see them engaged in actual shop work.

I was ushered into a large room, devoted entirely to the apprentices and their instructors, and given full opportunity to ramble about and observe conditions to my heart's content.

There was nothing of what we sometimes hear scornfully spoken of as "manual training methods," but the young men were doing regular commercial work to the requirements of an up-to-date inspection department, and doing it, by their careful teaching, with regard to speeds, feeds and tool-shapes, at a rate far exceeding that of any shop with which I am familiar. These were second-year apprentices. When the superintendent of apprentices asked my impressions, I told him that when these men completed their three years' training, I should be glad, if hiring men, to pay them more than the prevailing rate of wages, so long as they maintained the standards of speed and accuracy exhibited in the school.

Naturally my thoughts reverted to the days when Bob's uncle Dick and I were fellow "cubs," away back in 1872.

Dick passed no examinations and presented no certificates when he began his "time;" even the fact that he had been born being taken on trust without the corroborative statment from the physician who presided at that interesting event. He merely said to the boss "D'yer wanter hire a good feller to learn?" The boss replied "It's a hard, dirty trade. Have you the sand to stick to it?" On Dick's stout affirmative assurance the boss bade him come to work the next Monday at the munificent wage of $3 a week.

He received no instruction in mathematics nor in any other scholastic branches; however, he was to discover later, there were men in the shop fully competent to teach them. His first weeks were spent in sweeping, striking for the blacksmith, trotting out to buy tobacco for the men, climbing a rickety stepladder to "ile" the shafting, gaining wisdom in the lacing of belts, and it must be confessed, in a limited amount of loafing and skylarking.

Finding that one of the men was an ex-sailor, he devoted as much of his noontimes as remained after "wolfing" his lunch, to mastering some of the mysteries of knots, bends and splices: an accomplishment for which he soon found use.

There were in those primitive days, no "safety-first" push-buttons to throw out a magnetic clutch, close the

engine throttle, or even ring a bell in the engine room; the prevailing method in case of accident being to hurl a hammer or convenient piece of junk against the wall separating the shop from the domain of the engineer. That functionary, Fred, was of a somnolent temperament, and spent much time tipped back in a chair against the aforesaid wall, tempting mischievous workmen to throw chunks of iron at the other side of the board which supported his weary head. In consequence of this ruthless disturbance of his slumbers, Fred determined upon the installation of a more "stylish" means of communication, and enlisted for that purpose the services of Mike, the fireman; also he requisitioned (probably, alas, from some neighboring yard) a fifty-foot length of clothesline. This was to be festooned about the shop from staples in the floor-joists overhead, its remoter end being attached to a jingle-bell in Fred's dominions. Just as the last staple was put into place the noon whistle blew and Fred and Mike sprinted off to dinner. During their absence Dick brought together the ends of the line in a neat "long splice" and calmly awaited developments. Soon in came Mike and began overhauling the line to get it ready for reeving through the staples. After running through his hands what he asserted was a "moil" of it, he proclaimed his firm belief that "aither some Sassenach has cut off the both inds or else Fred shtole only the middle of the rope." The sinful Dick, always glad to be of assistance, suggested that he should cut the rope, assuring him that this would be "a short cut to the attainment of the desired end," but Mike indignantly repudiated this kindly advice, saying "That wud make but the wan ind, and if I cut it twicet to make the two inds, the domned rope wud be too short, ye fool!"

How do you suppose Dick spent his evenings after the brief day's work (from six to six, minus dinner time and plus occasional overtime) was done? There were then no movies to interest and instruct the youthful mind. He had conceived a great admiration for Tom, the boss, and when the latter said "study, study, boy, and you may make something of yourself," it was but natural that he should obey.

Finding that Dick had acquired in his schooldays, some smattering of geometry, Tom lent him a book on trigonometry, in which had been marked such parts as Tom thought likely to be of service in the trade. This he allowed Dick to keep but one or two days, then made him return it, telling him that he shouldn't see it again till he had mastered logarithms; at the same time lending him a book on that subject and offering help as an instructor. In afterlife Dick often spoke of the wisdom of this treatment, as the "logs," eliminating the drudgery of calculations left his mind free to revel unfatigued, in the delights of "trig"—and they were veritable delights to him.

The blacksmith's helper, whom the men called "Frangswah" when not too much hurried, and Jack or Bill or anything else when they hadn't time to recall his lawful designation—he spoke in times of stress, words alleged to be French, though I fear they belonged to the objurgatory portions of that tongue. Dick entertained the hope of acquiring the language from "Frangswah" till someone intimated that the variety spoken in France differed in some respects from that used in Canuckia, whereupon Dick concluded a treaty with a French machinist in a neighboring shop, under the terms of which each was to teach his own language to the other. Sundays afforded the only time available for these liguistic diversions, and I never heard that Dick received during his apprenticeship, any prizes for regular attendance on Sunday School.

Fred and trigonometry, two apparently unrelated subjects, were linked in Dick's mind about this time, by a happenstance. The shop possessed and held in high esteem an old planer, originally of the chain type, which Tom had altered to a rack-and-worm arrangement. The calculations for the worm he made himself, and made them well with one exception. I have heard a tale of a sea captain who, by a slight error in the characteristic of a logarithm used in working up his day's observations, found his ship's position to be somewhere in Montana. Tom's error involved more work for its correction perhaps, but afforded much amusement for a shopful of fun-loving machinists. By some queer quirk of mind he took the carefully determined circumference of the worm for its diameter, and didn't discover his error till the worm was on its shaft and ready to be placed in the planer. Then as it was evidently wrong, he sledged it off from the shaft and with his usually placid temper sadly ruffled, hurled the monstrosity with such Samson-like force that it neatly removed from the wall the board against which Fred's head was resting, capsized that gentleman's chair of repose and propelled him, half-awake, across the brick floor till his orbit became tangent to the engine bed, whereupon he decided to go no further.

It is a well-known principle of physics that the arrest of motion always is accompanied by the evolution of heat, and this case goes to confirm the rule as there was an immediate ebullition of violent language in the realm where Fred ruled as monarch. Not being, like François, bi-lingual, he had to confine himself to English, but his efforts at self-expression were masterly, establishing a record seldom equalled and never excelled in that shop.

One Use of the Advertisements

By Frank C. Hudson

Some of the boys complain at times about the large number of advertiser's pages in the *American Machinist*, but whenever I hear one complain I tell him of some of the uses I make of them.

As an example, I showed one recently the amount of information which appeared from week to week in the series of advertisements of the Cincinnati Bickford Tool Co. Using Chapter 52 as illustrative, I pointed out the excellent lesson in designing which it contained. This is only one of many instances where valuable data can be found in the advertising pages from week to week.

Keeping Machines on the Job

By BRYAN T. HAWLEY

This article points out the necessity of employing inspectors and skilled mechanics to examine all machinery and keep it in repair as an insurance against production holdup. This, the writer states, will lead to a minimum cost of upkeep and maximum reliability.

SOME authorities claim that high-maintenance costs on the mechanical equipment of a factory are a good index of the value of the investment represented; but so much depends upon whether the high-maintenance costs are caused by prevention and preparedness, or by neglect and petty economy, as to leave the claim incomplete.

It would be well to take into consideration what incentives operators are given to use the equipment right, and how much attention is paid to inspection and machine oiling.

Thorough, conscientious mechanics in these positions will show wonderful returns for the money paid them. Many times the oiler aspires to become a machine operator, when in reality the importance of proper lubrication, in many cases is such as to suggest the reverse. Actual practice shows that in many cases, a piecework operator can be trained to get standard production on certain machines in a fraction of the time required to train an oiler to see that proper lubrication is given.

Unless prepared to issue exact rules as to the quantity and class of lubricant each particular bearing on a machine should receive, the employment of a competent mechanic as oiler is worth while. In the days which have passed in most shops, when boys served an apprenticeship and the fundamentals of fits and fixtures were slowly assimilated and digested, they acquired a habit that is apparent in many toolmakers of today; namely, seeing to it that their tools and equipment are in shape for the morrow. Piecework and specialized production necessitates provision for care of machines; and as production is specialized, so must the inspection, adjustments and repairs be specialized. When depreciation is high, as it is in most all specializing plants, a certain part of the depreciation is due to machine development, in which the good producer of yesterday is supplanted by the modern machine.

Another part of the depreciation is due to normal wear and old age. It is not production that wears out a machine so much as neglect, and a goodly part of the high depreciation may be eliminated by inspection and repairs. Machines having reciprocating, intermittent, index or reverse mechanism, require much more attention than those of continuous action. The maintenance costs are higher on punching and shearing machines, broaching, shaping and milling machines, than on machines of the boring-mill and lathe types. A monthly inspection together with adjustments and repairs may require an average of two hours for each machine of a certain type on a special class of work. A weekly inspection and adjustment occupying a half hour may be required for another line of machines; while for still another type, a thorough going over may be necessary only once in six or eight months.

To obtain best results, each battery of machines should have a different line of inspection and adjustments; and as far as possible, a definite set of rules should govern the inspector. These rules should state what parts are likely to cause trouble. An inspector to make the final adjustments, together with a repair man and helper may be required on a battery of 20 machines, or such a staff may be able to care for even 100 machines, as the case may be. Their work should be mapped out in advance, and they should not be taken for other duties.

Nearly all railroads find it practical to make their repairs through inspection, with the result that their rolling stock seldom fails under overload. Stocking up with repair parts is looked upon as a dead investment—one that does not pay interest or dividends; yet such an investment is insurance against production holdup. It sometimes occurs that the investments in repair parts, coupled with the cost of making repairs and adjustments, makes the cost account top-heavy, and shows that the machine itself is a poor investment in spite of its being a good producer. Thus the importance of an individual cost account for each machine.

Frequency of Inspection

Parts liable to failure or subject to heavy wear should receive more frequent inspection, and methods be employed to eliminate causes of failure. When a machine part requires replacement, either through breakage or wear, investigation by a skilled mechanic will go a long way toward determining future liabilities. A flaw causing a break in a machine part requiring infrequent repairs would hardly warrant carrying such a part in stock; but in any event, the cause of trouble must be found. In cases where this can be accomplished, replacement may be made without considering future renewals.

Often when pushed hard for production, many a good mechanic will make the same repair or replacement the second time without taking thought or time to seek the cause. Even with reasonable inspection, small faults in internal mechanism may be carelessly overlooked, and result in a greater loss in another direction.

The majority of machines have either cams, locking devices, feed mechanism, index or gear shifters which cause trouble when some part refuses to function; some operators, regardless of instruction, persist in occasionally using a hammer or wrench instead of their heads.

There is a difference of opinion as to figuring in dollars and cents the loss per day caused by a disabled machine. Much depends upon the type of machine and its duties. Contracts, prices, holding up other machines, etc., all must be factors in the estimate.

With a battery of 10 machines on which parts are interchangeable, a part costing $10 may require replacement once in two years for each machine. This means five replacements a year. It is generally wise to procure

parts from the machine builder, and three days is a remarkably good average delivery, even when ordering by wire. It is reasonable to assume that three days of lost production would mean a loss of $20 quite aside from the indirect losses. Such a needed part could be carried in stock continuously at an insurance rate of 10 per cent. for $3 per year, as against the probable loss of $30 per year due to production loss. But all machines cannot be considered from the same angle. A wise decision regarding the carrying of specific repair parts, depends upon many conditions such as value of machine, production requirements, cost of repair part, and time of delivery.

The first question in keeping machines on the job is one of policy in the matter of who shall hold the reins and do the driving. Are the machines to drive the repair department or is the repair department to drive the machines? If the policy of the machine user permits the machines to do the driving, inspection and foresight is useless, and condition of equipment is controlled by ungoverned depreciation. This is a situation that grows in proportion to the demand for production.

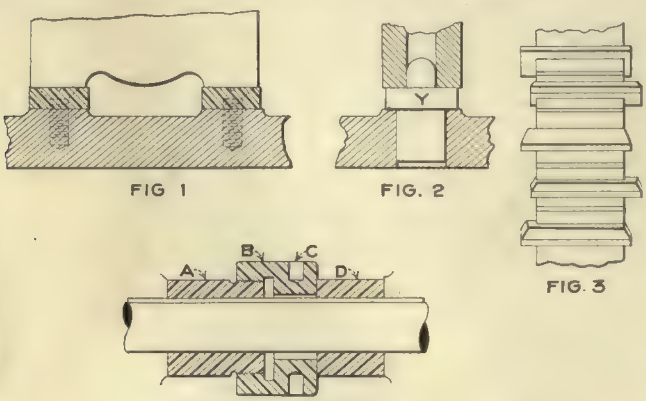
Where the policy of the machine user calls for control of equipment condition, foresight must be used in making such repairs as will result in maximum reliability with minimum cost of upkeep.

Efficiency in Milling Fixtures

By J. Ahlers

No greater precision is required on any machine work than on aviation engines, and it is interesting to note the provisions which are made for extreme accuracy and rigidity in the design of tools and fixtures for this work. Here are a few features in the design of milling fixtures which are worthy of note and imitation.

The work is never allowed to bear on the cast-iron surface of the jig if the operation demands any degree



FIGS 1 TO 4. VARIOUS MILLING KINKS

of accuracy. Hardened steel strips or pads are provided under all bearing points, as shown in Fig. 1.

Locating pins *Y* are designed as in Fig. 2, especially those of the smaller diameters. A pin of uniform diameter will invariably get bent or battered out of alignment, but a pin like the one shown is good practically all the time. The large diameter is a drive fit in the jig casting, the smaller diameter is hardened and ground to size, and the shoulder which is lapped to a true surface, insures the pin being kept in place.

In Fig. 3 is represented a cutter which is used in place of the interlocking cutter. When interlocking cutters are worn they are ground and then packed up between the halves to maintain the original size of the face of the cutter. The one shown in the illustration is merely an inserted blade cutter. When it becomes dull it is reground and then every blade is offset to one side, so that the width of the cut can always be held the same.

When cutters are adjusted, or are adjustable, the spacing between them changes. This is taken care of by means of the adjustable spacer sleeve as shown in Fig. 4. It is merely a sleeve *A* bearing against one cutter and threaded for a nut *B*, which is turned by a pin in the holes *C*, and another solid sleeve *D* bearing against the other cutter. The only member which turns is the nut and this eliminates any wearing of sleeves against cutters.

A Floating Reamer Holder

By H. E. McCray

The writer has had an opportunity to try a number of forms of floating and so-called floating reamer holders. Some work well until worn, others work indifferently from the start. We have adopted the form shown in Fig. 1, as being equal, if not superior, to most others, especially for hot-rolled or other tough steel work. It has been our experience that reamers give more trouble in this material than in either cast iron or brass.

The steel reamer *R* fits the standard $\frac{1}{8}$-in.-per-ft. taper on the holder *D*, and is driven by the two keys *K*.

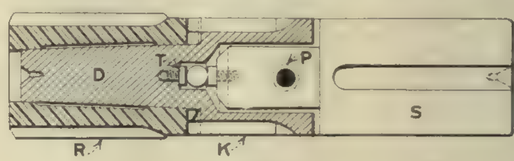


FIG. 1

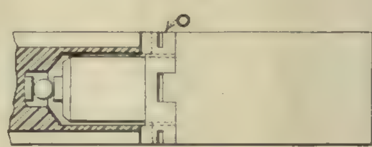


FIG. 2

FIGS. 1 AND 2. FLOATING REAMER HOLDER DRIVEN BY PINS AND AN OLDHAM COUPLING

The holder is bored $\frac{1}{32}$ in. over the size of the small diameter of shank *S* giving this amount of float. Holder *D* is drilled out beyond the counterbore to a suitable size to admit the hardened thrust plug *T*, and the steel ball. A similar hardened thrust plug is supported in the end of shank *S*. The counterbore for the ball allows about $\frac{1}{32}$-in. play, and the holder and shank are kept separate laterally by the same amount. The entire thrust is taken by the ball and thrust plugs, allowing the reamer to follow the hole with very little effort.

Several forms of floating drivers were tried, but the two shown work best. In Fig. 1, the drive is by a hardened pin *P*, a drive fit in shank *S*, but having $\frac{1}{32}$-in. play in the holes in the driver. This works well for smaller size reamers, but wears out more rapidly than the form shown in Fig. 2. Here the drive is taken by the shackle ring *O*, which is the standard Oldham coupling drive.

The Forging of an Off-Set Jaw

BY J. V. HUNTER

Very frequently in foundry papers the statement is made that the day of the steel casting is surely arriving and that eventually it will to a great extent replace most of the forged and pressed steel parts. The utterers of such statements usually feel that the casting can be made in many forms which the forging can not be made to assume. This is frequently true, but the designers of many machine parts are gradually learning how to distribute the metal in them and so to shape them that some manner of forging will make their creation possible, and in addition to this work of the designer the forge shop toolmakers are adding one new method to another, so that each added device will take care of one more trying problem.

THOSE who handle only one side of the foregoing proposition may be justly pardoned for taking a somewhat limited view in favor of their side, but while today I feel that we can turn out as good a steel casting as most of the foundries, I am in no way inclined to favor the introduction of a casting for a part where by any manner of scheming, a method can be arranged for forging an adequate part. So far as a brief comparison of the two characters of output may be made there is first, much to be said by way of choice for the shrinkage, strains and cracks that will occur in steel castings, rather than for those strains that may be put upon a piece of steel while it is being hot-worked by the smith. But if the forging practice has been carefully worked out, the product will by a subsequent careful heat treatment gain an exceptional advantage over the casting through the elimination of practically all strain. However, so far as steel castings are concerned no manner of treatment will relieve the voids that are too often left in them by the contraction of the molten metal.

It is my opinion that a forged part is preferable in the machine shop for the subsequent finishing operations, because it has none of the sand and grit which can never be thoroughly removed from a casting, and this grit will always add to the tool upkeep expense, while in general more material must be removed from a casting in the finishing operations than it is necessary to remove from a carefully designed die forging.

Another point: while the character of the work required by different shops may vary greatly, in the vast majority of cases the demands of the average manufacturer for his average parts can be supplied much cheaper in forgings than they can be in castings. This applies particularly to that class of forged output which may be obtained without too many different forging operations for any one piece. It stands to reason that a man, when hot die-forging parts, can usually handle many times the number of parts per day that any steel molder could be expected to obtain from sand molds.

The greatest factor in forging work of today is probably the high-grade, heavy-duty forging machine, built so strongly and with so little give in its parts that its output will run remarkably close to die sizes. Good dies for such a machine while not too costly, still represent some investment, and the great problem is to avoid if possible the building of any wasted experimental sets in order to plan the "follow-through" of each subsequent operation that may be necessary in order to complete the forging with a minimum number of passes, and always obtain high-class work. Since hot steel when it is being worked does not always run in the necessary directions in sufficient amounts, it is sometimes necessary to make up a few experimental forgings with cheap cast blocks for dies to determine accurately just how much metal may be required to fill out certain corners.

The offset pull-rod jaw forging shown in Fig. 1 is a case in point. It is a difficult and peculiar railway-truck forging, which production was gradually developed through several different methods to the present economical one. This jaw is of a type that the foundryman might claim could only be made economically in a steel casting, but what railway man would care to trust a casting in so important a position? Then, too, this might have been beaten out under a heavy drop-hammer at a considerable loss of metal, but few railway shops have heavy drop-hammers, and ours is no exception in that regard, likewise most of them have good size steam forging hammers, and the method originally employed was to forge this out under a 1500-lb. steam hammer.

OPERATIONS REQUIRED TO FORGE JAW

In Fig. 2 is shown the sequence of the operations that were required to forge this jaw. Bar stock, heavy enough to provide the full diameter of the jaw, was first necked down as shown at *A*. This was followed by the drawing down operation at *B*, in which the metal was crowded out considerably more upon one side; these first two operations were done with standard flat dies in the hammer. The special cast-iron forging dies shown in Fig. 3 were then put in the hammer.

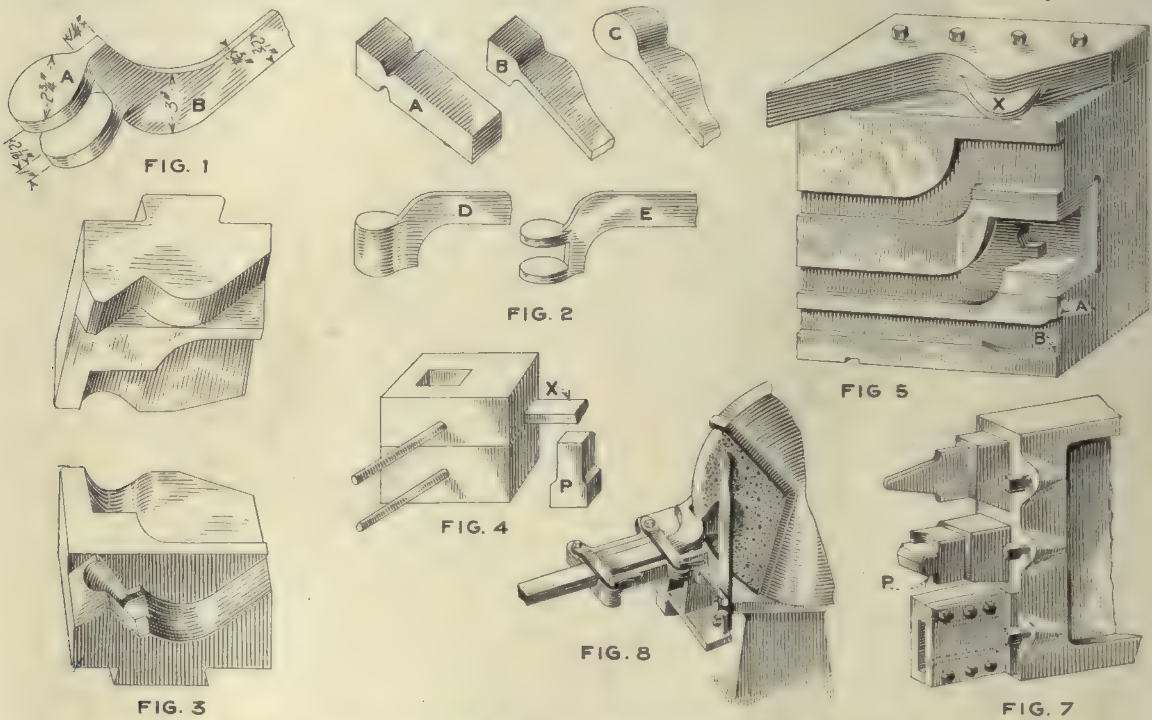
By laying the forging in the shallow recess of these dies, the round swaging of the jaws was obtained as at *C* in Fig. 2. From this point the forging was stood on edge in the deep recess of the dies and struck again with the hammer, which gave it the curved off-set as at *D*. To shape this up well it is necessary to work the forging back and forth a number of times between the two passes of these dies. Finally all forgings are nicely worked up into the form *D*, and the flat dies are replaced in the hammer for the next operation.

This consists of punching out (hot) a large portion of the stock from the heavy end of the forging in order to form the jaws. To so do the punching die-blocks shown in Fig. 4 are employed; these are recessed in the center to provide a perfect casing for the forging, the stem of which in this particular illustration is seen to be projecting from the side of the die at *X*. The punch *P* is inserted in the hole in the top of the die and driven through by the hammer. From this operation the forging comes out as at *E*, it may and will require a little trimming with a hot chisel to remove the fins, and possi-

bly a little hammer work to square up all sides. By this method the forging work is so uncertain for size that sufficient stock must be left on the inside of the jaws to provide for a machine cut.

The coming of the modern high-grade forging machine created another possibility for the manufacture of this jaw; when made under the hammer one of the lengthy processes had been that of drawing down the full length of the bar, for a weld at any point of this was not permissible; but if a jaw might be upset on the end, then a rolled bar of the necessary size could be used for a starter. To serve this purpose the dies shown in Fig. 5 were planned and developed for use in a 4-in. size of heavy-duty forging machine; and in this connection the methods followed in planning the sequence of operations for a set of dies may be of some interest ing with the width *B* of Fig. 1, while *A*, Fig. 5, provides the stock to insure that the corresponding corner in the forging shell be completely filled out. The forward portion of the bar that enters the header will furnish the majority of the material for the formation of the jaws. The planning of the exact shape of this pass was not the simplest proposition, for the two upsets had to come in exactly the right place after the bending.

To insure this the upper portions of the dies, which constitute the bending pass, were placed in a bulldozer; a wood pattern was made of the first-planned shape from the first pass, and a lead casting made from this pattern. This lead casting was then bent in the bending dies, which gave a good idea of the approximate displacement that would occur when bending up a hot steel bar. After several changes in the shape of the



FIGS. 1 TO 8. OPERATIONS AND TOOLS FOR AN OFFSET JAW FORGING

Fig. 1—The finished jaw forging. Fig. 2—Steps in forging under a hammer. Fig. 3—The hammer dies. Fig. 4—Jaw shearing punch and die. Fig. 5—Forging machine dies. Fig. 7—The punches. Fig. 8—The jaw grinding fixture

as indicating a few of the many points that must be foreseen and arranged for in such a development.

The mere matter of upsetting a jaw is a comparatively simple one, for this means simply the gathering of the necessary stock, a splitting operation to divide it into halves, and a final forming and shaping operation. In this case, however, the considerations involved in obtaining a full, sharp corner at *A*, Fig. 1, and the increased width for stiffness at *B*, together with the trouble occasioned by the peculiarity of the offset from the continuation line of the bar, necessitate radically different treatment in the die design. In fact the increased width at *B* is the determining factor, because it eliminates all possibility of making the bend after upsetting the jaws, since the additional metal at this point must be the first thing provided.

Referring to Fig. 5 which shows the completed dies and headers, the bottom pass is the first operation on the bar, this being used in connection with the hollow header opposite it, the two upsetting the additional width of stock. The point *B* in this figure correspond-

pattern, and the bending of the corresponding lead castings, the exact shape was determined.

It will be noted that bolts and a heavy key have been provided to secure the bending blocks to the top of the main dies; these were necessitated by the extreme height of the dies which caused them to extend much above the die space of the machine, so that these blocks would otherwise have had no backing to take up the stress of operation. The bending die on the side which has not been illustrated, is the reverse of the one shown. It also has a lug *X* in a corresponding position. The purpose of these lugs is to prevent the metal from upsetting during the bending operation, as they are fixed above the die itself at just the proper thickness for the bar. If the pull on removal should distort the bend somewhat, the forging can be struck again above the lugs, which will restore the shape. The matter of preventing any upsetting of the bar during the bending operation is an important one that must be taken into account in any forging of this nature, since such an upset will come between the grips

of the dies in the next pass and prevent them from closing properly.

In Fig. 6 is shown the forgings as they come from the various passes, starting from the left. A small square of iron is laid on the outer end of the bar after the second pass when replacing it in the furnace to take a welding heat for the third pass, and furnishes the additional material required to make the jaws. Owing to the depth of the hollow header that would have been required to collect sufficient metal to form these jaws, which would have then required an additional pass to upset this end, this expedient was adopted for supplying the material, and as the pull-rod is made of high-grade forging iron, this added piece will weld homogeneously with the rest of the jaw. When steel is used there is less possibility of getting

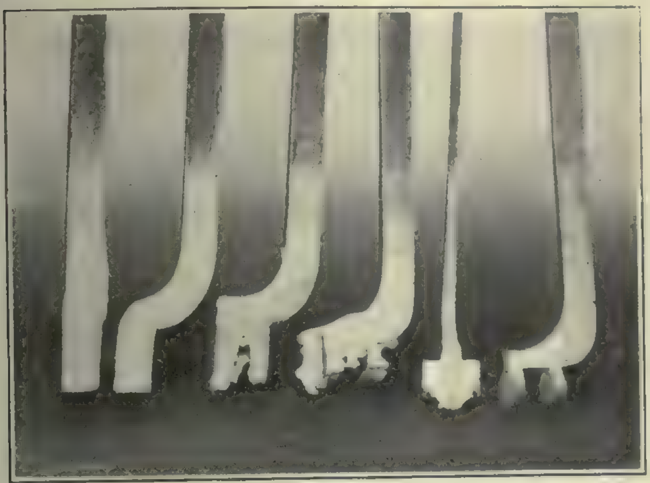


FIG. 6. EVOLUTION OF THE FORGING

a perfect weld, as a high enough heat is likely to burn the metal, in consequence an additional operation will have to be employed as noted.

The third operation is a splitting one as can be readily understood from an inspection of the header which is the top one of the three in Fig. 7. The splitting wedge must be wide enough at its base, that the two halves will permit the next header to enter between them without actually catching on the outer end of either.

The last pass, which in this case is the center header and pass in the die, puts all of the finishing touches upon the forging. This pass not only represents a large part of the toolroom work upon this job, but it is also very desirable that it should stand up in the best possible shape, and show little wear, distortion, or age-cracks due to the influence of the hot metal; consequently it is desirable that this should be made of a special die forging steel. This is a grade of alloy steel that has been especially developed by the tool-steel manufacturers for just this class of work, and it is akin to the well-known high-speed steels, which can stand constant and long continued contact with hot steel with a minimum amount of damage. Since this steel is much more expensive than the cast steel from which the remainder of the dies are made, only the necessary portion is inserted for the working part of this pass, as will be noted where the light lines define its borders. Keys or bolts will hold it firmly in position.

It will be noted that the header extends at least a half-inch wider on each side than the actual width of the round end of the jaws; this is necessary in order to give the working edges of the header the necessary strength and support. On this header it will be seen that the outside corners of the central portion have been cut away at *P*, this provides a filling space in which the surplus metal from these middle fins can run away, without causing too great a fin pressure, with the consequent strain upon the machine and dies. Just how important this point is, can be seen from the side-view of the completed forging, shown the fifth from the left end, Fig. 6, where it can be seen that the fins have completely filled out into the corners.

All fins made are very light and are removed with a sledge and hot chisel. A mandrel is laid between the two jaws after trimming, to ascertain that these have not been spread. After the trimming the finished jaw forging is shown at the right end of the row in this same illustration.

Mention was made earlier of the accuracy of these machine forgings as compared with castings; and in this particular case the work came out to such close limits that it was possible to grind the jaws to a finish on their four faces instead of milling as had been previously done. The jig for this grinding operation is illustrated in Fig. 8. This consists primarily of a swinging casting in which the forging can be clamped to hold the jaws parallel with the bar; this casting swings on a light shaft supported from the bottom bracket, that when the outer end is swung down the forging will clear the wheel, either to shift from one face to another, or for removal from the jig. The lever at the right of the jig will shift the carrying rig either one way or the other, and by this means the necessary pressure is applied to the forging when it has been brought up into contact with the wheel. This method for finishing has proved to be very rapid, affording even a greater degree of accuracy than was actually required.

Making Cams for Automatic Screw Machines

By Arthur Jenner

The methods described in this article pertain particularly to means for quickly making any of the 100 divisions of the cam, and also for rapidly roughing the blank to any required shape ready for milling. The milling operation can be performed in more than one way; and as these methods are well known, it will not be necessary to touch upon that part of the work. Where a considerable number of cams are needed for Brown & Sharpe automatic screw machines in the production of small accurate parts, these methods may be used with satisfactory results, as to cost and quality of product.

The stock is round-edged cold-rolled machine steel, $\frac{1}{4}$ x $5\frac{1}{2}$ in. for No. 00 machine, $\frac{5}{16}$ x 7 in. for No. 0 machine and $\frac{3}{8}$ x $8\frac{1}{2}$ in. for No. 2 machine. After the required blanks have been cut off with a hacksaw, as in Fig. 1, the burrs are removed and the large holes drilled. Fig. 2 shows the method of locating the blanks in a stack on the drilling machine, using two angle irons. The reaming size drill, $\frac{1}{64}$ in. under ream size, is used to

spot to its full size. Then a $\frac{5}{8}$-in. drill is run through all the blanks, followed by the drill first used as a spotter. This eliminates the chatter consequent to following a small drill with one of much larger size. The corners are next countersunk or chamfered about $\frac{1}{32}$ in. on each side, and the hole reamed to standard size, each blank being handled singly on this operation. The pin hole is then spotted, drilled, chamfered and reamed, using the jig shown in Fig. 3. A separate jig is of course necessary for each size of cam. These jigs are made of machine steel and pack hardened.

The blanks are carried through in quantities of from 50 to 100 each size up to this stage and are turned into stock to be drawn out as occasion demands. The average cost of any size blank, for material and labor, in 1915, was 25c. each.

Forms No. 121 D. R., Brown & Sharpe Manufacturing Co., from whom they may be purchased, were used in detailing the required individual cam and its layout.

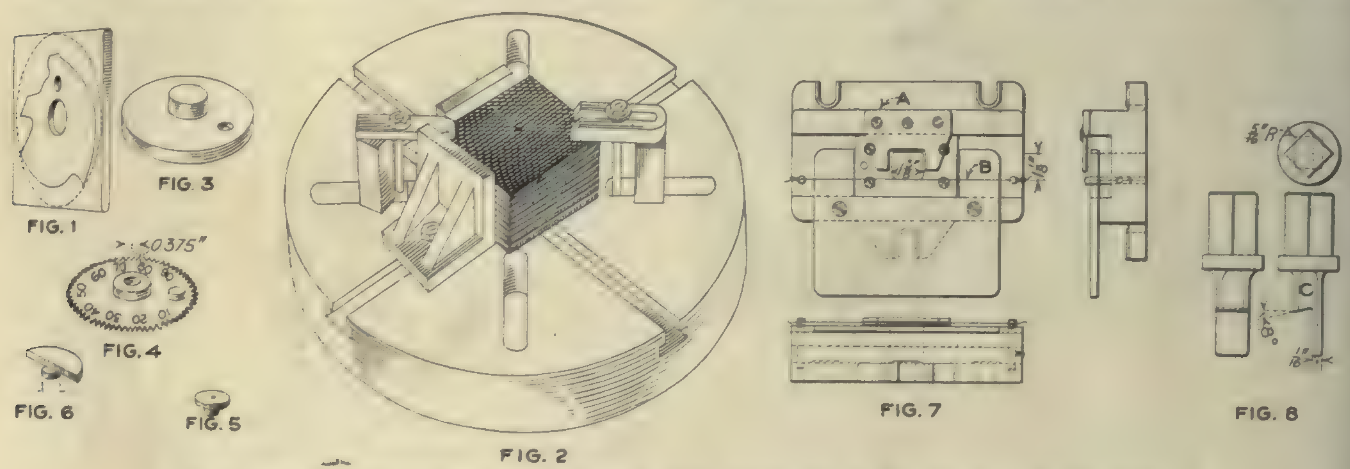
Three disks, as in Fig. 4, were made of $\frac{1}{16}$-in. ground steel, $3\frac{1}{2}$ in. in diameter, each having 100 cuts like saw teeth, but fitted with studs and pins to suit the three cam sizes. The 0.375-in. hole in the stud is to receive the plugs shown in Figs. 5 and 6. The plug illustrated in Fig. 5 carries a center spot for the dividers when describing the radii of the highest points of the cam.

The plug, Fig. 6, has the head cut away to the center and is used with a straight-edge in combination with the disk, Fig. 4. The disk is laid upon the blank and registered by its plug and pin, thus making a protractor. The necessary divisions only are marked off by the use of the foregoing tools. The drops and abrupt part of the rises are marked off from the detailed layout on Form 121, previously referred to. It is usually unnecessary to lay out that part of the rise corresponding to the cutting period on the front and rear slide cams, as this will be taken care of in the milling and should be noted on the detailed layout, as, for example, 0.001-in. rise per 2-deg. rotation of cam.

Instead of cutting away the surplus stock by drilling small holes around the contour or by jig sawing—the two most common methods—the die shown in Fig. 7 is used in a press running about 50 strokes per minute. The height of the stripper plate A is changed to suit the thickness of stock being trimmed, by putting one or two $\frac{1}{16}$-in. spacers under the stripper. This stripper plate is only necessary when a bite is taken using the whole cutting edge of the punch in roughing out. It also prevents breaking the wire B. This wire, about 0.025 in. in diameter, is stretched across the face of the die at the same height as the under face of the stripper and as close as possible to the front face of the punch C, Fig. 8, and is used as a guide for trimming to the cam layout. By keeping the line of the layout always in sight, sufficient stock is left for milling. This wire is adjustable to suit the various thicknesses of stock and should be kept as close as possible to the cam surface.

The work rests on a plate, Fig. 7, which is flush with the die face. The punch, Fig. 8, is made with a guide, or extension that is always in the die, and should be long enough so that it will not come out when at the top of the stroke. Care should be taken to lubricate the back face of the guide, as considerable pressure is exerted, when the punch is cutting. No lubricant is necessary for the cutting edges.

It will be found that a careful operator will become quite dexterous in the use of this press tool, and good time will be made. A cam similar to Fig. 1 can be cut out in less than 10 min., leaving a minimum of stock for milling. The cams after milling should be tried out on the screw machine. If satisfactory, they are pack hardened. The cam can then be mounted upon an arbor, and the dwells ground on a cylindrical grinding machine to verify the concentricity of the cam at the sizing period.



FIGS. 1 TO 8. METHODS OF LAYING OUT THE CAMS AND SOME OF THE TOOLS USED

Calculating for Electromagnets

By S. H. Hartshorn

On page 1096, Vol. 47, there appears an article on "Calculating for Electromagnets" by W. Thomas. The writer would refer this gentleman to the work on solenoids, by Charles R. Underhill, 84 Stanley St., New Haven, Conn. The charts which Mr. Thomas refers to, are more or less impossible to get, owing to the great changes in magnetic pull, made by very slight changes in design. His problem, however, is purely one of the length of the magnetic circuit, and the number of ampere turns involved, as the voltage has merely the effect of sparking when used too high. What is more, most electromagnets and solenoids, such as the one described, are dependent on very small currents, either from $\frac{1}{2}$ to 2 amperes.

The Making of Plug and Ring Gages

BY J. H. SMITH

Some valuable suggestions in regard to the manufacture of a product that is in great demand at the present time. Various types of gages are discussed.

THE steel for plug gages should be roughed out and annealed, this is especially the case with large or complicated gages to prevent warping or cracking in hardening. The grinding allowance is from 0.010 in. for small gages up to 0.020 in. or more on larger ones. For hardening I used clean water or salt water, sometimes with the chill slightly taken off. After hardening a plain gage heat the measuring end until water will boil upon it. The handle end can be drawn to a straw color. Gages that have slots, etc., are better made of machine steel pack hardened.

It is good practice to re-ream the centers of the work slightly after turning and before hardening. If this is done, and the work is not too badly warped in hardening, a little polishing out with the folded corner of a piece of emery cloth will clean out the scale or dirt. It is better to lap the centers of work held between centers, or ground on both ends, but for gages ground on one end only the final lapping of the gage will correct any lack of roundness.

Grinding-machine centers should be frequently inspected, especially after grinding high-speed steel. I grind mine at least once a week. In the commercial grinding department, centers are ground every day. This is essential if close work is desired.

Centers Should Be Thoroughly Cleaned

Before grinding, the centers should be thoroughly cleaned. The work should then be rough ground and laid aside until wanted, to give it time to season. The allowance for final grinding is from 0.003 to 0.006 in., according to size. If less than 0.002 in. is left on, and gages are laid aside for a few weeks, it is likely that some will warp so badly that they will not clean up. Work ready for lapping should also be laid away until actually wanted, as it will often swell one or two ten-thousandths of an inch.

When using the automatic feed, one should take in consideration the expansion of the grinding machine. This expansion, due to heating up of the grinding machine, will sometimes make a difference of 0.002 in. on the work one or two hours after starting up. Plenty of water should be used to avoid surface cracks. On stepped plugs one has trouble to keep the corner of the wheel sharp unless the corner of the work is sufficiently undercut. Corners should be inspected for undercut clearance before hardening.

The wheel should be trued at the height of the center line, otherwise, feed lines will show upon the work. I ground the projecting part of the tail center straight and fitted a diamond toolholder as shown in Fig. 1 to it. The opening *A* fits the center, a hexagon head screw holds it. The hole *B* at right angles to it fits the shank of a diamond toolholder, and also has a hexagon head screw to clamp it. I prefer the diamond holder with a screw cap, to one where the diamond is brazed in. If kept in one fixed position the diamond will dull and will more or less glaze a hard or fine wheel, with the adjustable holder one can turn the diamond to present a sharp edge again. If the centers and grinding machine are kept in good condition 0.0002 in. will be enough finish allowance for lapping. After a little experience the roundness of the work can be judged from the sparks, or felt by hand while the work is running. Mottled work shows that the wheel is out of balance. Care should be taken to have the grinding-machine spindle properly adjusted in its bearings if duplicate parallel work is to be expected. For lapping I use washed flour of emery. To prepare it I take a clean can and fill it about ⅛ with emery, then fill with lard oil. After stirring I let it stand for about 10 min., then carefully pour off the oil on top into another clean can. The emery which is suspended in the oil at the end of 10 min. will not scratch. If finer emery is required the oil can be allowed to stand longer before pouring off. If there is much work to lap, and a high polish is not required, 5 min. will be long enough for the emery and oil to stand. Keep covered when not actually using, and when working near a dry grinding machine, as coarse particles will cause the gage to be scratched. A little kerosene prevents gumming of the lap. I make laps for small work of brass, and for large gages I use cast iron. In Fig. 2 is shown an external lap. There are grooves *A* inside, but they must not run to the ends. For a holder I used a ring as shown in Fig. 3. In shape. this ring is similar to a die holder, but with one handle long enough to rest against the lathe bed. This prevents the lap from turning with the work, and all the workman has to do is to push the lap endwise. Three screws are necessary, the center one *A* is for opening a tight lap, the other two *B*, for closing. For a gage 1½ or 2 in. long, I use a lap about ¾ in. long; a lap should always be shorter than the work. Lapping should not be done at too high speed. On the average lathe use the slowest speed with the back gears out; this is about the right speed for ordinary sizes of gages. For small gages up to say ¾ in. diameter a speed lathe with quick-acting chuck is a handy thing to have. A slight movement only, is necessary to put in or take out the work. I use the tailstock for heavy gages only, as it is too much trouble to move every time, besides it is in the way when pulling the lap off.

Lapping Six Gages at a Time

It is more economical to lap six or more gages at a time. When I have a number of gages of the same size to lap I use the piece of sheet iron shown in Fig. 4. It is about 2 in. high with openings *A* to put the gages in. This is put in a pail of suitable size and the gages are put in the openings. This method saves the trouble of fishing for every gage from the bottom of the pail and the hands are kept dry. Starting on one end of the receiver, Fig. 4, one can

lap the gages one after the other. When all of them are lapped, the first one can be taken out, dried off, and measured again. Benzine, kerosene or soda water can be used to cool them; benzine smells bad; kerosene takes the skin off the hands if used all day; soda water mixed with a little lard oil is cleaner and cools them faster.

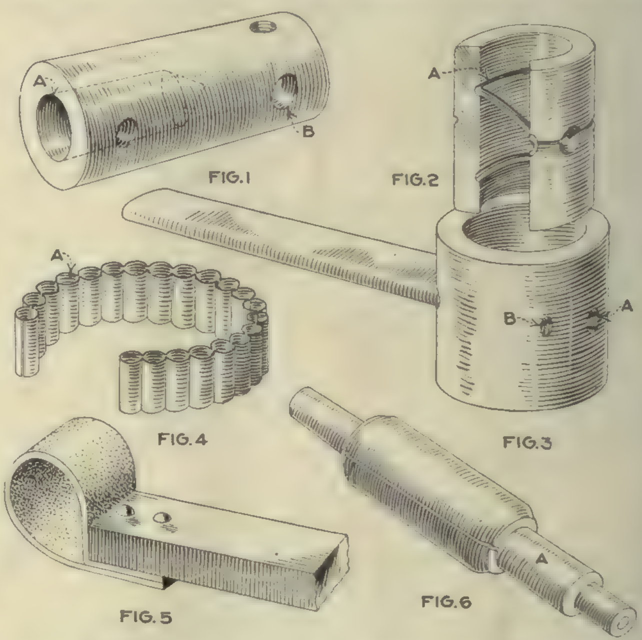
After getting everything ready, the gage is chucked and the sharp corners are removed with an oil stone to prevent ruining the lap. It is then wiped off lengthwise with a soft rag, and measured to ascertain how much it is over size. The lap is then put on, and the tension screws adjusted for a stiff fit. If the work is taper it should be lapped straight first. With every revolution of the work, the lap should be moved about $\frac{3}{4}$ in. along the gage back or forth, because if the lap is a tight fit and rapidly moved here and there the highest points will be taken off first. This does not take place when the speed of the work is high, the lap a loose fit and leisurely moved with a feed of about $\frac{1}{32}$ in. per turn of the work.

Avoid Lapping Near the End of Gage

Care should be taken not to lap too much near the end of the gage. About five or six times back and forth to within about $\frac{1}{16}$ in. of the end to one time over the end is often enough. The reason for not lapping the end as much as the rest is to avoid bellmouthing. When the lap is removed, the end of the gages usually gets reduced enough. The lap should be removed quickly, otherwise it may result in bellmouthing. It is not so difficult to remove the first 0.0001 or 0.00015 in. as it is to remove the last 0.00005 in. It is good practice to test one gage first, as most micrometers vary at one point or another. They may be all right on zero or 1 in. and be out 0.0005 or 0.0001 in. on $\frac{3}{8}$, $\frac{5}{8}$ or $\frac{7}{8}$ in. One cannot expect a measuring machine at the price of a micrometer. I used a 1-in. and 2-in. micrometer with ten thousandths for lapping alone; a similar one for finish, and one with thousandths for rough grinding. Grinding is hard on a micrometer. The soda water and grit will get into the barrel and soon destroy the accuracy of a micrometer. To get the right size I proceed as follows: Leaving the gage rather full, I go to the inspection room and get it tested with the Swedish gages set up as a snap gage, but without a clamp holder. Less than 0.00005 in. oversize on the gage will break the Swedish blocks apart; if the gage is too small it will fall through the Swedish gage set-up. When correct this first gage is used as a master. By now and then trying the micrometer on it, while lapping the other gages, one can get close duplication. The man who does light gage work should not do heavy work as it destroys the delicate touch necessary for this class of work. A skilled lapper should be able to lap thirty $\frac{1}{4}$- to $\frac{1}{2}$-in. gages a day, when everything is going right.

It sometimes happens that there is a spot or spots that project above the surface of the gage; these can be removed with a narrow lap about $\frac{1}{4}$ in. wide.

To get a high finish on the gage, the lap is dried off and the gage lapped allowed to dry for a few moments. When doing this one should take care to have the lap a tight fit and not lap too long, going rapidly back and forth, otherwise the lap is apt to score the work. If one has plenty of time one can use machine oil only when 0.00005 in. oversize. This gives a brilliant polish. The sharp corners should be stoned off slightly, this finishes the gage. Although many gages are made of tool steel good results can be had with machine steel pack hardened, where many are needed the use of machine steel results in a big saving. We rip them out from cold-rolled bar stock on the screw machine 100 or 200 at a time. Care should be taken to have the centers run quite true, otherwise too much must be left on for grinding. If rightly carbonized they will last longer than tool steel, although they may show soft spots here or there. With pack-hardened gages it does not do to leave copper sulphate coloring on the work as it sometimes prevents the carbon penetrating. Pack-hardened gages act somewhat like high-speed steel on the wheel and take longer to lap to size. When making ring gages great care should be taken to clamp lightly for grinding the hole. If gripped in the chuck one should be able to pull the gage out by hand. I



FIGS. 1 TO 6. LAPS, LAP HOLDERS AND ACCESSORIES

usually grind both sides on a surface grinding machine and use parallels and small clamps to hold against the faceplate. The best results will be obtained if the wheel is kept inside the hole, not letting it run farther than about half the thickness of the wheel, out of the gage on both ends, unless the grinding spindle is exceptionally solid. This prevents bellmouthing to a considerable extent. Small gages can be lapped to size immediately after hardening. Before the war 0.004 in. was enough room to leave to clean up a $\frac{1}{2}$-in. gage, but now instead of shrinking, the hole often goes 0.003 in. or 0.004 in. oversize. Gages over $\frac{1}{2}$ in. are better if ground out first. Leave plenty of room for lapping as ring gages have a tendency to get out of shape after a few weeks, or be out of round owing to soft spots. The lapping allowance which I find satisfactory is 0.001 in. for $\frac{1}{2}$- to 1-in. gages, 0.0015 in. for 1- to 2-in. gages and 0.002 to 0.003 in. for 2- to 3-in. gages. To hold the gage while lapping use a piece of leather belting laid double, and nailed to a stick of wood long enough

to rest against the lathe bed, see Fig. 5. The tighter the strap is, the better it will hold. This method of holding a large gage, bushing or lap is superior to a clamp as it grips the work all round with an even tension. For small work a lapholder used on plug gages can be used. As a material for laps for female gages I use brass for small ones and cast-iron bushings for larger gages. The bushings are reamed with a standard taper-pin reamer ¼-in. taper to the foot. The arbors *A*, Fig. 6, to fit are either hardened and ground all over or have only the ends hardened to preserve the centers, one end of the arbor is made straight to grip in the chuck. The lap should be bored or reamed, split lengthwise then driven on an arbor tight enough to hold while it is turned on the outside. These laps do not need a key to prevent turning on the arbor as is the case with lead laps. Lead laps are not good for round work as they lose shape too easily when driven on the arbor or when a sharp corner of the work gets caught in the lead. A further objection is that they lack the necessary elasticity to hold them on the arbor when driven back. Cast iron found in every shop, is elastic enough, and once made, holds its shape for a long while. Laps about ¼ in. diameter give better results when grooved, but the grooves should not run to the ends. I make these grooves by running the lathe slow, digging the tool in and moving the carriage by hand, cutting an irregular spiral groove to suit. The grooves can also be filed in or holes can be spotted in the surface of the lap to keep the emery on. The ends of the lap should be reduced for about ⅛ in. and the corners rounded to prevent raising a burr when driving it. The lap can be pressed on or driven with a piece of copper.

Small Size Lap

Where the laps in use are of small size, I have a washer drilled with different sized holes to drive the lap farther when needed. The center is taken out of the tail spindle and the washer rests against the face of the tail spindle. Only for big laps is it necessary to use the tail center as a support. When lapping it is good practice to put a little emery in the center of the slot in the lap. This will gradually work its way out. The ends of the lap should be wiped off; the lap should not be used too wet when the hole is near to size, and care should be taken to have the lap a tight fit in the work. To get a high polish, dry off the lap, and work with the dry lap. The same methods of lapping can be followed with bushings, but a little coarser emery or carborundum can be used for lapping them, as one does not have to avoid scratches so much as with gage work. If the ends of the gages are ground after lapping the hole will have to be lapped again as the ends will close in with grinding.

If there are no taper reamers to ream laps, an easy way to bore is as follows: put a taper arbor between centers and with indicator set compound rest of lathe; drill hole and put the tool upside down on the right-hand side or back with the lathe running forward. This will give the right fit at the first setting if both indicator point, and tool are on the center line. If a long small hole has to be bored, hammer or rather forge the boring tool for its entire length to stiffen it. Both cast-iron and brass laps should be annealed. For keyway gages the slot in the lap should be cut spirally.

Wheels for Tool and Cutter Grinding

By Robin Duff

One of the most neglected places in a shop is the wheel rack of the universal tool- and cutter-grinding machine. I never yet have worked on a tool- and cutter-grinding machine where I did not feel like apologizing for my poor assortment of wheels. Neither have I seen in any factory a rack having an equipment of wheels that approached the ideal. Where the use of the machine is open to all toolmakers in a toolroom, the condition of the wheels is generally deplorable. A toolmaker as a rule will go to the machine, select a wheel (generally the best-looking wheel in the rack) and if it is not exactly the shape he wants he will unhesitatingly dress it with the diamond to suit himself. Sometimes this spoils the wheel for its original use.

The large majority of racks contain worn-down wheels in plenty, and the operator usually has to make the best use of these that he can. This is not fair since the requirements of his work are such as to demand the use of the best wheels obtainable. Good operators are decidedly scarce, and one of the best ways to hold them in the factory is to give them the assortment of wheels for which they ask. To call down an operator for doing an indifferent job of grinding when the proper equipment for the work has not been furnished him, is one of the short cuts toward losing his services, especially if he has requested the purchase of some particular wheel and did not get it.

Toolroom foremen should familiarize themselves more completely with the particular needs of the tool- and cutter-grinding machines. If the operator is a man of sense and experience, and asks for a wheel of a certain grade and grain, give him that wheel. He surely must know what he wants, so do not overrule his judgment. Many a job that takes three hours to grind could be done in an hour if the wheel assortment were more varied as to grain, grade, shape and size. I remember not long ago, one toolroom foreman who persisted in buying for me such wheels as 80 and 100 L Norton when I specially requested 3846 K and 3860 K Norton. He did this while still admitting that I appeared to know more about grinding wheels than any man who had previously worked for him.

A hard wheel will inevitably cause temperature changes, and a consequent distortion of the work, even though the discoloration usually associated with excessive heat may not appear on the surface.

A good wheel list for the grinding of such carbon steel and high-speed work as plain milling-machine cutters, formed cutters, gear cutters and inserted-tooth milling cutters is not a formidable list to remember. Taking the Norton vitrified alundum wheel for example, the job can be done with one or the other of the following wheels: 3846 J or K; 3850 J; 3860 I or J, and using 5000 surface ft. per min. as a wheel speed. There is nothing difficult to remember about this simple list of wheels, all of which should be in the wheel rack.

It is always important in giving the grain and grade of the wheel to state the maker's name, by reason of the fact that different wheel manufacturers have not adopted a universal method of marking.

A Graphic Method for the Design of Cone Pulleys

BY RAYMOND S. BROWN

That cone or step pulleys offer the simplest and cheapest method for effecting variable-speed power transmission between parallel shafts is proven by their almost universal application for driving machine tools from overhead shafting, and for many other purposes where it is permissible to interrupt the transmission of power in order to effect a change in speed.

THE design of cone pulleys so that the one belt shall fit all steps with uniform tension is a feature which has been dscussed by several writers, and a number of methods for finding the proper pulley diameters have been devised.

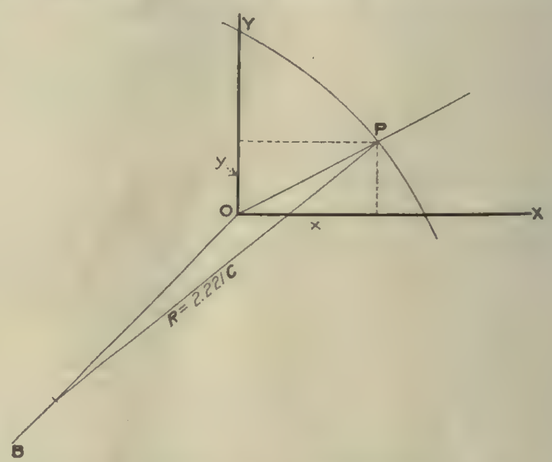
In the case of cone pulleys operating with crossed belt the solution is very simple, the rule being to keep the sum of the diameters of opposite steps constant. Where, however, the belt is open, as is usually the case, this rule, if followed, would result in the belt becoming tighter when shifted from pulleys of equal diameter to pulleys of unequal diameter. Where the belt angle does not exceed 10 deg. this tightening of the belt may offer a slight advantage since it automatically increases the tension as the arc of contact decreases, thereby tending to preserve constant belt slip. For angles much in excess of 10 deg., however, adherence to the constant-sum rule would result in the belt slipping excessively on the equal steps or breaking on the unequal steps. Under this condition, therefore, the pulleys should no longer have the contour of true cones, but should be constricted at the ends, giving them, if exaggerated, somewhat the shape of a projectile or an acorn.

The mathematical equation for belt length in terms of the pulley diameters and the shaft spacing, involves both trigonometric and algebraic functions of the diameters, and is unfortunately, not well adapted to practical design. This fact has given rise to several approximate solutions of the problem, the two best known being an algebraic method by Rankine, and a graphical solution by Burmester.

According to the Rankine method the sum of the pulley diameters for unequal steps should be less than the sum for the equal steps by $\frac{(x-y)^2}{2\pi c}$, x and y being the pulley diameters and c the shaft spacing. This approximation assumes the curve giving the relation between x and y to be a parabola. It is quite accurate for small values of $(x - y)$.

A more accurate solution of the problem is that given by Burmester and described in the various editions of Kent. It assumes the above-mentioned curve to be a circle of radius $\sqrt{5}$ times the shaft spacing. This method is open to the objection that there is a slight error in the value of the radius coefficient which should be $\frac{\pi}{\sqrt{2}}$, and in addition, the solution is complicated by a great deal of unnecessary geometrical construction. As a modification of this method the writer offers the following graphical solution which he believes to be the most simple and accurate so far published. The solution is as follows: Lay off on a drawing board two orthogonal axes OY and OX and draw the bisector OB of the exterior angle YOX. Having given any two opposite pulley diameters, lay off one of the diameters to some convenient scale along OY and the other diameter along OX, thereby fixing the point P.

Using as a radius the number $\frac{\pi}{\sqrt{2}} = 2.221$, multiplied by the shaft spacing, draw the arc of a circle through the point P, the center of the arc lying on the bisector OB. Any pair of diameters read from this arc will then give opposite steps on the pulleys which will take the same belt length as that required for the steps x and y.



GRAPHIC METHOD OF DETERMINING CONE PULLEY DIAMETERS

In case a definite speed ratio of the shafts is desired the corresponding point P may be found by intersecting the arc with a straight line, as OP, having this speed ratio as its slope. It will be noticed that when the speed ratio is near unity the value of x increases at the same rate that the value of y decreases, or in other words the constant-sum rule holds good.

The accuracy of this method is very great and is limited in practice only by the scale to which the diagram can be drawn. It may be proven that the error in belt length will be less than 0.01 of 1 per cent. provided the belt angle does not exceed 60 deg. In ordinary cases the error will be much less than this.

The diameters read from the arc are the actual pulley diameters and no correction should be made for thickness of belt.

The value of the radius $R = \frac{\pi}{\sqrt{2}} C$, is determined by writing the exact equation for belt length in terms of x, y and c, and finding the radius of curvature by the use of differential calculus.

Trade-Marks and the Manufacturer

By GLENN B. HARRIS

In these progressive times there is hardly an article of manufacture that is not the subject-matter of a trade-mark.

BUILDERS of lathes, milling machines, grinding machines, boring machines, and in fact of machine tools of all descriptions, are generally provided with some identifying name or sign to distinguish one manufacturer's product from that of another of like or similar character.

Trade marking also extends to the different makes of tool and machinery steel entering the make-up of the manufactured article; the saws and saw blades for cutting the raw material, even the cutting compounds used on the tools of the machines and compounds for lubricating purposes are protected by a trade-mark, and this protection extends even to the coal used under the boilers.

Value of a Trade-Mark

The value of a trade-mark consists of an assurance to a manufacturer or merchant of a vendible commodity, of protection in the use of a name, sign, or symbol, by which the product becomes known. It is also a guarantee of the genuineness of the marketed article, and may be said to be in this respect, the commercial substitute for one's autograph. The trade-mark distinguishes the goods of one manufacturer or merchant, from that of another; and to the end that they may be known in the market as his. Thus he is enabled to secure such profits as result from a reputation for superior skill, industry or enterprise; or from the expenditure of large sums of money for advertising purposes, in order that his product be widely known and a demand therefor created.

In its protective value it may be compared with the protection afforded by a fundamental patent, as the trade-mark is not only used in connection with patented articles, but also with commodities not patented or proper, patentable matter.

The trade-mark is the means, and perhaps the only means, by which the manufacturer or merchant is enabled to inspire, and retain public confidence in the integrity and quality of things made and sold; and thereby secure for them a permanent and reliable demand, which is the life of manufacturing and commercial operations. The trade-mark is the only means by which the public is protected against frauds and impositions of the crafty and designing who are ever on the alert to appropriate to themselves the fruits of the well-earned reputation of others, regardless of individual rights or the public interests.

As the true interests of manufacture and commerce have been more perfectly developed, understood and appreciated, it has been found that an exclusive property right in trade-marks, not only imposes no restriction on the freedom of trade, but that its direct and inevitable tendency is to promote and foster that laudable competition which stimulates effort and leads to excellence because of the certainty of protection in the attainment of adequate reward; it also serves to safeguard the interests of the public.

It is now a well-settled fact that the right of the manufacturer or merchant in his trade-mark is of a nature and character, that makes its security and protection the imperative duty of the highest courts; a duty which cannot be evaded in the slighest respect.

Nearly all countries protect the integrity of a trade-mark in some manner; while most civilized countries have entered into treaties which secure to citizens and corporations of a foreign country, the exclusive use to the distinguishing feature of an article of commerce or manufacture.

Origin of Trade-Mark

The trade-mark is as old as commerce itself. Seals and other emblems of ownership were coexistent with the birth of barter and traffic, and as a matter of fact without the aid of symbols of ownership or of origin. We may reasonably assume that marks were found to serve an important purpose from the beginning of competition in manufactures and the incipiency of commerce.

A written certificate of the genuineness of any article could not be understood by the nomadic peoples, who desired to trade natural products for something made by the hands of skilled artisans. Hence a simple emblem as a crescent, a sun, a star, an animal copied from nature, when once associated with a particular line of goods or with the handicraft of a certain man, would be readily understood. It was as if to say, "When you see me, you know I came from so and so," therefore it has come to be known that a man has no more right to plunder his neighbor's emblem, than to steal his gold or other possessions.

Matter Subject for Trade Marking

A trade-mark as stated must be an arbitrary word, sign or symbol, or a combination of these; and it must not in the least be descriptive of the goods in connection with which it is used. It must not in anyway be deceptive, or calculated to mislead the public. Geographical, and proper names are not susceptible of trade-mark protection unless arranged in some peculiar or distinguishing manner, or surrounded by identifying means; and in these cases, it is really the arrangement that forms the salient feature of the mark. This fact must be clearly stated in the application to the Commissioner of Patents, to whom is delegated the power to examine trade-mark applications and to grant them if they are in regular form. As for instance the words "High-Speed Lathe" would not be subject to protection, but if arranged in some distinguishing manner fully set forth, the application would be allowed. With relation to the use of words calculated to mislead, it might be well to give an example. Should a manufacturer, or a merchant desire protection for a machine and make use of the word "Magnetic" when there was nothing magnetic in its composition, trade marking would not be permitted.

In present times it seems to be the intent of manufacturers to coin a word from the first letters of the different words entering into the name of the firm or company producing an article or commodity, and in this way numerous attractive trade-mark names are produced. The prime idea should be to make the coined word a short one, and to have it so attractively and conspicuously placed as at all times to serve as a mark of identification. "AMCO," as applied to machine tools is short and quickly recognized, and as will be noted the letters constituting it are the first ones in "American Machinery," also the last the abbreviation of the word, "company." The ingenuity of the manufacturer need not be subjected to a very severe test in devising something that will adequately meet his requirements.

Procedure in the Patent Office

An application for trade-mark should be addressed to the Commissioner of Patents, Washington, D. C.; and can properly be made by an individual, a firm or copartnership, or an incorporated company. It is essential that the trade-mark applied for shall have been used in commerce with foreign nations, or with the states or Indian tribes of this country. The duration of a trade-mark is for a period of 20 years, and the fee required on filing an application is $10. The trade-mark may be renewed for an additional 20-year term on proper application being made, but not before within six months of expiration. A renewal fee equal to that of the original filing fee is required.

It frequently happens that application for a trade-mark is made by different parties on the same word or symbol, and for use in connection with similar lines of manufactured articles or marketable commodities. In this case what is termed an interference is declared, and it becomes necessary for testimony to be taken before an officer duly authorized for that purpose. The testimony is designed to prove, which of the contesting parties was the first to adopt and use the mark for commercial purposes as required by law.

The use of a particular word cannot be protected to cover other than one line of manufacture. The word "Hygrade" might be used on a certain machine tool, but this would not prevent its application to a hacksaw or cutting compound, nor in fact to any article of manufacture, not of a similar nature. It is however, plainly preferable that the trade-mark employed be as remote in its character from any in use as it is possible to make it; the far-seeing manufacturer has this in mind in distinguishing his product from others intended for similar uses. As a rule it is only the imitator who seeks to get as close to the border line of infringement as is possible, and yet escape it.

While it is not absolutely essential that an attorney be employed in the preparation and prosecution of a trade-mark, it will prove of great advantage to have the advice of an attorney skilled in this line of work. As a rule any competent patent attorney should be in position to render satisfactory service, and the money paid for his services will generally prove to have been money well expended. An attorney should be capable of so preparing the application and required drawing, etc., that technical objections on the part of the Patent Office will not be made; and if rejection is made on any of a number of grounds possible, the attorney is in a position to overcome the examiner's objections by written arguments, or if necessary to conduct an appeal to the different departments of the Patent Office having jurisdiction in appealed cases.

The common law without reference to the registration of a trade-mark in the Patent Office or in the different states which have adopted trade-mark laws, will give protection to the legitimate owner thereof as a matter of equity and justice; the general conclusion being that where a man has invented so to speak a new word, sign or symbol, or any new arrangement of words or characters, or even a word in common use, which he applies for the first time to his article of manufacture, to distinguish it from articles manufactured by another, he is entitled to its sole and exclusive use; and on proper proof of infringement of his right an injunction to restrain further use will issue, as also an order for accounting as to damages.

The great objection to a suit in equity to enforce a trade-mark is found in that the decision of one state court, is not binding on citizens residing in other states, therefore it may become necessary to bring a series of actions if this common-law right is to be enforced.

Some States Have Trade-Mark Laws

A large number of the states have enacted trade-mark laws, and in most cases there are severe penalties attached to any invasion of the rights of another in this character of property. In the main the state trade-mark laws are more or less drastic in their character, since large fines and even imprisonment may be meted out to the offender. The state trade-mark laws, however, only give protection within their own borders, and if a nonresident has not registered his trade-mark, he has no recourse whatever against the infringer. It is a fact, however, that many manufacturers and merchants avail themselves of state protection in addition to that afforded by Government registration, to the end that intending infringers shall not intrude on their rights for fear of the heavy penalties which might follow. The laws of the different states as to proper matter for trade marking, in most all instances follow closely those laid down in the United States statutes.

The safest plan for a manufacturer or merchant to follow is to apply for Federal protection, as in all cases the granting of a trade-mark by the Government is looked upon as *prima facia* evidence of ownership, and this ownership will be strongly upheld unless convincing proof can be brought to bear that fraud was resorted to in obtaining the mark; or that its claimant was not entitled to its registration in view of its use by others prior to his adoption thereof.

Another advantage of Federal protection is that this protection extends to all the states and territories of the Union, and one Federal court will take cognizance of the decision of a court of like distinction in another district.

In a successful suit for an infringement of a trade-mark, the sum arrived at as the actual measure of damages may be trebled by the court, before which suit is brought.

There is considerable consternation among manufacturers and merchants at the present time by the reported decision of the British Government to withdraw protection to all names registered as trade-marks. This

would have a far-reaching effect on those of this country who have registered their trade names in Great Britain, and who have always considered themselves thus securely protected. It would permit the unscrupulous to place an article on the British market, bearing the same trade name as that of an article of American manufacture, and for which by diligent effort a large and profitable business has been established. It is not to be doubted that strenuous objection to the proposed step will be urged by our proper officials; and as there is a trade-mark treaty in effect between this country and Great Britain, it hardly seems possible that the proposed act will be consummated.

And now Mr. Manufacturer, and Mr. Merchant, if you are not already properly "trade-marked," see what you can do in devising something characteristic, something that will clearly identify your product from that of another. All engaged in manufacturing, or merchandizing, place signs over your factories and different places of business, for identification purposes. These signs for the most part are of local benefit only. How much more essential then is it that your product, which may go to the four points of the compass, be clearly marked that it may be known on sight, and that the question of who made this or that machine tool, or where it came from can ever be raised. You will probably never have occasion to regret having secured a trade-mark, and its cost of procurement is extremely small.

Group Insurance

By A. J. Schneider

Owing to the many employers who study methods for decreasing labor turnover and increasing production, a description of group insurance in use at the Cincinnati Planer Co., should be worth while. When this proposition was offered by the insurance companies, the first question was, what good is it? The answer was, it will decrease the labor turnover, and at the same time you will get greater and better production from the employees. This insurance being in use only since October, 1917, it is too early to state positively whether these results will be forthcoming. Eventually it will be easy enough to tell if the labor turnover decreases. If it does decrease, the group insurance will be credited with its share of the improvements. If carefully studied, the value in dollars and cents can be closely estimated. If the labor turnover is low or improving, and production is high or improving, group insurance will be credited accordingly, in proportion to its share. It would be a mistake to say that turnover or production is entirely controlled by any one factor, but if a satisfactory improvement can be shown the money will be considered well spent. The average cost of this insurance is about $4 per year per employee (less than 2c. per day), depending upon age, and length of service of the 600 employees covered. It is hard to figure this as a losing proposition. It is almost sure to pay for itself.

A letter which follows was typewritten on the regular company letterhead; made up neatly; plain, short, and with the idea of conveying a personal touch directly from the manager to the home, thereby making a good impression on that powerful factor in human engineering; namely, home influence. The letter written in plain machine-shop english was mailed on a Friday so that it would be received on a Saturday, which was considered a phsycological time, giving the family an opportune time to talk it over on Saturday and Sunday with kith and kin.

In the employment department an immediate increase in the number of applications was noticeable. It can be seen that here is a good talking point for the employment manager, also for the superintendent and the foremen. Any employee, who is indifferent to this plan, would best be discharged from the organization.

One part of this proposition which received considerable study, was the question of whether this insurance should be based on wages or length of service. It was decided that the latter plan was the simplest and most efficient for several reasons. In the first place, sooner or later, many machine shops will adopt group insurance, and if it is based on wages, there will be nothing to hold the employee. As long as employees can change from one shop to another without an actual direct personal loss, they will do so in spite of increased wages, welfare work, or almost anything else. If two shops in the same locality have insurance based on income, an employee insured, say for $1000, would have no incentive for remaining with the old organization if he could get the same insurance in the new shop. However, it is understood that a certain percentage of employees are not inclined to change positions as long as they get good pay, and a square deal. If all employees were of this class, insurance would be unnecessary, and instead a higher rate of pay would be more effective. Another advantage in basing insurance on length of service is that it is simple, and leaves no room for doubt. Insurance based on wages would require considerable figuring in these days of premium, piecework, bonuses, etc. It would probably create dissatisfaction among some employees after policy comparisons are made, and "John" finds "Bill" is making more money, "because his insurance is bigger."

Amount of Work Required

The work required in connection with this insurance is simple, and only requires about two hours a week. A record card giving a complete record of each employee must be filled out, stating name in full of company and employee, birthday, address, beneficiary, etc. After this is filled out no other work is necessary unless the employee leaves the service or dies, except the checking of invoices and reports which has been boiled down to a simple system:

The letter is as follows:

To the employees of the Cincinnati Planer Co.:

We want you to feel that you would rather work for the Cincinnati Planer Co. than anywhere else. The ideal relationship between employer and employee can only be obtained through a long association. The fewer changes there are the better it will be for all.

The protection and care of those depending on you is of vital concern. In the event of your death or permanent disability, some plan to continue the protection and care which you are now providing, and the problem of how this is to be done, has no doubt often occurred to you.

To aid you in solving this problem of care for your dependents and as an expression of appreciation of your faithful work and loyalty to the Cincinnati Planer Co., we have arranged with the Travelers' Insurance Co. to insure your lives for an amount based on the following schedule:

Those who have been in our constant employ for three months are insured for $500; those in our constant employ for six months

for $600; at the end of the first year of continuous employment you are entitled to $700 insurance, and for each additional year's employment you are entitled to an increase of insurance in the amount of $100 each year until a maximum amount of $1500 has been reached.

Those who are not, as yet, by their term of service entitled to this insurance, will receive its benefits just as soon as they have completed a three months' term of continuous service. This insurance is made retroactive, meaning that you will receive credit immediately for the amount of insurance you are entitled to for past services. As the length of your service increases you will receive the increased insurance in accordance with the above plan.

This insurance has been in effect since Oct. 4, 1917.

These benefits will be provided at the expense of the Cincinnati Planer Co. No deductions from wages or contributions of any kind from the employees are required. This action is voluntary on the part of the Cincinnati Planer Co. It constitutes no contract to any employee and confers no legal right on them. It does not change your freedom to leave nor our right as employer to dismiss any employee.

All rights or benefits cease whenever any employee leaves or is dismissed from our service. In addition to offering life insurance protection, our contract also provides an income in case of your permanent disability, whether resulting from disease or accident.

An insurance certificate, stating clearly the benefits granted to you under this arrangement, will be mailed to your home as soon as we can supply the insurance company with the necessary information.

We hope that providing this insurance will further convince you of our desire to do all we can for our employees.

With our best wishes, we remain,

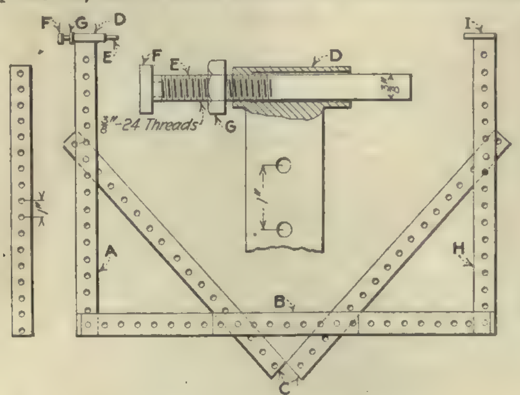
Sincerely yours,
The Cincinnati Planer Co.
(Signed) B. B. Quillen, Secy.-Treas.

A Caliper for Large Work

By M. W. Hughes

The accompany illustration shows a tool which I have found very handy and convenient in calipering large work. This tool as constructed, has now been in use for sometime with entirely satisfactory results and I thought a description of it might prove interesting to the readers of the *American Machinist*.

Calipers that are large enough for work over 24 in. are expensive, and I have known of many shops that did



A CALIPER FOR LARGE WORK

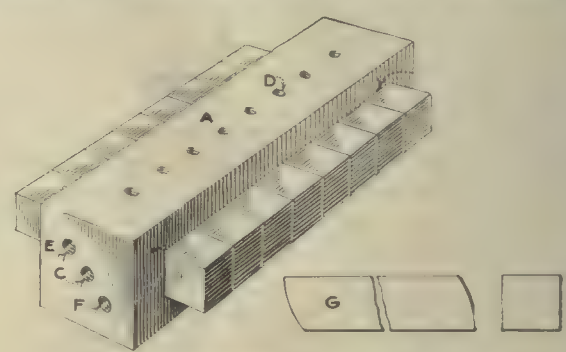
not have calipers of that size. In my own case I had to improvise a makeshift of wood to caliper a big bushing 30 in. diameter, and through this necessity I got the idea of making a pair that would take in any size. In construction of the device I used $\frac{3}{16}$ x $1\frac{1}{2}$-in. common bar steel and pivotally connected the sections *A*, *B*, *C* and *H* as shown. These sections are provided with a series of openings in order that different adjustments may be made.

To one of the sections *A* is attached a bracket or bearing *D*, which receives the threaded caliper rod *E*, which has a knurled head *F*, by which it can be conveniently adjusted. A jam nut *G* is located on the rod *E*, and is designed to lock the latter in adjusted position. On the end of the other section *H* is provided the piece *I*, which acts in connection with the rod *E* in making measurements. With the device described and illustrated I have been able to caliper over 54 in., and this is as large as I find necessary in my work.

Jig for Turning Ends of Square Tools

By Orville Walton

The illustration shows a jig for use in turning 1-in., square tools on both ends. The jig *A* is of machinery steel and accommodates eight pieces of stock. It is 3 in. square and 10 in. long, and has a horizontal slot extending through it which receives the stock to be turned. The stock projects beyond the faces of the jig. The openings *C*, *E* and *F* in each end are for the purpose of



JIG FOR TURNING SQUARE TOOLS

receiving studs to be carried on the centers. There are eight holes *D*, tapped in the upper face of the jig to receive safety-head setscrews which hold the stock in place for turning. After the stock is secured in position, the jig is placed in the lathe with the center studs at *C*, and the stock turned to length; then the center studs are moved to *E*. Turning the stock from this center position puts cutting clearance on one end. The center studs are then moved to *F*. Turning from this position puts clearance on the opposite end. A cutter with clearance on both ends is shown at *G*. This jig is also used for grinding the cutters, and has proved satisfactory.

Table of Angles for Dividing Circles and Laying out Polygons

By J. A. Raught

On page 1014, Vol. 47, G. A. MacGregor gives a table for the draftsman or toolmaker, and states that it is not included in most commonly used handbooks. The writer begs to point out that a similar table appears in the "American Machinist Handbook," pages 393 to 397, and is carried out to 500 instead of 50. Mr. MacGregor's table on page 1014 gives the included angle, while that given in the "American Machinist Handbook" is half the angle subtended at center, which is the most natural way. The handbook also gives the sine which makes it easy figuring to obtain the length of side by multiplying the diameter by the sine.

Labor in Great Britain After the War

THE following extracts from an address by Mr. Garrod, of the British Commission recently in this country, gives a good idea of the situation in Great Britain, and may afford an indication as to tendencies here and elsewhere. The whole matter must be considered in the broadest manner possible and without regard to pre-conceived ideas or prejudices:

Unions Will Be Stronger

"In my opinion nobody in our own country has any doubt whatever that after the war there is going to be a great process of bargaining between employers and men, or unions and federations. Neither do I think that anybody is very much in doubt that the unions are going to be infinitely stronger. The unions themselves, let me say, are filled with great apprehension. They think they are going to lose their most cherished privileges. But I believe that anybody who is really impartial and takes a reasonable view of this problem is pretty well persuaded that that is not going to happen.

I have no doubt whatever that the unions will be very much stronger, and the employers very much more ready to negotiate with them than they were before the war. I think perhaps I have not made it quite plain that the present relation between the employers and the unions is somewhat new. Take as an example the railway union: in 1911 when we were almost at war with Germany we had a serious railway strike going on at the time, it was hushed up and smoothed over, owing to the crisis that then existed. The real trouble back of that strike was not the demands of the men, but the fact that they were presented through the unions, and the railway companies with one or two exceptions refused to recognize or treat with the unions at all. If you went now to one railway president in England after another, I am quite sure you would not find one of them who would wish to restore that condition. I go further when I say that I doubt whether there is any important and responsible employer in England at the present time who is not what we should call pro-union; and that, to an extent which in this country would really astonish you.

I will add one other thing: we have had recently a commission appointed by the British government to inquire into the causes of industrial unrest. There are eight reports made from eight different districts. I think from four out of those eight reports you will find one of the things that the committee recommends as highly desirable in the immediate future, is legislation by which every employer should be compelled to belong to an employers' federation, while every workman should be compelled to belong to a union.

That will serve to illustrate to you—because they were impartial persons making those reports, representing every class—it will serve to illustrate to you the enormous extent to which we have gone in dealing with union labor, and it will explain to you the fact that any Englishman you meet now, finds it very difficult to talk in any terms except those which advocate negotiation with the unions. When I look around at the problems confronting you here, I am left with a feeling of helplessness, because the instinct of the Englishman is to find out where the union is that is concerned with a labor difficulty—and get hold of the head of that union and see what can be done. That method cannot be followed in this country, and that is why we feel conditions are utterly dissimilar.

The Government Labor Guarantee

A guarantee to return to pre-war labor conditions was given by the government in perfectly good faith, and the government means to carry it out so far as it can be carried out. On the other hand, it is quite clear that a number of conditions have arisen during the war which will make a complete restoration in all its details not really practicable. All the government can do in such cases is to stand between employer and employee and see that there is a restitution which, if it be not identical, will at any rate be equivalent. With regard to the case of the women, there is going to be of course, a serious difficulty, and nobody will be bold enough to say how the situation is going to work out in every particular; but, I suggest one or two lines on which the problem may to some extent solve itself.

First of all, an enormous number of these women who have newly come into an industry are the daughters or wives as may be, of men who have gone to the front. There is a house that contained let us say a father and two sons, both gone to the front leaving two daughters and a wife at home. The absence on military service of the father and the two sons has more or less broken up the home, and these women have gone from the home to the factory; at the end of the war when the home is brought together again the women will in most cases return to their normal occupation of looking after it.

Women in Munitions Work

A very large class of women has come into unwonted occupations from industries which owing to the war have been closed down, or from some kind of service in which they are no longer required. For example, we have taken a large number of these women from domestic service. One of the reasons for this is obvious: everybody in England has to economize. We pay very high taxes, in many cases very high indeed; we also have to pay the war loans. The result is that even the richest families have had to cut down their ordinary establishments enormously, and the number of women normally employed in domestic service—and we employ normally, remember, many more servants than you do in this country, because the labor is cheaper—all of these women have been thrown on the labor market and have drifted into munitions work, very largely brought there by patriotic endeavors of their own. At the end of the war, however, more servants will undoubtedly be wanted, and a large number of these women will desire to go back to the quieter and less strenuous life.

Similarly with a lot of industries: for example the millinery industry, which with a great many other industries we class as unessential. Owing to the war these have been very largely closed down, with the result that the labor market has been flooded with women who have gone to the munitions factories. After the

war, if we are ever going to pay for the war, we have got to reëstablish not only the ordinary necessary industries, but also the unessential industries, as we have got to have a vast volume of unessential as wall as essential trade; and these women, I think, will in that way, get back to their ordinary places. There will undoubtedly be a residue, and we hardly know what to do with that. It must be remembered that there is another way of readjustment. When the war is over, we shall have lost in killed or incapacitated, let us say at least a million men; so there are a million jobs that must be filled somehow, and a large number of them will be filled by women."

Evening Schools

By Entropy

An evening school which runs by daylight is rather out of the ordinary, but it is merely following the change in hours of labor. If the men work in two or three shifts, classes can be running from three in the afternoon until nine or ten at night and accommodate the different men.

There is greater need than ever for these evening schools, not merely for the subjects which are ordinarily taught in day schools but for actual practice in the use of machinery and tools. For this purpose the toy machinery usually found in the manual training schools is rather inadequate and hardly inviting to grown workmen, but under war conditions it is so much better than nothing that it is a pity not to have its full value brought out. Men who get into the shops and get an opportunity to operate some machine like a milling machine or a drilling machine may, and do, earn fabulous wages after they become used to the one operation, but they are sure to lack any knowledge of the underlying principles which will help them to change to some other job without having to go through the same training and the same parrot-like imitation of what someone else has shown them.

The real value of this machinery can be made the most of by using it, not to teach a complete trade, which is impossible in a night school, but to give these men the next few steps in their development.

It is a well-known fact that evening schools do not reach the number of men who should take advantage of them. The numbers of those registered in night schools in our large cities, look large; but when we consider the number of men who could benefit by the training, or who stay through the courses for the whole season it is indeed small.

After a man has done a full day's work it requires considerable sacrifice and willpower for him to give up two or four evenings per week and go to a stuffy classroom to sit behind a desk which his 12-year old boy has occupied during the day and to be taught things which seem have no connection with his daily occupation. A school that can get a 60 per cent. attendance under such circumstances is doing well, and one that can run through a full season's work and have half of the pupils with which it started is doing remarkable work.

On the other hand the regular school sessions occupy so little of the total time as compared with that in which our shops are active that the overhead charges are enormous. There is probably no way in which a greater return for money expended can be obtained than by increasing the time which they are operated, provided of course that what is taught is worth while.

Making Schools Attractive

The problem then is to find how evening schools can be made more attractive to those who could profit from attendance.

One of the common misunderstandings to which pupils are subject is concerning the goal which they expect to reach. Led by advertisements of private schools they get the idea that going to school is a royal road to learning, and that mere attendance for a period of a few weeks will lay the whole world at their feet. The deception is painful and likely to put an end to their efforts.

That a man is lacking in some of the fundamentals of education is sufficient reason for the existence of evening schools. Not more than one in a hundred is willing to submit to a sufficient drilling in the fundamentals so that he can do with ease and certainty the advanced work for which he applies. He wants to omit all that and take up the subject which seems to him to apply directly to the work.

Instructors are likely to go the other extreme. They have been occupied on the fundamentals and they do not understand the demand for immediate practical results. They need to learn to disguise principles under the camouflage of the practical. This is difficult for a nonshop man to do. He is sure to leave some loose place so that the veriest boy from the shop recognizes that the problem which he presents is imaginary rather than real. The ideal instructor is a man with shop training, but with a good theoretical education to back it up. He should be a man who does not think so quickly that he cannot have patience with the slowness of those to whom he is presenting his subject.

Using the Right Kind of Seats

The physical side of the case is important too. When a man has worked at manual labor all day he finds it very irksome to wind himself up like a fishworm in a child's chair and keep conscious through a two-hour session. The child's chair is an invention of the devil, or some of the other backers of the Prussian system of education. It enables a single teacher to keep order among 40 or 50 wriggling youngsters, who never ought to be kept still at all, because up to their age their only gift is the physical exuberance that leads them to do perfectly innocent things that annoy a middle-aged spinster.

By the time a grown man has wound himself in and out of one of these contrivances for an evening, he longs for a little round table and a kitchen chair and a pipe if not for anything else more than to promote oblivion. And why not let him have this much? Such furniture costs less than the regulation child's desk and chair. It certainly would increase the percentage of attendance, and the tobacco smoke could be aired off in the morning. There are a great many men who are not accustomed to school surroundings. They would go to school and profit by it if they knew that they could go in their old clothes and be natural when they got there.

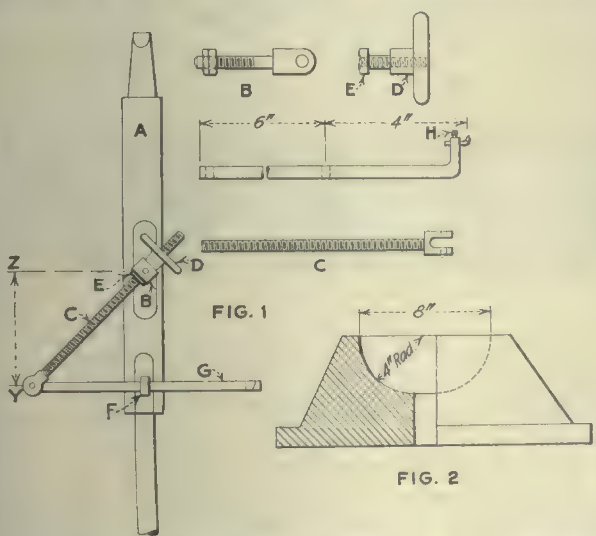
One other side attraction has a more than imaginary effect, that attraction is shower baths. If the school advertises that it provides shower baths, and that it will have in attendance some expert slum workers to manage things it will get almost no one there to take advantage of them. On the other hand if the showers are there, men will gladly pay a small fee for their use and go away appreciating the privilege, and the men who are attracted will be those who need the extra bath no more than the instructors. There is no good reason why the facilities of the school buildings should not be open to the parents and other citizens, and there should be no hindrance to their being comfortable while using those facilities.

A Radius-Cutting Boring Bar

By Adam S. Mill

Having a steel casting to machine in a half circle with a 4-in. radius, and our lathe being too small to swing the casting, it may interest some of your readers to know how the work was done on a 21-in. upright drilling machine.

Fig. 1 shows the device assembled ready for work, also some of the details. Fig. 2 shows the work which



FIGS. 1 AND 2. THE RADIUS BORING BAR AND THE WORK THAT WAS MACHINED WITH IT

has an opening through it which permits the passage of the pilot of the boring bar. The boring bar *A*, Fig. 1, is similar to the one used in many shops for counter-boring, and was made with a No. 2 Morse taper at its upper end, while the lower end was centered to run on a center secured to the base plate of the drilling machine, and running through the table of the latter. In this way the bar was kept from springing while taking a ½-in. cut.

A ⅝-in. hole was drilled through the bar, and it was then planed off on each side to afford a bearing for the stud *B*, the shank of which was threaded and extended through the bar, and held in place by nuts. This stud *B* was provided with a ⅜-in. hole for the passage of the feed screw *C*, having a coupling yoke at its lower end, and receiving a feed nut *D*, which was made so that it would come up to the stud just tight enough to turn. The nut *D* was made with a ½-in., 20-thread hole tapped through, and was fitted on the feed screw, and extended through the opening in the stud *B*, where a collar *E* was pinned, so that the feed nut could turn freely and yet be securely fastened.

A ½-in. tapped hole was provided in the boring bar to receive a stud *F* on which the cutting bar *G* was pivoted. One end of the cutting bar was journaled in the yoke of the feed screw. The cutting bar was of ⅜-in. square key stock, bent on one end to bring the cutting tool in line with the center of the bar, as shown at *H*.

Care should be taken to have the length of the cutting bar *G* from its center, where it is mounted on the stud *F* to the point of its connection with the feed screw, equal to the distance from *Y* to *Z*.

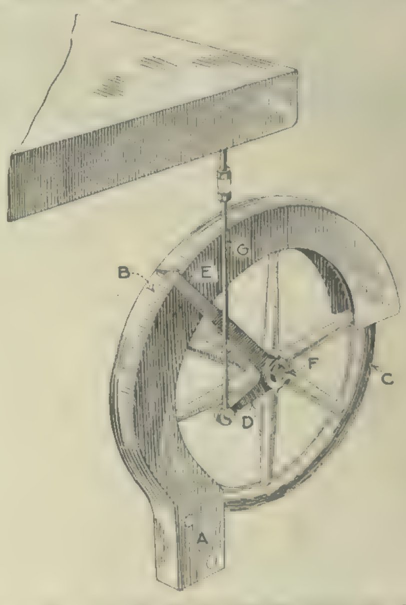
The action of the device is simple. When the drill is started the cutting tool is fed to the work by turning the feed nut *D*.

A Setting Scale for Woodworking Machines

By M. E. Duggan

The setting scale on many woodworking machines, wood planing machines, for example, is fastened at some point on the machine that is most inconvenient for the operator and the scale graduations are about as clear as the hieroglyphics on a Chinese laundry ticket.

In the illustration is shown a scale that is somewhat different from the ones now in use on woodworking planing machines. It consists of a light cast-iron shell A, made



SETTING SCALE FOR WOODWORKING MACHINES

to be fastened to the side of the machine, and having a circular portion *B* that fits over the hand-operated wheel *C*. It has on its periphery, in plain view of the operator, a graduated scale. The intervals between the lines or graduations are double the spacing on the standard rule or scale.

The bell crank *D* and indicator finger *E*, the latter being double the length of the former, is a one-piece casting or forging, and is mounted on the wheelshaft *F*. The indicator is operated by means of the connecting rod *G*, which is connected to the planing-machine table and the bell crank.

TIMES change. The Charge of the Light Brigade lives only in history. In its place comes the lumbering tank, the outgrowth of the caterpillar farm tractor, and sweeps all before it. Suddenly and without warning, the Germans found "tanks to the right of them, tanks to the left of them"—and not a tank blundered. The machine dominates modern warfare just as truly as it does modern transportation.

* * *

There is nothing mysterious about it. The caterpillar tractor may even be called a rough machine—with frames of steel, with wheels and gears and treads that carry its enormous weight over soft ground, across open trenches, through shell craters, when driven by the powerful gasoline motors within its armored sides!

* * *

Assembled by dozens and by scores in the gathering light of a November morning, each with its work cut for it, they started across No Man's Land, crushing down all entanglements, and swept on over the trenches leaving terror and submission in their wake. Behind them, protected by their armor and their bulk, the British infantry swept on to victory, and with little loss.

* * *

Built on the lines of the tractor and by similar methods as exist in shops building agricultural implements, these new monsters of the war show to what extent the machine shop is behind the boys at the front. Without these tanks—a new form of cavalry so different from the old—such a victory could not have been secured except by many times the number of troops employed in the offensive, and with enormous losses; but without the men in the shop, without the miners who dig the ore and the coal, without the railroads to transport them all, there would be no tanks to aid the men at the front!

* * *

Back of the tanks were the machines which built them: lathes, planing, milling, drilling, and boring machines.

* * *

Back of them are the men who ran them and you men of the shop, who are making any of the thousands of tools or parts which go to make the tanks possible!

* * *

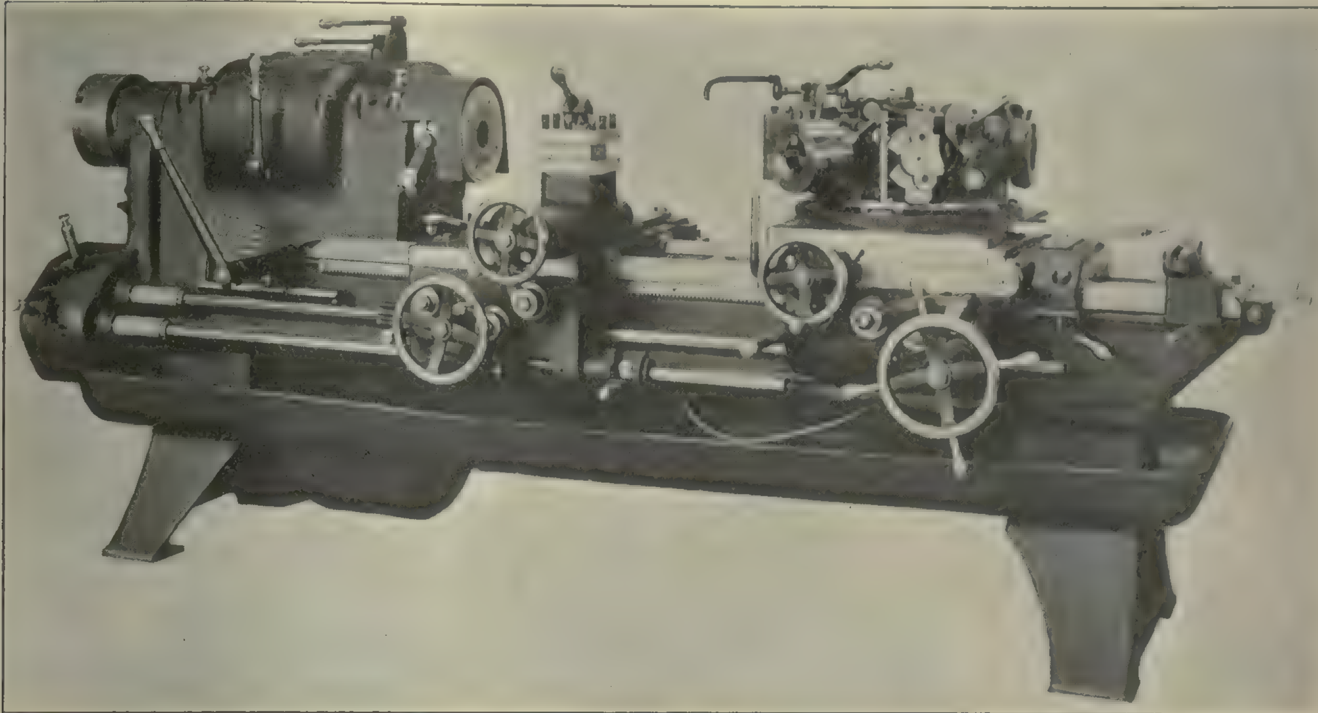
This war cannot be won without machinery. The more you can turn out the sooner the war will end, the sooner your brother or son or friend can bid goodby to war-torn France and come home. Do not forget that every delay in the production of such equipment, from any cause whatever, lessens his chance of ever coming back at all.

* * *

Are you doing your part?

Cincinnati Acme Universal Turret Lathe

SPECIAL CORRESPONDENCE



MAXIMUM auto-chuck capacity, 3½ in. round; 2$\frac{7}{16}$ in. square; 3 in. hexagon; hole through spindle, 3¾ in.; swing over bed, 24 in.; swing over auxiliary carriage, 17 in.; diameter of driving pulley, 14 in.; driving pulley r.p.m., 650; width of belt, 4 in; spindle speeds r.p.m., 14, 21, 30, 46, 66, 93, 140, 200, 280; revolution of spindle to feed turret and auxiliary carriage 1 in. (cross), 10, 14, 20, 28, 40, 60, 85, 120, 170, 240; revolution of spindle to feed turret and auxiliary carriage 1 in. (long) 10, 14, 20, 28, 40, 60, 85, 120, 170, 240; diameter of turret, 18 in.; travel of turret (cross), 8 in.; travel of turret (longitudinal), 44 in.; distance from center of spindlle to top of turret, 4 in.; center distance between V's, 14 in.; width of bottom of V's, 2½ in.; depth of bed, 12½ in.; countershaft pulley (tight and loose), 14 in.; width of countershaft belt, 4 in.; countershaft pulley r.p.m., 570; floor space of machine, 3 ft. 6 in. by 11 ft. 4 in.; floor space with stock stands in position, 3 ft. 6 in. by 22 ft. 4 in. Weights: plain machine, 6750 lb. net, 7400 lb. crated, 8200 lb. boxed; machine with chucking equipment, 7320 lb. net, 7920 lb. crated, 8800 lb. boxed; machine with bar equipment, 7500 lb. net, 8100 lb. crated, 9000 lb. boxed; both equipments, 8100 lb. net, 8750 lb. crated, 9750 lb. boxed.

THIS machine shown in the headpiece is known as the Cincinnati Acme No. 3 Uniersal Flat Turret Lathe, and is made by the Acme Machine Tool Co., Cincinnati, Ohio. It will accommodate chucking work up to 17 in. in diameter and bar stock up to 3½ in. in diameter and 44 in. long. The actual swing over the bed is 22 in.

The machine is especially adapted to chucking work, through the advantages of the side carriage with which it is provided. This carriage permitting multiple tool operations, makes it possible to machine castings or forgings with the least number of chuckings. The carriage may also be used to advantage when doing bar work. The machine can be equipped with either bar or chucking equipment or both, and either are interchangeable.

Accuracy and rigidity are insured by casting the head solid with the bed, maintaining alignment of the spindle with the V's upon which the turret carriage travels. The ways of the bed are exceptionally large and wide. Taper gibs to take up wear are used throughout.

Centralized control is one of the important features of the machine. The time between operations has been reduced to a minimum by placing all levers of control such as rapid-traverse lever, cross- and longitudinal power-feed levers, spindle-speed levers, binder handles, etc., directly in front of the operator.

The geared head is extremely simple in construction, and of maximum pulling power. Nine different speeds are possible with a minimum number of gears which are continuously running in an oil bath. The nine different speeds ranging from 14 to 280 r.p.m. are obtained instantly without stopping the spindle, and are controlled by the two levers at the front of the head.

The gear-shifting device makes it possible to change from any one speed to another with one continuous movement of either one of the speed-changing levers. When the lever has reached the point where the gears are out of mesh, the driving pulley is automatically disengaged from the driving friction and re-engaged after the gears are again completely in mesh. This feature enables the gears to be shifted from one speed to another while they are only turning over from their own momentum, eliminating all shock and pick up.

The spindle is made of high-carbon steel, and is mounted in renewable bearings of genuine babbitt. By means of a double-cone friction operated by a lever at the front of the head, the spindle can be instantly started, stopped and reversed.

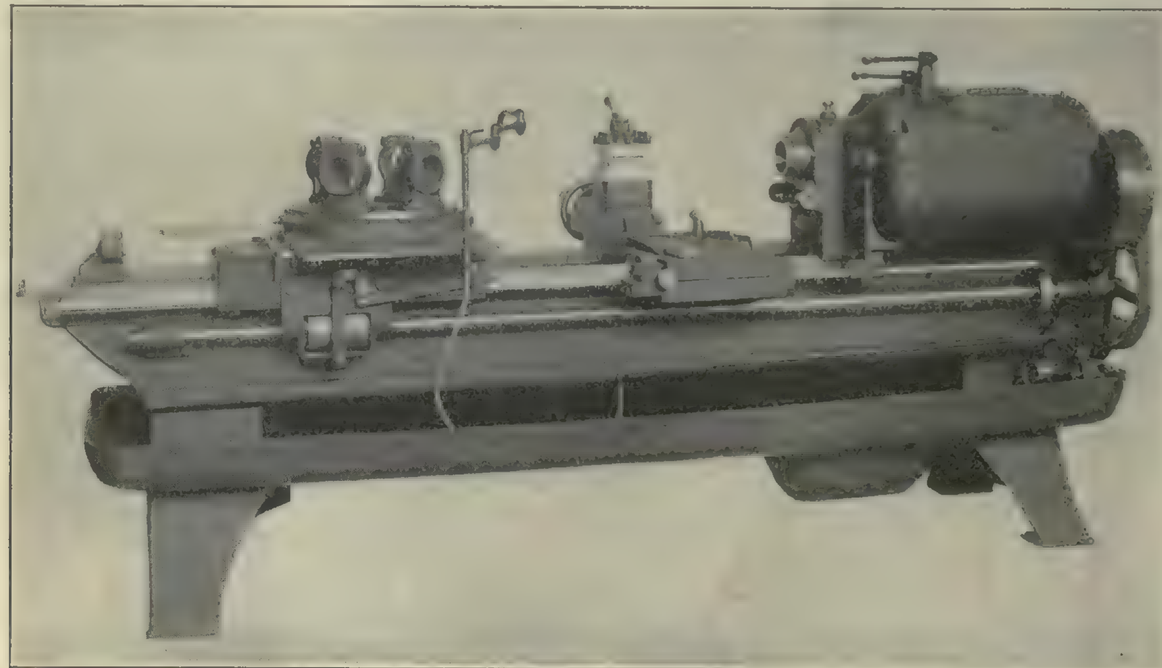
The side carriage illustrated spans the ways of bed, eliminating all overhang to the turret and tools, and is so constructed that it clears the chuck and can be moved out of the way to permit the use of short tools when using the flat turret. It is provided with six independent stops for the longitudinal movement, which are easily accessible to the operator. The square turret is mounted on the cross slide and is positioned by a hardened lockbolt located directly under the cutting tool. It can be indexed to four positions and a vertical movement of the lever at the top of the turret unclamps it and withdraws the lockbolt.

The cross-sliding flat turret revolves on a hardened and ground stem of large diameter and is automatically locked in position by a hardened and ground tool-steel taper plunger placed directly underneath the cutting tool. This plunger works in hardened and ground taper bushings let into the solid turret and as near the outer edge as practicable. The turret is further held down at the extreme outer edge with circular clamps. Oiling arrangement is provided so that oil can be fed to each individual tool. The cross slide moves on a long, narrow, dove-tail guide with wide, flat bearing surfaces on either side, and has an adjustable taper gib to compensate for wear; it is also provided with an adjustable hardened center stop. The crossfeed which is operated by hand or power in both directions, is furnished with a large, graduated pilot handwheel to facilitate forming operations. Power rapid traverse is provided in either direction along the ways, for the turret, and is operated by a lever conveniently located at the front of saddle. This feature creates a great saving in time and energy.

Twelve longitudinal stops are provided: one independent stop for each turret face, and six auxiliary stops which are operated by the index knob at the right of saddle. When necessary, as many as seven different shoulder lengths can be machined by first using the independent stop and then the six auxiliary stops; the latter are operated by turning the index knob from zero to 7, 8, 9, 10, 11 and 12. To pass any of the 12 longitudinal stops, it is only necessary to turn the index knob half way between any of the numbers.

Power feed is provided for the cross and longitudinal movement to both the side carriage and turret. The gear box at head end of machine furnishes 10 feeds from 10 to 240. Stops are provided for the longitudinal movement, and for the cross movement, a large micrometer dial with observation stops. All feeds can be reversed by operating levers conveniently placed in aprons of side carriage and turret. The saddle has a continuous bearing on two exceptionally heavy V's on the bed.

The lathe bed is both deep and wide to give great rigidity under heavy cuts. The bed is strongly braced by cross-girts. The V's are exceptionally large to allow for the load of the apron and side carriage.

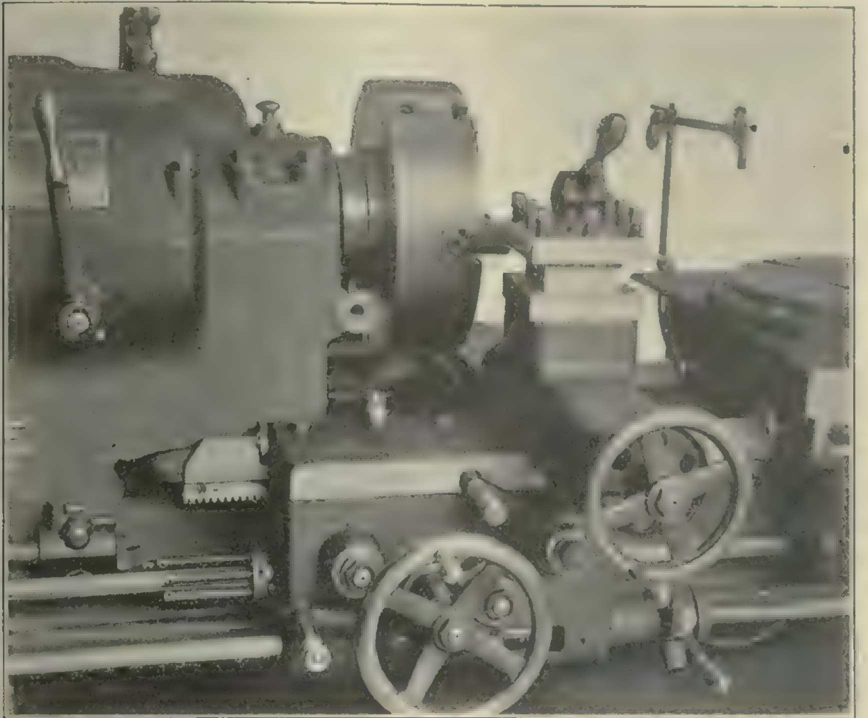


THE BACK OF THE MACHINE

The pan is made deep, and an oil reservoir is attached to the pan. A perforated cover serves as a strainer and allows the oil to drain back into the reservoir.

A geared oil pump is furnished which provides an ample supply of oil when machine is running in either direction. Two pipe lines are furnished, one for the turret tools and the other for the side carriage. A very efficient oiling system for the machine has been provided for. Dirt-proof oilers are furnished throughout, and in sight and easy access of the operator. A plain, tight- and loose-pulley countershaft is furnished. The loose pulley is provided with a self-oiling bushing with a large oil chamber allowing ample lubrication. Where conditions permit, the use of the overhead countershaft can be avoided by belting the machine directly to the line shaft.

The automatic chuck is especially designed to insure holding the work accurately and with great gripping power. It can be opened and closed while the machine is running, by the long lever at the front of the head.



A CLOSE VIEW OF THE CARRIAGE

The distinctive features are that the work does not have end motion while chuck is being closed, thus producing accurate shoulder lengths. The master-collet parts that hold the jaws are held fast against the closing ring, which prevents all dirt and chips from getting between them. This prolongs to a great extent the accuracy of the chuck. The jaws do not collapse, and extremely short work can be held without tilting. For variations in diameters, adjustment for $\frac{1}{16}$ in. larger or smaller is provided. The jaws can be easily removed without dismantling the chuck. To insure accuracy and long life all working parts of the automatic chuck are hardened and ground, and the chuck jaws are hardened but not ground unless specially ordered.

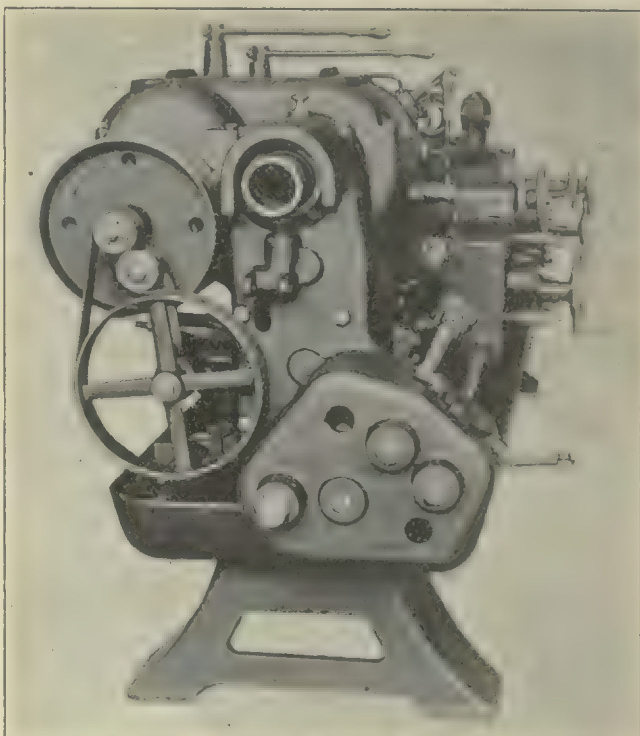
The simplex-roller feed is extremely simple in design and operation as only one adjustment is necessary. By adjusting the jaws to the size of stock with a spanner wrench, then slightly releasing them, the rollers will have the proper tension. The roller feed is operated by the same lever that actuates the automatic chuck.

Three roller-rest turners are furnished with the equipment for bar work, and are adjustable for any diameter of work from $\frac{3}{8}$ in. to $3\frac{1}{2}$ in. The design of this tool is such as will keep the faces of the rollers absolutely parallel with the turned surfaces at all times. The rollers always maintain a full bearing on the work. This not only results in better finish but also insures a more accurate guide for the cutting tool. The body is of cast steel and the roller shafts are supported their entire length, eliminating all overhang and obviating any chance of the rollers tilting. The cutter is of high-speed steel, and both cutter and back rests can be quickly withdrawn to pass over a large diameter without changing the set-up of the tool.

A 5 to $7\frac{1}{2}$ hp. constant-speed motor is recommended, running at 1200 minimum to 1800 maximum r.p.m. By placing the motor on a sliding base on the floor at the head of the machine, it can be belted to the driving pulley. Special motor arrangements can be furnished on application. When machine is ordered with plain equipment only, the following is included: tool stand, four toolholders, tight- and loose-pulley countershaft, oil guards, oil pump and piping, and chasing attachment with one leader.

A chasing attachment is furnished regularly with the machine, located at the right end of the carriage apron. One leader is included having five threads (right hand) which will cut $2\frac{1}{2}$, $3\frac{1}{2}$, 5, 7, 10, 30 and 42 right-hand threads as per chart. Additional leaders for other desired threads, furnished at extra cost. For left-hand threads, left-hand leaders are required. Length of thread that can be cut, 4 in.; diameter of work for external thread, 0 in. to 14 in.; diameter of work for internal thread, $2\frac{1}{4}$ in. to 16 in.

A taper turning attachment can be furnished for the side carriage when desired, at extra cost—turning tapers up to 3 in. per foot and 12 in. in length. The following tools in addition to those furnished with the plain machine, are furnished when bar equipment is ordered and is a part of the equipment.



VIEW OF THE HEAD END

One automatic chuck and 23 sets of bushings, holding all size bars from $1\frac{1}{2}$ to $3\frac{1}{2}$ in. round and $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{5}{8}$, 2 and $2\frac{3}{8}$ in. square and hexagon, and $2\frac{3}{4}$ in. hexagon; one

roller feed and three stock supports; three roller-rest turners; one pointing tool; one centering tool; one 1-in. drill chuck; one 2-in., style D, automatic-opening die head and chasers to cut 1-, $1\frac{1}{8}$-, $1\frac{1}{4}$-, $1\frac{3}{8}$-, $1\frac{1}{2}$-, $1\frac{5}{8}$-, $1\frac{3}{4}$-, $1\frac{7}{8}$- and 2-in. U. S. Standard threads.

The following tools, in addition to those furnished with the plain machine, are furnished when chucking equipment is ordered:

One 15-in. three-jaw-geared scroll chuck with reversible jaws; one 15-in. faceplate with bolts and clamps; two tool blocks; two tool plates; twelve turning cutters; six boring cutters; two $1\frac{1}{2}$-in. boring bars and cutters; one $3\frac{7}{16}$-in. bar for turning and boring; one extension-drill support with four sockets for standard taper shanks.

The Trend Toward Centralized Control

The United States Chamber of Commerce in a carefully prepared statement which was unanimously approved by the directors, points out that the newest plans announced by the Government are tending to decentralize war efforts, and urges with the strongest emphasis the creation of an adequate central control.

"The failure to be guided by the fundamental principle that centralized responsibility and control is needed for the success of any enterprise," says the statement, "will bring about unintentional interference with vitally important programs such as that in connection with shipping. There will be production far beyond our capacity of ocean transportation; our Allies will be deprived of supplies which we would desire to give them; effort will be expended in the creation of needless new facilities; collateral problems, such as the housing of employees will be neglected until they seriously interfere with other programs; the distribution of essential materials, such as coal, will not be where most needed in connection with the war; vast quantities of material and labor will be used in unnecessary activities, and in general there will be the atmosphere of confusion which comes from inability to secure prompt decision.

From the beginning a committee of the United States Chamber of Commerce has worked consistently along the line of the experience of other nations now at war, and of the business principles of consolidation and responsibility expressed in the resolution adopted at the War Convention of American Business in Atlantic City that 'all war buying,' in whatever departments, boards and administrations now located, 'should be assembled under the control of one board or executive department.'

The new plan for making the War Industries Board a coördinating body having now been announced, the United States Chamber of Commerce Committee feels it essential at this time to recommend to the board of directors of the United States Chamber of Commerce, the publication to our members of a statement, which, will make clear the views of the committee which are divergent from the policy of this new plan. The committee of the Chamber of Commerce heartily approves the steps taken by the Secretary of War in consolidating the organization of the War Department, increasing the personnel and improving its efficiency by drawing in business men of experience in organization, but it cannot agree with the statement that such reorganization of this department takes the place in any degree of a department of munitions or a board of central control. Similar improvements in other departments, boards and administrations would but tend to develop a decentralized system of purchasing instead of providing for a centralized system. However efficient the War Department, the Navy Department, the War Industries Board, the Shipping Board, the War Trade Board, the Fuel Administration, the Food Administration, the Railway Administration may become, the need for centralized control is but the more emphasized thereby.

Equally, the more efficient the individual departments become, the less will be the actual authority and control of the War Industries Board and its chairman in centralized purchasing. That body, which has served from its inception to the present time as the only centralizing agency that has yet been created, and to which the committee of the United States Chamber of Commerce has looked with hopefulness as the body out of which a centralized control of purchasing for all departments might be evolved in view of the disposition to grant it ever-increasing powers, becomes by the present theory, not a centralized control, but at best, an efficient clearing house to which department officers—with whom will rest the responsibility for production—refer their orders before they are placed.

More Coördination Necessary

Even with the establishing of a Department of Munitions, War Industries Administrator, or War Supply Board, with full control over the responsibility for the procurement of munitions and supplies, it is still necessary to provide more complete coördination of the various new administrations and agencies of the Government whose separate activities affect the efficient conduct of the war programs as a whole. The United States Chamber of Commerce does not believe it is necessary or advisable as the situation now exists to bring the Food Administration, the Fuel Administration, the Railroad Administration, the War Trade Board, or the Shipping Board under the control of the authority responsible for buying.

At the same time the work of these agencies involves the maintenance of the financial and economic strength of the country, and the effective use of its industrial resources. The United States Chamber of Commerce therefore believes that there should be created some small board or council with no other duty than to have constant supervision over, and general direction of the work of these administrations and of such additional agencies of similar character as may be created from time to time. Its view is, that such a small council should sit continuously, devoting itself to constructive planning, and settling conflicts which may arise from time to time between these administrations and boards, and adjusting the activities of one agency to another as the war needs of the country may require.

No one who has been given the opportunity to inquire into the situation, can refrain from an expression of appreciation of the spirit by which all charged with this great work are animated, or of the splendid accomplishments which may be seen in many directions. Whatever may be the organization or method by which the Government endeavors to meet its great problems,

American business may be trusted to give its unfailing support; but men trained in production and distribution would be failing in their duty if they did not express their conviction, drawn from their experience, that whatever may be the form, the need for centralized control and responsibility is demonstrated by all industrial experience.

How the Priority Certificate Works

The question of priority certificates as it affects machine-tool deliveries, is not clearly understood in all cases, and in order to make the matter clearer we have secured certain definite rulings, and certain underlying principles which are involved in these certificates, have been made plain.

The first object of the priority certificate is to secure the delivery of the machine in question at the date of delivery specified when the order was placed. It does not, as is often supposed, give a machine precedence over other machines as to dates of delivery, but it is to insure the delivery according to agreement. If a machine is needed at once, then the priority certificate gives it precedence over any machines having a lower class certificate, and also over any machine of its own class, providing this does not prevent the delivery of the other machine by the time called for in its delivery date.

The matter is simplified considerably if we bear in mind the fact that the main object is to secure the delivery of the machine on the date specified when it was ordered. This assumes, which is reasonably safe, that every one orders the machine for a date of delivery at least as early as necessary. With the delivery date fixed and covered by a priority certificate, the shop schedule must be so arranged as to prevent this delivery being delayed by shipping other machines ahead of it.

Four specific cases are given herewith together with the rulings in each case. Any case not covered by these will be considered promptly.

Q. (1) What disposition shall we make of a machine opening up on our program for earlier shipment than A-1's own order with specified delivery dates which we will maintain and assuming the delivery of the machine opened up will not interfere with the contracted dates of the A-1's?

A. (1) If you can make delivery of all A-1 orders on the dates contracted for, or on the dates specified in priority certificates issued thereon, then any machine which may be opened up on your program for early shipment may be delivered on orders held by you of a lower classification. If you have no A orders then the delivery may be made on B orders; if you have no A or B orders then the delivery may be made on orders which would be rated as Class C orders. In other words, the priority certificate is designed only to secure delivery as called for in the contract, or in certain instances as called for by a definite date specified in the certificate. Delivery may be made on orders of a lower classification provided such delivery will not interfere with the deliveries as above noted.

Q.(2) What disposition shall we make in the above case of A-1's, but having certificates calling for earlier delivery than that contracted for; for instance, calling for delivery "immediately" or "as soon as possible"?

A.(2) In the event the priority certificate should call for delivery "immediately" or "as soon as possible" instead of calling for the direct date specified, and a machine of the type covered by such certificate should open up for delivery on your schedule, then such machine should be delivered under such certificate.

Q. (3) What is the status of Allies' orders placed prior to Sept. 21 which do not interfere with contracted dates of A-1's for later delivery or with dates of delivery specified in the A-1 certificates?

A.(3) Allies' orders placed prior to Sept. 21 are automatically classed as A-2 unless otherwise specifically covered by instructions from the Priorities Committee. The delivery of A-2 orders should be made on the date contracted for or specified in priority certificates.

Q.(4) What relation will an AA-1 order bear to all other orders already entered on our books, provided such deliveries will not interfere with contracted deliveries of A-1 orders or with orders for deliveries specified in A-1 certificates?

A.(4) An AA order should be given sufficient precedence over all the orders of a lower classification on your books to secure the delivery date specified in the AA order. If such AA order will prevent the delivery of any A orders on your books you should notify this Committee in regard thereto, specifying what orders will be delayed and to what extent.

The Lyons Fair—1918

The third annual Lyons Fair will be held Mar. 1 to 15, 1918. The first two fairs were held in 1916 and 1917 in the full tide of war. The world's press has recorded a magnificent, almost unhoped-for success. The number of adherents from 1342 in 1916 (Foreign exhibitors 143) to 2614 in 1917 (Foreign exhibitors 424), and the amount of business transacted in the fair was 57,000,000 francs in 1916 and 180,000,000 francs in 1917. The last figures do not include the business done by means of catalogs in the United States bureau. The amount of this business alone totaled $42,000,000.

In 1916 no American concern was represented at the fair, and in 1917 in spite of extensive publicity only 33 firms were represented. It is hoped, however, that this year the United States will be well represented. American business men should realize that the Lyons Fair will give them contact not only with French buyers but with buyers from Spain, England, Holland, Italy and all other exhibiting countries.

This fair is not an exhibition but a commercial proposition. The booths are permanent structures, so arranged that their exhibitors may have showrooms and salesrooms, and if they desire, private offices as well. Only commercial men are interested. No goods can be sold at retail, orders being booked in wholesale quantities from samples exhibited.

This fair not only offers an opportunity for concentrated sales effort to those who wish to extend their markets, but also offers a great patriotic opportunity for Americans to place American business on its proper footing.

Full particulars concerning rules and regulations to exhibit at the fair may be obtained from George B. Van Cleve, 1790 Broadway, New York City, who is chairman of the American Committee of the Lyons Fair, or from The Lyons Fair, Hotel de Ville, Lyons.

Sidelights

EDITED BY D. BACON

These United States may adopt, unanimously, a resolution favoring the daylight-saving plan. The matter is now before the House Committee on Interstate and Foreign Commerce.

Workmen's Delegates for Large Plants, But Not for Small

The French Ministry of War Industries has issued a letter to employers which states that in large plants it is effective to use elected delegates of workmen as a medium of adjusting difficulties between men and employers, but that they cannot be effectively employed in plants that use less than 500 workingmen.

Tin for Manufacturers

An adequate supply of tin for the United States manufacturers is said to be assured by the withdrawal of the British embargo on shipments made by way of the Pacific coast. United States receipts from the Straits Settlements, amounted to 56,220,348 lb., during the last fiscal year. Japanese ships will be the principal means of transportation for this product.

Eight States Pledged To Get Money

The Federal Board for Vocational Education announces an allotment of $240,000 to each of the eight states: Connecticut, Idaho, Illinois, New Hampshire, North Dakota, Maryland, Missouri and Vermont. They have complied with the terms of the law by which they agree to raise a dollar for every Federal dollar received. The total Federal fund available is $1,880,000.

Additional Insurance for Wage Earners

The Committee on Labor of the United States House of Representatives has reported a resolution calling for the creation of a commission of five, two of whom shall be employers, two representatives of organized labor, and one a representative of the United States Department of Labor, for the purpose of investigating the practicality of a Federal system of social insurance for wage earners.

Mexico Needs Goods

The import duty is off automobiles in Mexico until June 30. Export terms are modified. Import duties are not declared off in Mexico unless the exempted goods are much needed and no internal arrangements for supplying them are provided. This period of no-import duty may be extended when June 30 is at hand, but we have no assurance of that; meantime, Mexico wants automobiles.

Bricklayers Come Under the Flag

The Government has sent out a hurry-call for white bricklayers. Questionnaires are being examined that the bricklayers may be culled from the ranks of registered labor; but this is not enough: bricklayers are called upon to volunteer their soldier-services. These skilled men are wanted for duty in France. They are wanted for work on cantonment buildings just now, and to do other construction work for the Army. Bricklayers, soldierize yourselves! Do it now!

Niagara Falls Power Taken Over by the Government

The United States Government has requisitioned the electric power generated by the Niagara Falls Co., by the Hydraulic Power Co. of Niagara Falls, and that of the Cliff Electrical Distributing Co. Approximately, 110 factories which are not working on war contracts will curtail their electric power requirements and substitute steam for electricity; 100,000 hp. imported from Canadian plants will be exclusively used for war purposes.

Closing the Parlor: Opening the Factory

The President's family has closed the Blue Room in the White House—which does not mean a simple extinguishing of a society center. When the Blue Room of the White House is closed certain diplomatic functions are declared off, and diplomatic functions are as much a part of a country's machinery as is Congress. If every manufacturer in the country will undertake to close up his parlor and stick to the living room, he will help to put a good many thousands of tons of coal in his factory furnaces.

Freight by the High Road

There are fleets of motor trucks running between Boston, New York, Philadelphia, Washington and Baltimore; also from Pittsburgh to New York. By this means there has been transported a piledriving outfit, with boilers and engines to be used in a shipyard job. Two 20-ft. tanks weighing about 12 tons, were transported by motor trucks from Chester to Reading, Penn.; five tons of supplies for the Red Cross were thus transported from Philadelphia to Boston, thence to Europe. The truck transportation took less than two days, and the distance was 520 miles. Since July, a fleet of 22 trucks has been running daily, between Philadelphia and New York.

This motor-truck system conducts transportation to Washington, Baltimore, Wilmington, Hartford, New Haven, Springfield, Providence, Harrisburg, Reading, Bethlehem, Trenton and other cities, and the route involves the territory of nine states.

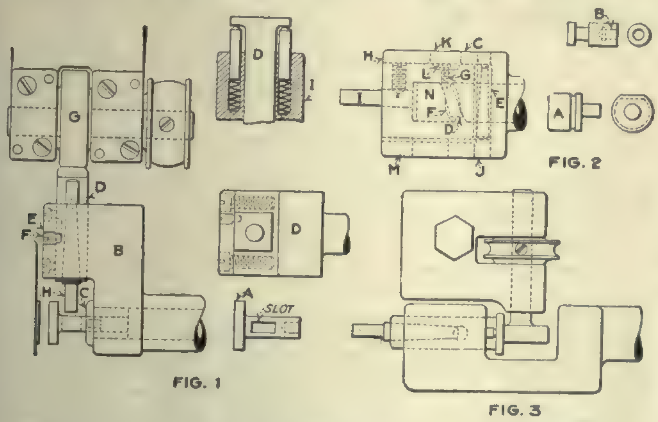
At times these loads have been of a value to carry an insurance of $50,000. Finished leather to the amount of 14,000 lb. has been carried from Philadelphia to New York for export; 90 tons of musical instruments have been carried on 19 trucks from Philadelphia to New York in one day. Thus nearly every sort of thing has been transported with an economy of expense, handling and time. These figures suggest the enormous possibilities of the motor-truck freight system.

Slotting and Shaping in the Automatic Screw Machine

By Elam Whitney

The tools described, which are used as attachments for Brown & Sharpe automatic screw machines, were designed to include second, or hand, operations with the automatic machining of the parts shown.

At *A*, Fig. 1, is illustrated a stud that is completed in a No. 0 Brown & Sharpe automatic screw machine from $\frac{5}{8}$-in. round brass. The slotting was formerly done in a separate operation after being drilled in the drilling machine to remove stock. To shape this slot in the automatic screw machine, the spindle is stopped with a standard attachment, and stock is removed for slotting by drilling two holes with a special combination cross-drill and cutting-off attachment previously described in these columns.



FIGS. 1 TO 3. SLOTTING AND SHAPING ATTACHMENT

The special shaping-tool holder *B* is mounted in the turret and carries the bushing *C*, which supports the stem while shaping the slot. The shaving-tool holder *D* is a square plunger and is retained in the holder *B* by the plate *E* and the retainer screw *F*. The eccentric *G* is driven by the pulley shown mounted on the rear cross-slide giving motion to the slotting plunger *D* and the cutter *H*. A cross-section at *I* shows the spring plungers that keep the toolholder in contact with the eccentric *G*.

In operation the stem is turned with a box tool, the spindle stopped, and a hole cross-drilled to remove stock for one end of the slot; the drill is withdrawn and the stock fed forward and a second hole cross-drilled to remove stock for the other end of the slot. Thc cross-drill is then withdrawn, and the turret is indexed and advanced to bring the special shaping tool into line with one of the cross-drilled holes. It is caused to remain in this position by a dwell on the lead cam, while the rear cross-slide advances sufficiently for the eccentric to push the cutter through the work. The throw of the eccentric is equal to the diameter of the stem of the work plus clearance, and the speed of the pulley is sufficient to give the cutter rapid motion, while the lead cam causes the turret to advance and then slowly withdraw, thus giving the cutter a fine feed to complete the length of the slot. The width of the cutter is the same as the width of the slot.

The cams are similar in design to those for operating swing or undercutting tools. After the work is completed, the lead cam causes the turret to dwell until the rear cross-slide has withdrawn sufficiently for the shaping tool to clear the work, at which point it has ceased operating and the turret may then be indexed. The fed of the lead cam for this shaping operation is 0.001 in.

Other parts that were successfully completed, including shaping cuts, are shown in Fig. 2. The economy of completing these parts in one setting is obvious. The piece *A* is made in a No. 2 Brown & Sharpe automatic turret forming machine from 0.750-in. soft machinery steel, extruded stock, the shape being the same as that shown. After the groove has been turned, the spindle is stopped with the flat side of the stock up. The groove is then completed by a shaping operation similar to that described above.

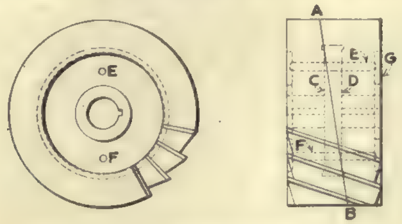
For such light cuts in soft brass and machinery steel as shown at *B*, the special shaping tool *C* may be used. This tool is self-contained, mounted in the turret and driven by the high-speed drilling attachment. The revolving shaft *D* carries a thrust collar *E* and the cam slot *F*, which through the roller at *G* give the bushing *H* and the cutter *I* a reciprocating motion. A hole at *J* provides a means of assembling the taper pin in the thrust collar, and the hole *K* provides for assembling the hexagon nut *L* on the roller *G*. A rectangular key is shown at *M*, and the straight slot *N* opening into the cam cut provides a means of assembling the shaft *D* into the bushing *H* after *G* has been assembled. This slot is located radially on the cam slot at the beginning of the return stroke, so as not to interfere with the roller *G*.

For machining heavier cuts than those shown in Fig. 2, the shaping tool, Fig. 3, may be used. The construction of the tool differs from that in Fig. 1 only in the application of the cutter, which is located longitudinally instead of transversely.

An Adjustable Side-Milling Cutter

By C. W. Miller

This cutter is made in two parts; the adjacent sides are on an angle when assembled, as shown at *A* and *B* in the illustration. This is done in order that the cutter, when opened by a washer located in the center between the faces *C* and *D*, may be kept to proper thickness after it is ground. The reason for making the adjacent sides of each part on an angle is that when the cutter is ground, and a washer wider than space *CD* is used, there will be an opening; and were the sides straight, a ridge would be left on the work. The parts



ADJUSTABLE MILLING CUTTER

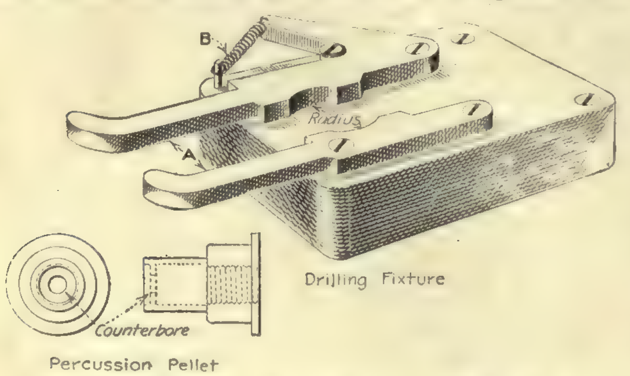
are held together by two dowels *E* and *F*, in the recesses *G*, having their ends beneath the cutting surface.

In making these cutters the first thing done is to make the holes in the blanks, and then plane the angles. Each half is then put on an arbor, and the recess in the center is turned out (faces *C* and *D*). The halves are then put together on a plug and drilled and reamed for the dowels *E* and *F*, after which they can be turned and milled as a whole in the usual way, except that care must be taken to keep the halves together. This cutter obviates the use of the expansion interlocking cutter, which is very difficult to make. This cutter is very satisfactory in use.

Fixture for Drilling Small Holes

By G. C. Wells

In the production of percussion pellets for time fuses, the tooling on the automatic screw machines which produced these parts, was such that it was impossible to counterbore the small hole in the end of the pellet. This



FIXTURE FOR DRILLING SMALL HOLES

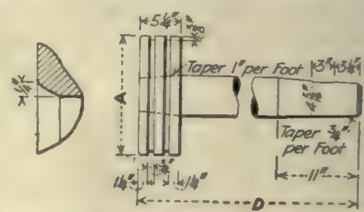
operation was therefore done on a drilling machine with the fixture illustrated. The base of the fixture was made as thin as possible so that the operator could rest arms and hands on the drilling-machine platen in order to operate the fixture with the least amount of effort. The handles were gripped in the left hand, and a definite number of pellets found their way through an orifice in an elevated box, down a chute to the drilling-machine platen. The pellets were placed on their correct ends for drilling, and fed along one after the other. An undrilled pellet pushes one that is drilled out of the fixture down another chute and into a box. This feeding operation was done without interfering with the drilling operation, because the drill spindle was operated with a 5-ft. treadle. The spindle speed was 8000 r.p.m., and the production in 9 hours was 15,000 pieces. The recesses cut in the clamps *A*, center the pellet while the pilot on the counterbore, insures concentricity. The spring *B* for holding the clamps open was discarded, as the operator found it unnecessary for this class of work. For some kinds of work, however, it would be an advantage.

Recording Cylinder and Piston Repairs

By Martin H. Ball

In the table is shown a method of keeping a record of steam hammer and cylinder repairs. It is also applicable for use in other classes of work, and provides a convenient method of keeping a repair record up to date. This record may be kept in any desired or convenient place on the cylinder, by space lined horizontally and vertically. On the horizontal lines are noted the

	A	B	C	D
Sept. 14, 1914	$14\frac{41}{64}$"	$14\frac{21}{32}$"	$14\frac{13}{16}$"	$70\frac{5}{8}$"
March 6, 1917	$14\frac{31}{32}$"	15"	$15\frac{5}{32}$"	$70\frac{7}{8}$"



METHOD OF REPAIRING PISTONS

dates of the repairs, while the vertical sub-divisions contain dimensions of the cylinder, piston, piston rings and length of piston rod after each repair job; dimensions *B* and *C* refer to cylinder bore and piston-ring diameter respectively.

For example, in *B* column it is seen that on Sept. 14, 1914, the cylinder was bored to $14\frac{21}{32}$ in. and on Mar. 6, 1917, to 15 in. Records are similarly kept of repairs made on piston heads, piston rings and also on the piston rod; as the anvil base is always set on wood, which allows it to settle somewhat, provision is made to record the increased length of piston rod as required.

A method of attaching the piston head to the piston rod is shown in the illustration. We have used this method for a period of about three years with excellent results, and on hammers ranging from 2000 to 6000 pounds.

The piston rod is tapered to fit and extend through a tapered opening in the piston head. The piston head is heated and shrunk on the rod, and the rod then well riveted.

The hammers referred to are probably worked as hard as any that might be found. During the period of three years they have been in service, they have operated practically without interruption 115 hours per week. The material hammered was of carbon and high-speed steel, neither of which yields readily under the hammer, especially the high-speed steel, and this constituted about 20 per cent. of our hammer work.

J. V. Hunter's article, page 475, Vol. 47, was interesting, because we have never been supplied with anything excepting the heads and rods made in one piece from hammer manufacturers, which would seem to indicate that they consider the one-piece article to be the preferable construction. The first time we made the piston head and the piston rod in two pieces, it was on an emergency repair job, when time could not be spared to obtain the material to construct the piston rod and piston head in one piece. Since that time the method described has been found economical in both time and material.

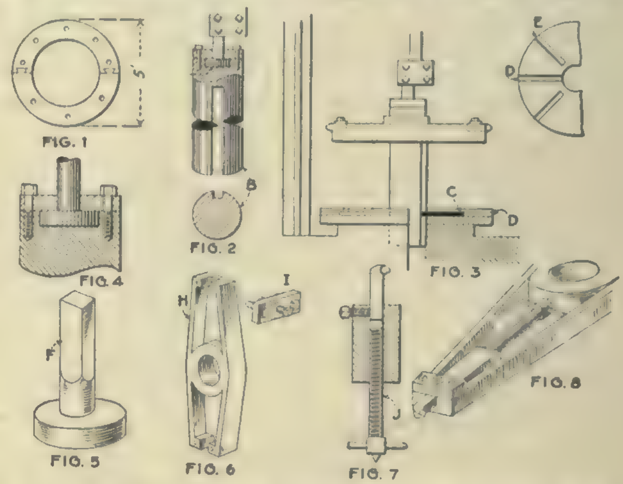
Boring a 4-Ft. Hole in an 18-Ft. Ship Casting

By H. G. McLean

Some time ago we had a steel boom-deck casting for a dredge come into the shop, which required boring out to allow for a brass bushing to overcome the friction. The casting was in halves, 18 ft. outside diameter with a bore of 4 ft. The bushing was to be ¾ in. thick and cut in two; each half to be held in place with countersunk screws. The top was to be faced back 6 in. so as to allow for a brass ring, shown in Fig. 1, which was dove-tailed to make an even joint. This ring had an outside diameter of 60 in. and an inside diameter of 48 in. and ¾ in. thick. The halves of the brass ring were also fastened in place by means of countersunk screws.

To accomplish the work we turned down a piece of steel 7 in. round and 3 ft. long as shown at *B* in Fig. 2. We cut a keyway 2 ft. long to receive a key *C*, which fitted in a slot *D* of the boring-mill table *E*, shown in Fig. 3. At the top end of the boring bar we bored out a 3-in. hole 1½ in. deep, shown in Fig. 4. We then made a shank, *F* as illustrated in Fig. 5, to fit into the toolpost head, the bottom having a boss fitting neatly into the 3-in. hole of the boring bar.

Thus we were able to use the feed of the machine, as the boring bar could revolve, being driven by the key *C*, shown in Fig. 3. We made a casting *H* of cast iron as illustrated in Fig. 6, bored and pressed on boring bar with two setscrews; a slot in each end for the tool which was held in place by a strap *I*. To face off we used a jackscrew *J* as in Fig. 7, while Fig. 8 illustrates the manner in which jackscrew worked the tool out. Being able to cut only one way it was necessary to use three different lengths of tools. Each half



FIGS. 1 TO 8. DEVICES USED IN STEEL BOOM-DECK CASTING

Fig. 1—Dove-tailed brass ring. Fig. 2—Boring bar attached to toolpost. Fig. 3—Toolholder in position for operation. Fig. 4—Toolpost and boring bar connection. Fig. 5—Detail of connecting shank. Fig. 6—Casting and cap for holding tools. Fig. 7—Detail of jackscrew. Fig. 8—Jackscrew mounted in casting

of the boom-deck casting was jacked up from the floor and bolted to housings of machine. Fig. 9 shows the work in progress, and Fig. 10 illustrates the work succesfully completed and ready for shipment.

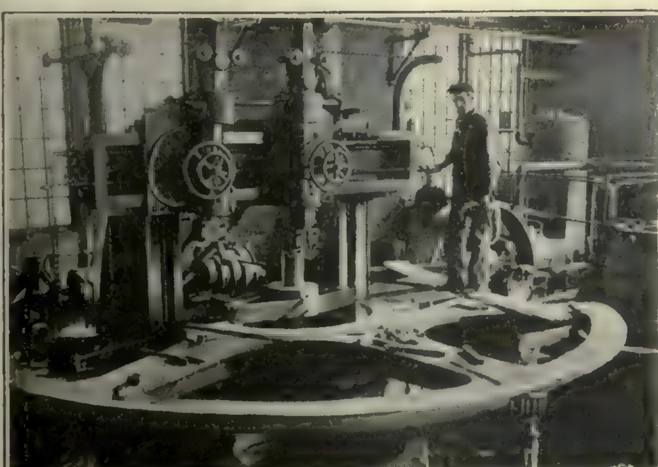


FIG. 9. CASTING ON BORING MILL

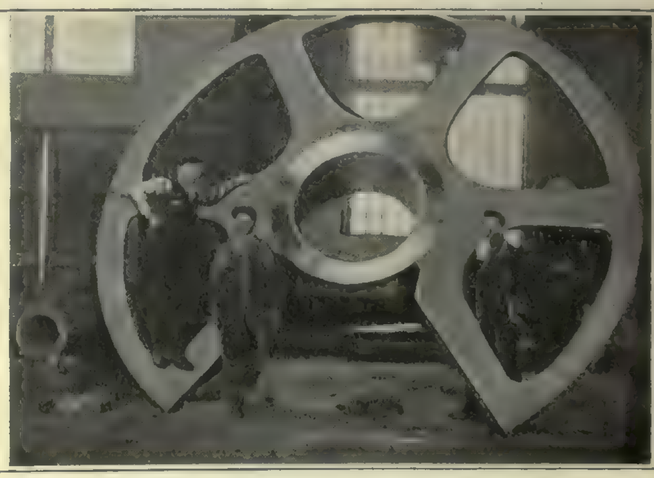


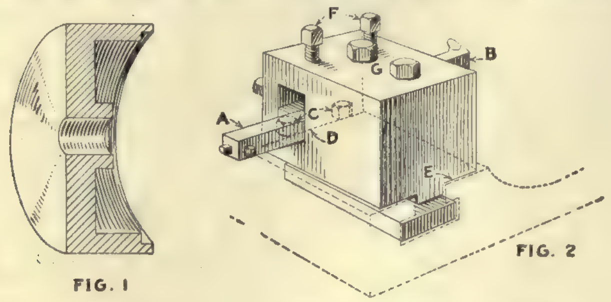
FIG. 10. THE FINISHED CASTING

Special Toolholder for a Lathe

By C. Anderson

The drawing shows a toolholder that I have found very handy in machining a casting similar to that shown in Fig. 1. The device shown in Fig. 2 holds two tools, *A* being used for machining the bore, while *B* is used for machining the counterbore. Using a toolholder in the regular toolpost, I face the hub, and rough the counterbore nearly to size. I then put my special toolholder in place as shown, pushing it up solid against the two capscrews *C*, which are screwed into the compound rest, and which act as a locating stop. The compound rest is swung around at right angles, and the

toolholder must be so designed as to bring the tools on center, having a little room for above and below center adjustment. In boring out, the edge *D* is set up against the stop, and for machining the counterbore the edge *E* is next to the stop. The clamping surfaces must be kept free from chips, and no chips must get between the toolholder and the stop. I do not claim that this device will bring all the pieces alike within a thousandth,



FIGS. 1 AND 2. CASTING AND POSITION OF TOOLHOLDERS

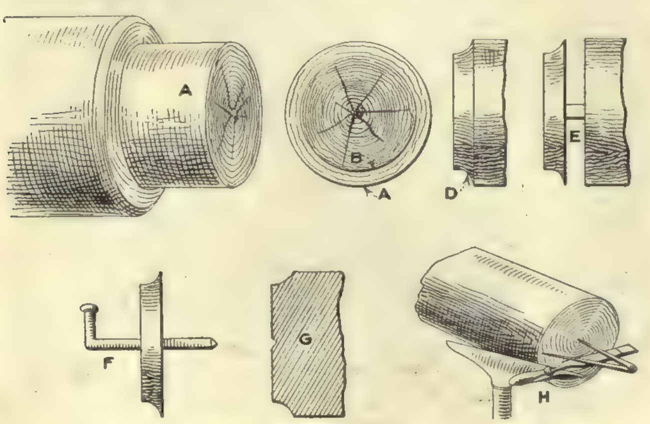
but it has the old way of using the regular toolpost stopped a mile. Being solid and held very rigid, prevents the tools from pivoting so that by using the graduated dial and bringing each tool to about the same place it is only necessary to do one measuring on each diameter, the bore being reamed out to size by hand and a couple of thousandths leeway being allowed on the counterbore. The screws *F* hold the tools in place and the toolholder is clamped to the compound by means of the screws *G*.

Turning Small Bosses for Use in Pattern Work

By William C. Nelson

The following has been found a simple and quick method of turning bosses from 2-in. diameter down to the smallest size used on jig and fixture work for small parts of machinery.

In the illustration the wooden chuck is shown with



TURNING SMALL BOSSES FOR PATTERNS

the stock *A* glued thereon, and also shows the different steps followed in the method.

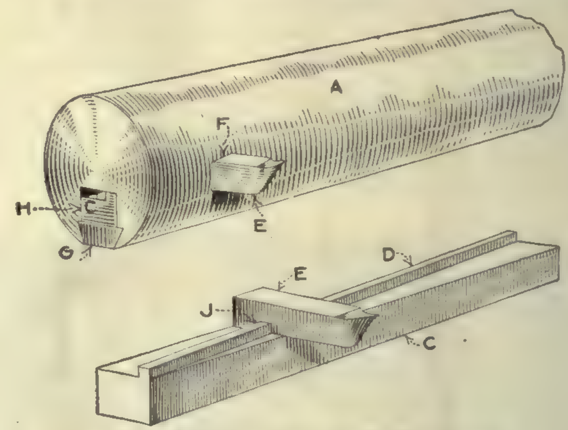
The order of procedure is as follows: True up the diameter of the stock *A* to the size of the fillet required and face off the stock. Mark off with dividers the circle *B*, which is the true diameter of the boss. Gage with marking gage the required height or thickness of the boss, and this line should be gaged $\frac{3}{64}$ in. deep. Turn diameter and fillet as shown at *D*. The next operation is to cut off the boss if no hole for a dowel is to be drilled in the latter. To cut off, take cutting-in tool ($\frac{1}{8}$-in. chisel) and using gage line as guide, cut into small enough diameter to break off as shown at *E*.

If it is desired to use the boss as a loose piece (using center dowel as shown at *F*) first, after turning, take diamond point tool and turn small countersink in the center of the boss, which should be turned exactly true as shown at *G*. Next using the countersink as a center for a twist drill, bore a hole to the depth required. It is needless to add that the hole should be drilled before cutting in for thickness of the boss. Bosses up to $1\frac{1}{2}$-in. diameter, and in almost any thickness, can be turned in the following manner without moving tool rest from its original position: First, set the tool rest to proper position for turning diameter; second, face off the end of the stock; third, set dividers to radius of circle, and setting a tool across tool rest as shown at *H*, locate center and scribe circle. After this operation proceed in the manner previously described to the conclusion of the job.

A Bar for Boring Taper Holes

By William Seelert

The boring bar *A*, as shown in the accompanying illustration, is provided with a rectangular slot milled its entire length, and afterward closed by the dovetailed piece *G* making a rectangular hole *H* the length of the bar. In the hole *H* of the boring bar is located the



A BAR FOR BORING TAPER HOLES

key bar *C* which is a sliding fit, and is provided on its upper face with a key *D*, which is made the same taper as one side of the bore in the work. The tool *E* fits in an opening *F*, cut crosswise in the boring bar, and is provided with a slot *J* to receive the key *D*.

It will be apparent that with the boring bar, key bar and tool assembled, the cutting tool *E* may be moved crosswise of the boring bar in either direction by moving the key bar in or out. The device is mounted on a milling machine, and as the end of the key bar, which controls the degree of taper, must move along with the work, it is secured to a small bracket mounted on the milling-machine table. By making different lengths of tools the bar described will cover a large range of bores. For every different taper a separate sliding key bar is required.

The Great Value of Constructive Inspection

By Teckeer

Of all our toolroom worries what can equal that trouble-maker, money-loser and depressor of enthusiasm: the inspector's report tag, "rejected." And what would we give to be able to avoid these rejections, or at least to make their appearance a rarity! This is our problem, and it is big.

Even five and six years ago lively discussions were carried on in the pages of the *American Machinist* as to the scarcity of good mechanics and the reason. Now, it follows, that if mechanics good enough for the character of tool work required at that time were scarce, today it is almost an impossibility to get capable men. The number required is probably 100 per cent. more than formerly, and the class of tool work demanded is on a much higher plane. The best toolmakers of five years ago have had plenty of study and experience ahead of them to hold their leadership with today's gagemaker. The field is too big and difficult to be covered easily. There is a real vacancy to fill, a big gap to breach, and as a first active step I suggest constructive inspection by the progressive, tool supervisor.

The duties of such a man are particularly trying and he should possess marked characteristics of tact, determination, confidence and competence. Doubtless there are a thousand other things to add to this list when we look squarely at his duties. He is the target to be hit from every angle—by the workman, the foreman, the draftsman, and so on; he finds himself the center of fire from the long-range guns. Yet this will prove his tact, his assertiveness and his competence. Any new method is met by opposition, oftentimes the better the method, the more obstinate the opposers. Today's necessity demands methods of relief in this work. One way out is through intelligent help, and the quicker we realize it and adopt likely principles, the quicker shall we progress. It will be evident to all concerned then, that this new cog must mesh and soon will be accepted and used, and better results shall follow.

The progressive tool supervisor as an inspector must be a keen observer both of man's character and ability, as well as of the progression of the work in his field. He must work absolutely with the foreman, not for nor above him. The foreman can at any time refer him to any workman who is in difficulty. This is apparent to all, for a foreman often has no time to sit down and work out angles for a man, nor to verify a difficult dimension, and in many cases he has no time to study a drawing of a really difficult job and advise as to how it should be done. In fact in some cases the foreman could not do the job in any event, for a capable foreman is not always a world-beater as a mechanic. Principally shall the progressive inspector advise on best methods, help make set-ups, verify measurements, solve difficult drawings, angles, etc., advise on best manner of grinding (for in that alone, there are many kinks), of lapping and best lapping compound. And in this way we have progressive inspection.

One word on inspection that is not progressive: I know of no toolroom wherein work is inspected until completed. The tool may have taken days, or even months to build, but it is carried along by the workman until complete. Then it is inspected, and sometimes rejected.

Is it not worth while to avoid these expensive errors?

This same idea of inspection, advice and leadership may be found as I suggest, in some of our best schools in the mechanical arts. I have had the good fortune to see in Wentworth Institute of Boston, Mass., tools and gages hardened, ground and lapped; and machine work of every description done accurately and to compare favorably with any commercial shop's product. This work was done by students of from one to five years' instruction—part of the time, only, in the machine and toolroom. This shows in no mean way the value of intelligent, skilled leadership; and certainly what can be accomplished with boys and men considered novices, can be equaled and bettered by men of greater experience and training. The secret lies in the leadership; in the personality as well as in the ability of the men under whose training the novice is.

Again, in every toolroom employing a number of men, we find but few mechanics whose advice as to how to proceed with a certain job is constantly sought by their associates; we have need of such men as a recognized unit—not at the bench but in the role of progressive tool inspectors.

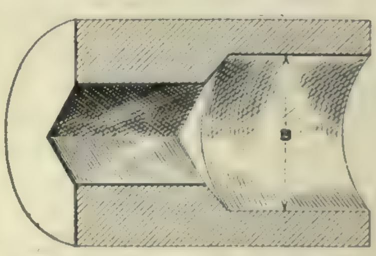
As expert toolmakers, of unquestioned ability, conscientiously giving their best to further the efficiency of their fellow workmen and to avoid costly errors and faulty methods, their need is urgent in shops doing high-quality work, and their salaries will be but a diminutive unit in comparison to the economy and effectiveness of this policy.

In conclusion I would state that enough such men are to be had, though they may be rare, and not to be had without effort. A pretty good lead to follow is the quiet unassuming fellow, who perhaps has worked years for you, unmolested by any, and whose work seldom bears that tag "rejected." When you find him, he will fall into his new position naturally and the other workmen already know his worth much better than you do, thus the first step in progressive inspection has been quite easily made.

Chuck Wrench Repairs

By William Earnest

We had considerable breakage and wear on chuck wrenches and decided upon the following procedure: An apprentice was given the job of turning up a number of bushings as shown. The blacksmith heated them



THE CHUCK WRENCH REPAIR PART

and drove a square drift through the small end. The hole at the end *B* was made a size suitable for a shrink fit on the shank of the old wrench.

Editorials

The Facts Behind the Shutdown

Now that the first shock of the recent shutdown of industry has passed, it is only fair to consider the various factors which led up to it before we judge too harshly, those who are responsible for it. Although the order was issued by Dr. Garfield as a measure of fuel conservation, the underlying cause seems to have been the lack of sufficient transportation facilities with which to handle coal and other commodities.

The plain facts of the matter seem to be that our railway equipment, particularly of locomotives, is sadly inadequate for our needs. The railroads have allowed their motive power to deteriorate to an unheard of degree and have ordered almost no new locomotives to take the place of those which are constantly wearing out. Whether this neglect of rolling stock was justified by the failure of the railroads to secure the advanced freight rates demanded, or whether it was a policy adopted to force the granting of these rates at a later time, does not affect our present situation, which is that our transportation system is not sufficient for our needs. There have been almost no locomotives built for American railways during the past year, and there is at the present time but comparatively few on order. Unfortunately it is not deemed practicable to transform the Russian locomotives now in this country awaiting shipment, to meet our requirements; and there has not as yet been announced the placing of large orders by the new Director General of the railroads. This seems to be the next logical step, as it is apparently the only way in which to relieve the congestion of coal and freight of all kinds, which is our main problem at the present time.

As an indication that the closing period was to reduce the amount of manufactures, the same closing rule was applied to concerns using water power as to those using coal. And the criticism of closing without sufficient notice is answered by the fact that any advance notice would have almost certainly augmented our accumulation of products to be shipped, which was the one thing to be avoided at this time. A careful study of the exemption list will indicate that only the most urgently needed munitions were allowed to be manufactured, on the ground that it was useless to congest terminals and to pile up a huge volume of supplies which it was impossible to transport to their destination.

Dr. Garfield asked for priority orders to move coal as long ago as Nov. 26, contending that unless the coal could be moved it would be impossible to ship either food or munitions to which priority shipping orders had been given. Had his request been met it is quite probable that at least a portion of the trouble might have been avoided, as at that time the weather conditions were much more favorable than they have been since.

Much of the difficulty in Dr. Garfield's opinion is due to the holding of cars for a longer period than necessary before unloading. With the present congestion it is his belief that a jail sentence should be given to every man who fails to unload his freight within twenty-four hours, and he hopes to have some such drastic law passed in the near future. Such a law would probably involve a large number of officers in the Quartermaster's Corps as they are noted offenders in this line; but all those who are truly desirous of helping the Government in every way possible at this time, will coöperate in this or any other measure which will tend to relieve the present congestion.

Knowing the facts of the case from the inside puts a very different light on the whole situation and makes us realize that we have perhaps been blaming Dr. Garfield unjustly for shortcomings which should rightly have been placed on other shoulders. The very fact that he was willing to face the avalanche of criticism which he knew would be aroused, in order to help save a situation for which he was apparently in nowise to blame, indicates very clearly that he is a man of more than ordinary caliber and should make us more lenient in any future criticisms.

The main criticism would seem to be the failure to include in the exempted list that portion of the machine-building industry which is engaged on the machines so urgently needed for the turning out of our large guns and similarly necessary munitions. But in this case also, Dr. Garfield seems to be blameless, as the list of exemptions was prepared by the Super-War Council which evidently overlooked the important part machine tools must play in all kinds of mechanical activity.

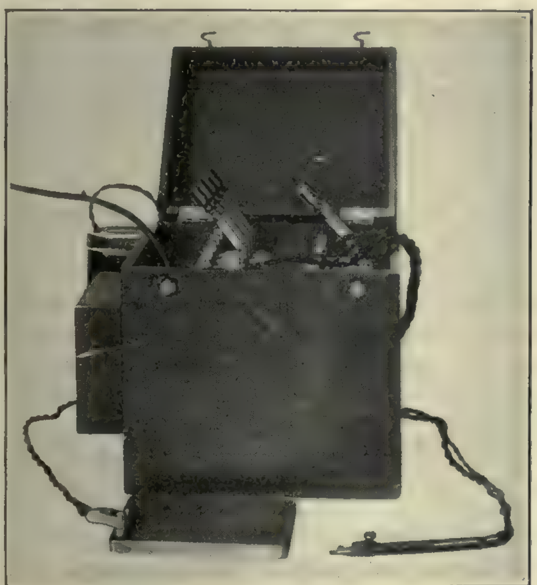
Now that we realize our shortcomings along transportation lines, we must not be surprised if there should be further shutdowns from time to time until the railroad congestion is relieved, until fuel can be supplied freely and promptly to all the ships available to carry our men and supplies to France, and until something like a normal freight movement is reëstablished. Germany, in spite of its wonderful organization, has frequently suspended all railway traffic except that governing the movement of troops and their supplies, for a period of forty-eight hours. We must be prepared to expect similar drastic regulations from time to time, although it is to be hoped that the railway congestion will not make this necessary when weather conditions become more normal.

Helpful suggestions or constructive criticism are always in order, and will, we are sure, be gladly received by those who are trying to secure the very best results for us. The present action in regard to the restriction of output was taken by Dr. Garfield instead of by the other departments in whose province it would seem to belong, simply because the legislation already enacted gave him the power to do this but did not confer the power to do this on any other department head. It was simply a case of utilizing the methods at hand to relieve so far as possible, a very critical situation, and it is our part to conform as graciously as possible.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Robinson Electric Engraving Machine for Tool Work

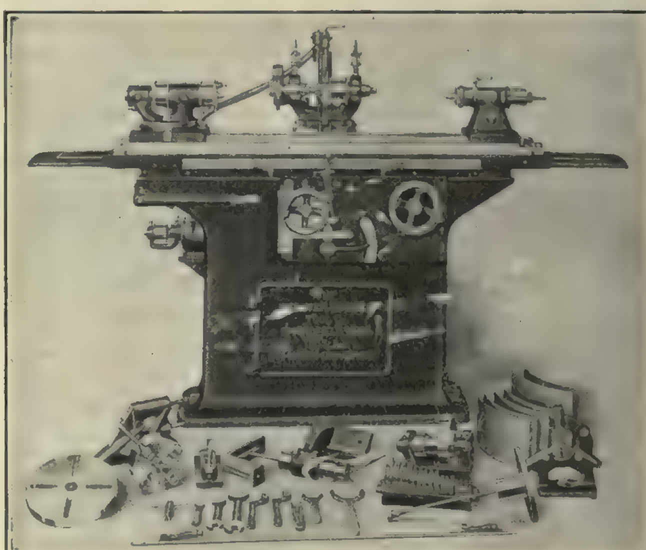
A new machine for electrically engraving hardened-steel tools, etc., with any kind of mark or name has just been placed on the market by the Production Equipment Co., Inc., 118 East 28th St., New York City. The Rhode Island Electrical Tool Co., Providence, R. I., is the manufacturer. The tool or piece of work to be marked is placed on the plate shown, and the pencil is used in the same way as an ordinary pencil for etching in the steel whatever mark or lettering is required. A special resistance block with adjusting switches is supplied for regulating the depth of the etching and to accommodate various thicknesses of steel. Ribbon steel can be handled. Lettering of any kind can be marked with no more effort or time than is required to write with an ordinary pen or pencil. Electrical connection is made from an ordinary electric-light socket, the standard equipment being suitable for alternating current. A special converter can be supplied for direct current. The chief point of advantage claimed for this machine over similar ones on the market, is that a special patented feature prevents sparking each time the pencil is applied to or removed from the work.



ELECTRIC ENGRAVING MACHINE

Webster & Perks Universal Cylindrical Grinding Machine

The universal cylindrical grinding machine illustrated is a 10 x 30-in. machine that has recently been placed on the market by the Webster & Perks Tool Co., Springfield, Ohio. It is known as the company's No. 1 machine. The base is of the cabinet type with shelves for tools or accessories, and has three planed bearing pads on the bottom. The bed is secured to the base by means of capscrews, and the V- and flat-ways are provided with roller oilers. Automatic table travel is incorporated and is controlled by adjustable dogs secured to the front edge of the table by means of a T slot. The table may be run past the dogs in case of necessity, without disturbing their adjustment. The swivel table rests on pads on the sliding table and swivels on a



UNIVERSAL CYLINDRICAL GRINDING MACHINE

Normal capacity, 10 x 30 in.; largest diameter with full-size wheel, 10⅜ in.; actual grinding length, 32 in.; swing over table water trough, 14 in.; swivel table graduations up to 3½ in. per foot or to 8 deg.; headstock graduated to 90 deg.; diameter of headstock spindle, 1⅝ in.; diameter of footstock spindle, 1⅝ in.; work-carrying centers, No. 3 Morse taper; diameter of grinding-wheel spindle, 1⅝ in. under center wheel; length of grinding-wheel spindle bearings, 3 in.; diameter of grinding-wheel spindle pulley, 3½ in.; diameter of center grinding wheel, 10 in. (3-in. bore); face of center grinding wheel, ½ to 1 in.; diameter of end-grinding wheel, 6 in. (2-in. bore); face of end-grinding wheel, ½ in.; least amount of reduction by automatic cross feed, 0.00025 in.; greatest amount of reduction by automatic cross feed, 0.005 in.; cross-feed hand wheel graduated to indicate reduction of 0.00025 in.; work speeds, four, 58 to 320 r.p.m.; table speeds, eight, 7 to 70 in. per min.; horsepower required, 4; floor space required, 43 x 116 in.; net weight, about 3600 lb.

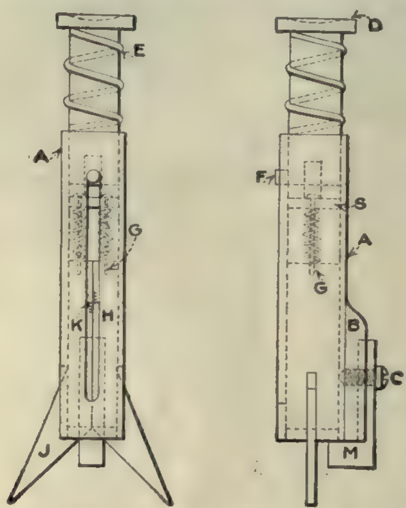
hardened- and ground-steel center stud fitting into a hardened-steel bushing pressed into the table. An adjusting screw, clamps and graduations for degrees and inches are incorporated. The headstock may be swung 90 deg. and is clamped to the table by means of two bolts fitting in T slots. The bolts are placed at an angle, this construction serving to draw the base against the front edge of the swivel table and insure proper alignment. A hollow spindle is used that runs in adjustable, alloy-bronze bearings. A double-row ball bearing is used for the dead-center pulley. The headstock drive is independent of the table feed and is controlled by a lever at the front of the machine. The footstock is secured to the table in the same manner as the headstock and is equipped with a spring center. This center is provided with a locking lever and with a lever for withdrawing. The wheel spindle is of tool steel and is mounted in adjustable, alloy-bronze bearings. Ball-and-socket type of bearing housings are used to secure proper alignment. The wheel-stand slide is completely universal. The handwheel for the table control can be rendered inoperative while power feed is being used, by means of a knob projecting from the center of the handwheel spindle. Adjustable ball bearings are used on the internal grinding fixture and the counter bracket. For wet-grinding work a centrifugal pump insures a proper flow of compound. The reservoir is in the base of the machine and a settling pan with three overflow baffle plates is used to prevent dirt or grit from reaching it.

Standard equipment includes countershaft; two universal rests; diamond toolholder and diamond; cutter tooth rest; 10-in. faceplate; face chuck plate with draw-in rod and collet; 6-in., four-jaw, independent chuck; internal grinding fixture, with counterbracket and belt; one pair of centers; set of work dogs; set water guards; one each 10 x ¾-in. and 6 x ½-in. grinding wheels, and one 1 x ⅜-in. grinding wheel for internal grinding attachment; one dead-center headstock pulley; center oiler and a complete set of wrenches and spanners.

A Gage for Testing Slots or Splines

By Arthur L. Collier

In the illustration is shown a gage which I devised for the inspection of slots and splines in shafts. I often found it difficult in our inspection department at the United Shoe Machinery Co. to determine whether the slots and splines were put in central, and it was on this account that the gage was designed. I have given it considerable use and find that it enables me to rapidly and satisfactorily inspect the parts of such work. The following is an explanation of the construction and operation: *A* is the barrel with a central slot *B* to which different sizes of keys *M* may be attached by the screw *C*. *D* is the plunger, forced down by the finger and returned by the spring as shown at *E*, while the stop *F* keeps it from coming out. This plunger is drilled at the bottom so that button *S* may be driven into it. This button has two holes in the head so that pins *G* may be inserted through them. The other ends of the pins are driven fast into the two half-round slide members *H* which fit the barrel and to them are attached the legs *J* which subtend an angle of 90 deg. The light springs shown around the pins *G* have sufficient power to keep the parts *H* forced out from the plunger. Now, as the key of the gage is inserted in the slot of the shaft, and the plunger forced down by the finger, the legs *J* will straddle the shaft. Should the slot not be central it is evident that one leg must strike the shaft ahead of the other, consequently, the marks *K* separate, and the distance apart when both legs touch the shaft, will be a measure of the amount that the slot is milled off central. A layout proves that the distance the marks separate is equal to twice the distance that the slot is cut off central in the shaft being tested.



A GAGE FOR TESTING SLOTS OR SPLINES

The Sales Question in Belgium

By Robt. G. Pilkington

The writer has been interested recently in the discussion of the sales question, as it relates to machine tools in Belgium. Most of the conditions germane to the sale of machine tools, are of interest to exploiters of other products.

I have knowledge of a new basic product that will be of future importance wherever any sort of structure is to be erected. Extensive preparations are on foot to market this product in every country where fundamental obligations are not considered as a scrap of paper. Needless to say, Belgium will receive attention commensurate with its needs. What the men behind this project desire now to know, especially from specialists in possession of first hand knowledge, is: how present conditions affect the usual procedure of inaugurating a sales campaign in Belgium? For instance, Belgium is completely overrun at present by those whose very name causes a sense of loathing. If it is desired, at this time, to establish permanent connections in Belgium to the end of prosecuting active work as soon as the war is over, can it be done? Was it possible for sale's agents who were active at the outbreak of the war to preserve any form of organization, or any sort of headquarters? Can even a patent be obtained, as is necessary if a product is new and of value?

These and kindred questions are not for theoretical or academic reply, but for the attention of such men as M. Henri Benedictus, who will confer a favor on the writer if he will discuss them in these columns.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Jan. 26, 1918—There is much complaint among manufacturers, particularly among those with small plants and some not so small, about the difficulty of getting information in Washington or elsewhere concerning the kind of materials that are needed, or concerning any details regarding them. When a man wants to look over a drawing and specifications of a shell, in order to know whether he can handle the job or not, he is not pleased to be informed that these are only available to bidders and contractors. It is like telling a man that if he can make the kind of a machine you have in the box, you will let him see it. Occurrences almost as bad as this are happening every day, and makers of machinery for making shells and similar munitions are having extreme difficulty in securing information needed to adapt their machines to the new types of shells. There should certainly be some place or methed whereby those with a legitimate reason for having information of this kind could acquire it without delay. A branch of the Bureau of Public Information might well be established for this purpose, headed by an engineer who understands the work. One of the great needs of the moment is, that necessary information be made available without delay.

The concentration of inspection under one head is a long step in the right direction. The Inspection Division in charge of Col. B. W. Dunn, which has been located in New York for some months, is now located at 18th St. and Virginia Ave., Washington, D. C. The shift was accomplished speedily and with very little disturbance, considering the magnitude of the task. In this same connection, it is difficult to see why part of the Ordnance Department should be at 18th St. and another large section at 6th St., while both Food and Fuel Divisions remain at 18th St. and Virginia Ave. Concentration is the order of the day, and it is a long journey from 6th St. to 18th St., and there seems to be no special need of the Food and Fuel Divisions being mixed in with a part of the Ordnance Department.

Munition Brokers at Five Per Cent.

Another and somewhat similar difficulty is encountered by some who desire to keep their shops going by taking work for some of the many things needed. Even well-known and goodsized concerns find it hard to get in touch with orders as they come along, and do not have the opportunity to look over the work and bid for it or arrange for its manufacture on the cost-plus basis.

Unless there is a man constantly on the job in Washington, and one who knows the ropes very thoroughly, such concerns declare there is very little chance of getting orders, or even of opportunity to see the work; and when these same concerns are approached by men located in Washington either as agents for other firms or as brokers, with offers of getting them contracts on a five per cent. basis, the proposition is not exactly relished.

All realize how thoroughly overwhelmed every department and division is, and it is not difficult to see how an overworked officer might welcome the opportunity to place orders by wholesale, finally to be distributed by the one party. This, however, is a dangerous business in many ways, and the sooner a system can be devised and put into operation whereby all manufacturers can get information and have orders issued direct, the better. Every reserve officer should sever his connection completely with all previous business interests, for the best of intentions are easily misunderstood when it comes to placing orders.

On the other hand I have recently met a man who secured a large order without influence of any kind. He simply stuck to the job until he convinced those in charge that he knew the work, that he was responsible in every way and that he meant business. This is one of the encouraging signs which will be welcomed by all.

Could We Use Russian Rifles?

There is an interesting development in the rifle field which is attracting attention and causing some comment. The New England Westinghouse Company of Chicopee Falls, have, as is generally known, been working on a Russian rifle contract for something over two years. They have, or had, at last reached the wonderful production rate of 5000 rifles per day, when the new Russian government decided that it had no use for more rifles and cancelled the contract. Immediately the Westinghouse people made up a number of rifles (rumor says about 50) to take the U. S. Springfield ammunition, and presented them to the Government for test. They not only rechambered the barrel but altered the magazine as much as necessary, and cut off the barrel to 24 in.—the same, or nearly the same as the Springfield. They evidently decided that the extra thousandth of an inch (the length of the Springfield according to the drawing is, or was, 24.001 in.) was not necessary, and the Westinghouse company presented them for test.

Just what happened is not public property, but there seems to be no reason to believe that the Westinghouse company would present rifles for Government test unless it was sure they would shoot and stand up under the heavy Springfield charge. At any rate the rifle board evidently decided that interchangeability

was still the only thing to be considered and refused the offer to make these rifles at the rate of 5000 per day, which would probably come pretty close to the number of Enfields which are now being made. Instead, they gave the Westinghouse company an order for Browning machine guns, which we all hope will astonish the world and win the war; but in view of the fact that huge orders for Brownings are already under way, distributed among a number of shops, that it means months of delay while the Westinghouse company is making jigs, fixtures, tools and gages for the Browning gun, the advisability of the contract is being seriously questioned in some quarters.

Five thousand rifles per day—which evidently could be turned out in a comparatively short time in addition to the large number of Enfields and Springfields which are now being made—would from the layman's point of view, be a very desirable thing to have at this time, when preparing for the new army which will soon be on its way to camp. While we can all see that it would be better if all rifles were alike, the main requirement would seem to be that they shoot the same cartridge. The Russian rifle is a bolt action, not unlike the Enfield and Springfield in operation, and would be easily learned so far as the handling is concerned. The necessity for interchanging parts on the firing line seems to have been somewhat exaggerated, and it would certainly seem better to have an ample supply of rifles than to be even a trifle scant of numbers for the sake of having them all alike.

As one prominent production man put it, he believed "Pershing would rather have a million rifles that would shoot, than all the interchangeability in the world." Rifles by the thousands and millions; machine guns in tremendous quantities, and artillery with all the ammunition needed, will make the Kaiser see that we really mean business.

Organizing the Small Shops

There is a great opportunity for some one to work out a thoroughly practical plan for coördinating the small shops of the country into such units as can be used for manufacturing parts of munitions or other needed supplies. There are hundreds of small shops throughout the country, each anxious to do all it can, and without direction or knowledge as to what is needed or what it can do.

There seems to be but one plan of solution, although the details must be worked out to suit different conditions. It is obviously not economical for a small shop to tool up completely to make entire articles such as fuses or shells. Too much of this has already been done in some of the artillery contracts. Several shops have been asked to make complete units, requiring a large variety of tool equipment and jigs and fixtures and gages when it would obviously have been more economical for each firm to specialize on some one part or unit, and assemble these units at a central point. This plan has its drawbacks, but they are far less serious than the drawbacks connected with the other method, if rational tolerances and sensible inspection are employed.

To have a district engineer go over the plants and their equipment; to decide upon the work they can do best and to organize them into a union for this work, seems to be the most feasible plan. This, however, can only be worked in connection with a central organization or clearing house for the War Department, located in Washington and having the power to parcel out contracts of this kind where it is feasible to do so.

Under the present arrangement this cannot be done; there is neither a sufficient organization, nor men to do the work, and one cannot blame the officer who tells the small shopman that he cannot bother with such small outputs; but a lot of small shops can aggregate a large total, and they must be utilized if we are to make the great showing that should be made.

Utilizing Present Equipment

Jewelry shops are practically idle in many places and typewriter shops are not over busy anywhere. They all have a lot of equipment which is available in some sort of munition work, or in parts of it. The typewriter shops for example, can readily make a number of rifle parts, either for the regular production or for spare parts, and many of them have engineers and production men who can be depended upon to see that the parts interchange as far as necessary. Men and women of the jewelry trades have certain kinds of skill which can be utilized, even if their equipment is not precisely in line with munition production. Utilizing skill, labor and equipment which already exist, instead of waiting to build new machines and to train new people, is in the same category as making two blades of grass grow where only one grew before.

Typewriter shops for example have a large amount of assembling space. This makes them the ideal place in which to assemble such work as comes within their scope, in addition to making as many parts as their equipment is suited to.

We must not forget that there are other things than shells and fuses. Sighting devices of all kinds, range finders, belt buckles, canteen equipment, water bottles, camp utensils, buttons and everything that goes into a soldier's or a sailor's kit, must be made by the millions. The new ships will require thousands of small parts that are not made in the shipyards, but that can be made in small shops throughout the country, when the industry is properly organized.

The suggested method would not only get production, but it would increase the personal interest and real loyalty to the cause. It is not easy to be intensely and enthusiastically loyal to anything unless you are a part and parcel of it. When a man knows that he is working on something that has to do directly with our winning the war, he cannot help but feel a keener interest, and nothing can tie the different sections of the country together closer, than to have all sections doing their bit on something tangible.

Men Wanted by the Ordnance Department

For service in the Ordnance Department of the Army the following positions are open to workers to serve in the United States:

Clerical Positions: 2000 stenographers and typewriters, men and women, $1100 to $1200 a year; 2000 typewriter operators, men and women, $1100 to $1200 a year; 2000 general clerks, men and women, $1100 a year; 500 index and catalog clerks, men and women,

$1100 to $1200 a year; 200 clerks qualified in business administration, $1200 to $1500 a year; 300 schedule clerks, men and women, $1400 to $1600 a year; 300 production clerks, not more than $1500 a year; 200 clerks qualified in statistics or accounting, $1100 to $1800 a year; 100 statisticians, $1800 a year; 100 multigraph operators, men and women, $1000 to $1200 a year.

Testing Positions: 200 engineers of tests of ordnance material, $1500 to $2400 a year; 200 assistant engineers of tests or material, $1000 to $1500 a year.

Mechanical Trades Positions: 2500 machinists, $4 a day; 500 machine operators, $2.75 a day; 200 drop forgers, $5.75 a day (piecework); 300 toolmakers, $4.50 a day; large numbers in practically all other trades.

Drafting Positions: 500 mechanical draftsmen, $800 to $1800 a year; 50 gage designers, $2000 to $3000 a year; 100 apprentice draftsmen, $480 a year.

Inspection Positions: 300 inspectors of small-arms ammunition, $1500 to $2400 a year; 100 inspectors of artillery ammunition (high-explosive shell loading), $1500 to $2400 a year; 100 inspectors of artillery ammunition (forgings), $1500 to $2400 a year; 100 inspectors of artillery ammunition (ballistics), $1500 to $2400 a year; 300 inspectors of field-artillery ammunition steel, $1500 to $2400 a year; 300 assistant inspectors of field-artillery ammunition steel, $3.50 to $5.00 a day; 500 inspectors of small arms $1500 to $2400 a year; 100 inspectors of material for small arms, $1000 to $1800 a year; 100 assistant inspectors of cannon forgings, $1500 to $2400 a year; 100 assistant inspectors of finished machine parts, $1500 to $2400 a year; 100 assistant inspectors of gunfire-control instruments, $1200 to $1500 a year; 50 assistant inspectors of steel helmets, $1000 to $1800 a year; 50 assistant inspectors of cleaning and preserving materials, $1000 to $1800 a year; 400 inspectors and assistant inspectors of powder and explosives, $1400 to $2400 a year.

Salaries named are the usual salaries at entrance. Higher or lower initial salaries may be paid in exceptional cases. Positions paying salaries higher than those named are usually filled through promotion. Men only are to apply unless it is otherwise specified.

For further information apply to the representative of the United States Civil Service Commission at the post office or custom house in any city, or to the Civil Service Commission in Washington, D. C. Except for the positions of stenographer and typewriter, typewriter operator, multigraph operator, and general clerk, applicants are not assembled for a written examination, but are rated principally upon their education, training, and experience, as shown by their applications and corroborative evidence. JOHN A. MCILHENNY,

President, U. S. Civil Service Commmission,

Washington, D. C.

Personals

E. S. Pardee has been appointed mechanical engineer of the Cleveland, Cincinnati, Chicago & St. Louis railroad with headquarters at Beech Grove, Ind.

William H. Fetner, formerly acting superintendent of motive power of the Central Railroad of Georgia, has been appointed superintendent of motive power.

W. D. Hitchcock has been appointed master mechanic of the Albuquerque division of the Atchison, Topeka & Santa Fe railroad with office at Winslow, Ariz.

L. W. Hendricks, formerly master mechanic of the New York, New Haven & Hartford railroad has been appointed superintendent of shops at Van Nest, N. Y.

W. W. Lemon has been appointed superintendent of the motive power and car departments of the Denver & Rio Grande railroad, with headquarters at Denver, Colo.

George M. Verity, president of the American Rolling Mill Co., Middletown, Ohio, has been appointed by Governor James M. Cox a member of the Ohio State War Work Council.

Guy E. Tripp, of the Westinghouse Electric and Manufacturing Co., recently appointed to the Ordnance Department of the U. S. Army, has been given a commission as colonel.

George W. Perks, formerly general manager of the American Seeding Machine Co., Springfield, Ohio, has succeeded **A. P. Lohmann** as chief engineer of the B. F. Goodrich Co., Akron, Ohio.

L. L. Allen, formerly general foreman of the St. Louis, Brownsville & Mexico railroad at Kingsville, Tex., has been appointed master mechanic of the Gulf Coast Lines, with office at De Quincy, La.

Nelson P. Hall has taken up the duties of district sales manager for the Chicago territory of the Van Dorn & Dutton Co., Cleveland, Ohio. Mr. Hall will occupy offices at 14 East Jackson Boulevard, Chicago.

Charles A. Swan, formerly superintendent of the Becker Steel Co. of America, has joined the sales organization of the Hess Steel Corporation, of Baltimore, Md. Mr. Swan will look after the company's business in the Cleveland and Detroit territory.

The Charles A. Strelinger Co., Detroit, Mich., is now looking after the sales of the Gisholt Machine Company's machines in the Detroit and Michigan districts. The sales in this district were formerly taken care of by Charles Spalding, who resigned Jan. 1, 1918.

James Hartness, president of the Jones & Lamson Machine Co., Springfield, Vt., and past-president of the American Society of Mechanical Engineers, has been appointed a representative of that society to a joint conference in London, England, on the matter of standardization of aircraft production.

Obituary

Lieut. Gordon D. Cooke, formerly of the Field Service department of the McGraw-Hill Co., Inc., died at the base hospital, Fort Bliss, Jan. 10, 1918. The cause of death was pneumonia. As preliminary training for his work in the Field Service department of the McGraw-Hill Co., he served on the editorial staff of the "Engineering News-Record" for a short period, and later took up quarters in his home city, Detroit, Mich. Lieutenant Cooke entered the service on Sept. 1, 1917, at the age of 24, with a commission of second lieutenant in the Engineer Corps.

Christopher W. Levalley, founder and a member of the board of directors of the Chain Belt Co., Milwaukee, Wis., died suddenly of heart failure at his home in Milwaukee, Jan. 4, 1918, at the age of 83 years. Mr. Levalley was born in Manchester, Conn. At the outbreak of the Civil War he enlisted in the army, and after the war he became superintendent of the St. Paul Harvester Co., later becoming general manager. It was at this time that he saw the necessity of a positive drive for harvesting machinery, and in 1891 he went to Milwaukee where he established the Chain Belt Co. Mr. Levalley was a donor of a great many gifts to charitable institutions.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

The sixth annual meeting of the Chamber of Commerce of the United States of America will be held in Chicago, Apr. 10, 11 and 12, 1918. Elliot H. Goodwin, Riggs Building, Washington, D. C., is general secretary.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Jan. 25, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$23.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia................	33.75	33.75	30.00
*No. 2, Valley......................	33.95	33.00	31.00
No. 2, Southern Cincinnati...........	35.90	35.00	25.90
Basic, Eastern Pennsylvania..........	33.95	30.00	30.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Jan. 25, 1918	One Month Ago	One Year Ago	Jan. 25, 1918	One Year Ago	Jan. 25, 1918	One Year Ago
Structural shapes ...	$4.20	$4.20	$3.75	$4-4.04	$3.85	$4.20	$3.75
Soft steel bars......	4.10	4.10	3.75	4-4.04	3.85	4.10	3.85
Soft steel bar shapes.	4.10	4.10	3.75	4.14	3.85	4.10	3.75
Plats, ¼ to 1 in. thick	4.45	4.45	4.75	4.39	4.50	4.45	4.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

Pittsburgh, mill	$3.50	$3.25
Warehouse, New York..................	4.70	3.75
Warehouse, Cleveland	3.98½	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Jan. 25, 1918	One Month Ago	One Year Ago	Jan. 25, 1918	One Year Ago	Jan. 25, 1918	One Year Ago
*No. 28 black......	5.00	6.45	6.45	5.50	6.45	5.50	6.45	5.00
*No. 26 black......	4.90	6.35	6.35	5.40	6.35	5.40	6.35	4.90
*Nos. 22 and 24 black	4.85	6.30	6.30	5.35	6.30	5.35	6.30	4.85
Nos. 18 and 26 black	4.80	6.25	6.25	5.30	6.25	5.30	6.25	4.80
No. 16 blue annealed.	4.45	5.65	5.65	4.85	5.65	4.95	5.65	4.70
No. 14 blue annealed.	4.35	5.55	5.55	4.75	5.55	4.85	5.55	4.60
No. 10 blue annealed.	4.25	5.45	5.45	4.65	5.45	4.75	5.45	4.50
*No. 28 galvanized..	6.25	7.70	7.70	7.50	7.70	7.00	7.70	7.25
*No. 26 galvannzed..	5.95	7.40	7.40	7.20	7.40	6.70	7.40	6.95
No. 24 galvanized...	5.80	7.25	7.25	7.05	7.25	6.55	7.25	6.80

*For painted corrugated sheets add 25c. per 100 lb.; for galvanized corrugated add 5c.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Jan. 25, 1918	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Jan. 25, 1918	One Year Ago
New York	$15.00	$8.00
Cleveland	15.30	7.50
Chicago	15.00	6.00

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

$\frac{3}{8}$, $\frac{11}{32}$, $\frac{5}{16}$, ¼, $\frac{7}{32}$, $\frac{3}{16}$ No. 8, $\frac{3}{32}$ and No. 10 ⅛ .... No. 12 .... $\frac{3}{32}$, No. 14 and $\frac{1}{16}$.. No. 18 .... No. 20	21.00 @ 30.00

*Very scarce.

Cast-Iron Welding Rods

$\frac{3}{16}$ by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

***Special Welding Wire**

⅛	33.00
$\frac{5}{32}$	30.00
$\frac{3}{16}$	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Jan. 25, 1918	Cleveland Jan. 25, 1918	Chicago Jan. 25, 1918
Tire	4.10	5.00	4.10
Toe calk	5.70	5.50	4.35
Openhearth spring steel...	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	14.00	11.25	12.00
Coppered bessemer rods....	9.00	....	7.00
Hoop steel	4.95	....	4.95
Cold-rolled strip steel.....	9.00	....	8.50
Floor plates	6.19½	....	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4......	29%	17%
4½ to 6......	44%	32½%	4½ to [illegible]......	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Jan. 25, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	30.00
Tin, in 5-ton lots...................	85.00	86.00	42.88
Lead	7.00	6.50	7.50
Spelter	8.00	7.75	7.50

*Government price.

ST. LOUIS

Lead	6.85	6.37½	7.33
Spelter	7.87½	7.50	9.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Jan. 25, 1918	One Month Ago	One Year Ago	Jan. 25, 1918	One Year Ago	Jan. 25, 1918	One Year Ago
Copper sheets, base.	31.00–33.50	35–37	41.00	32.50	44.00	32–33	42.00
Copper wire (carload lots)	32.00	36.00	36.00	28.50	44.00	31.50	36.50
Brass pipe base...	36.50	38.50	47.50	36.50	52.00	38.00	46.50
Brass sheets	30.75	35.75	45.50	29.00	47.	30.50-31	44.00
Solder ½ and ½ (case lots)	48.00	40.50	27.50	47.00	28.25	44–45	28.25

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Jan. 25, 1918	One Year Ago
Mill	$25.00	$42.00
New York	30.00	45.50
Cleveland	34.00	42.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.. 19.00

	In Casks		Broken Lots	
	Jan. 25, 1918	One Year Ago	Jan. 25, 1918	One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.00	22.50	22.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Jan. 25, 1918	One Year Ago
New York	14.25	15.00
Cleveland	17.00	16.75
Chicago	16.00	15.75

Women in Airplane Production

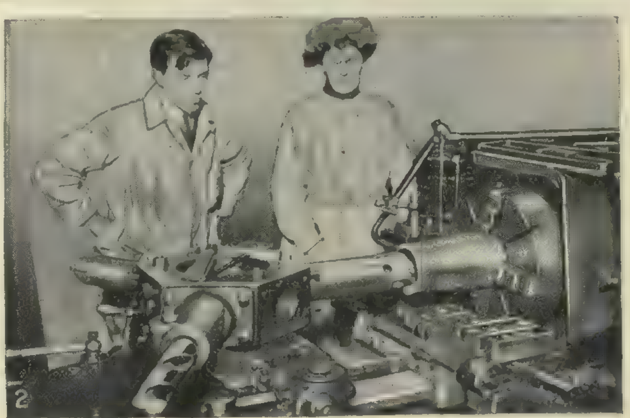
By I. William Chubb

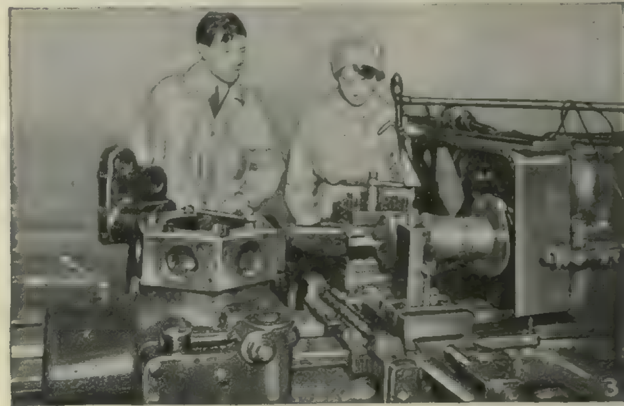
Women are successfully filling the positions of skilled mechanics in the majority of machine operations connected with airplane engine manufacture in Great Britain.

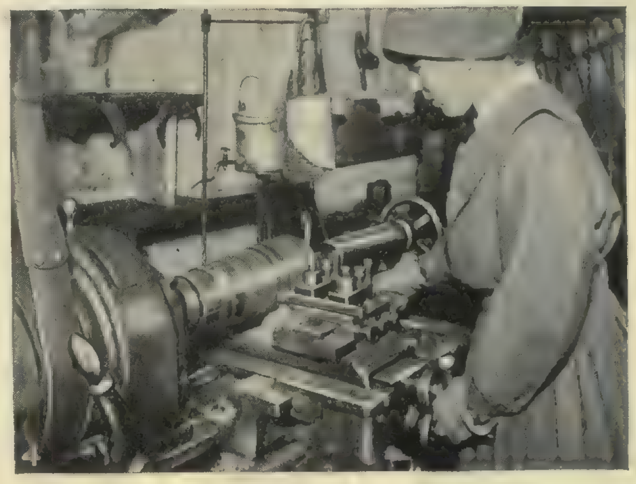
THIS article on the employment in Great Britain of women in miscellaneous work called for in the production of airplanes appeared on page 705, Vol. 47. The present article is concerned mainly with some of the operations undertaken by women in England in the manufacture of engines for aircraft. In this direction, as this article will perhaps suggest, a large amount of extremely good work has been done, and the exhibitions organized and held throughtout the country by the labor supply department of the British Ministry of Munitions, have always had as an attractive feature, examples of engines and engine parts resulting from women's labor. Women have been employed on the Clerget, R. A. F. (Royal Aircraft Factory), Hispaño Suiza, Beardmore, Gnome and Le Rhone engines, to say nothing of the internal combustion engines used for tanks, motor cars, tractors, motor busses, motor lorries, and, in short, all motor vehicles.

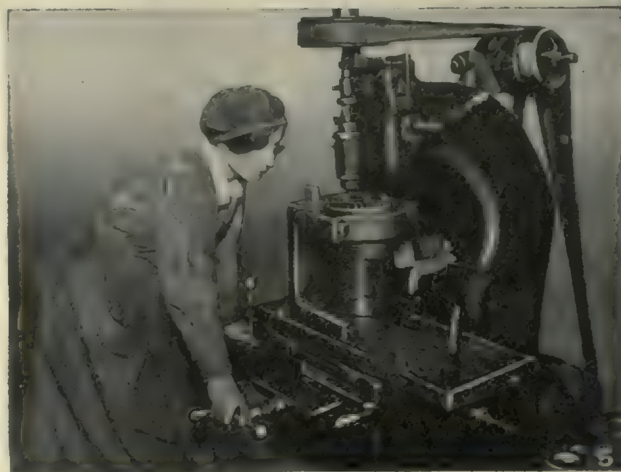
WOMEN IN AERO ENGINE PRODUCTION. PUBLISHED BY PERMISSION OF THE BRITISH MINISTRY OF MUNITIONS

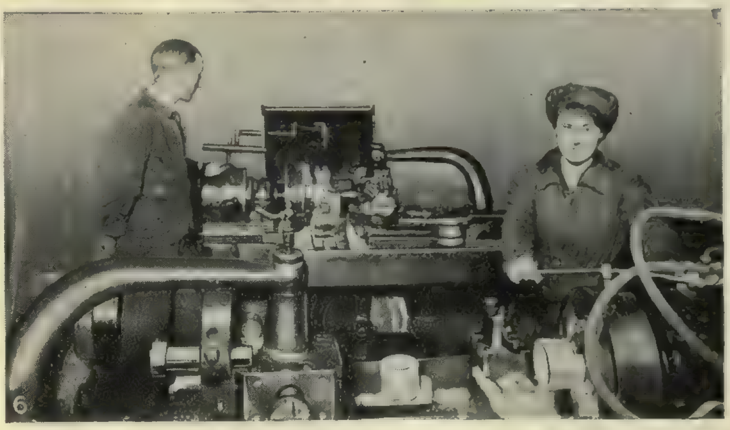
All the illustrations here given are from photographs due to the courtesy of the department named, and relate to the work of women in several factories throughout Great Britain. The larger part however, is concerned with the production of the Clerget engine for which Gwynnes, Ltd., have more than one works. This engine is of the multicylinder, rotary type, and with only the slightest reservation, it is machine-produced throughout. The firm named is among the most successful exponents of female labor. In certain factories there are about 1800 employees, of whom 700 are women. They are of all classes, literally; from the daughters of duchesses to the farthest opposite swing of the class pendulum; and if a general rule can be applied it is that the women at the extreme ends of the social scale are most successful in this work; for the middle class seems rather uncertain as to its social status and fails to "mix"

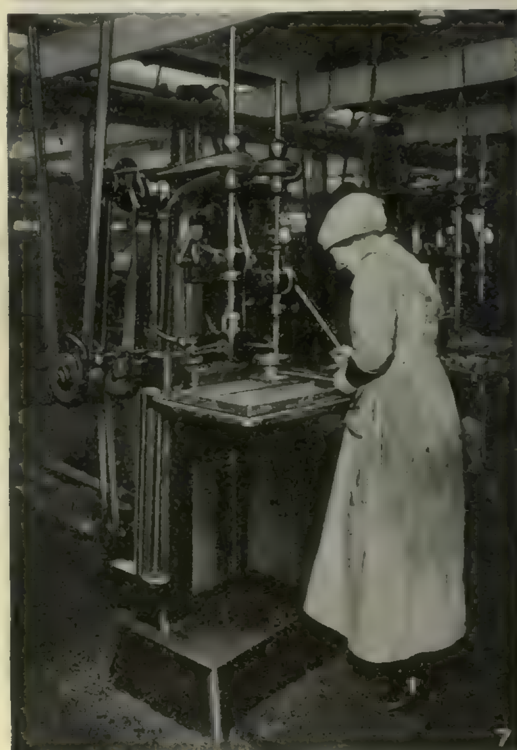


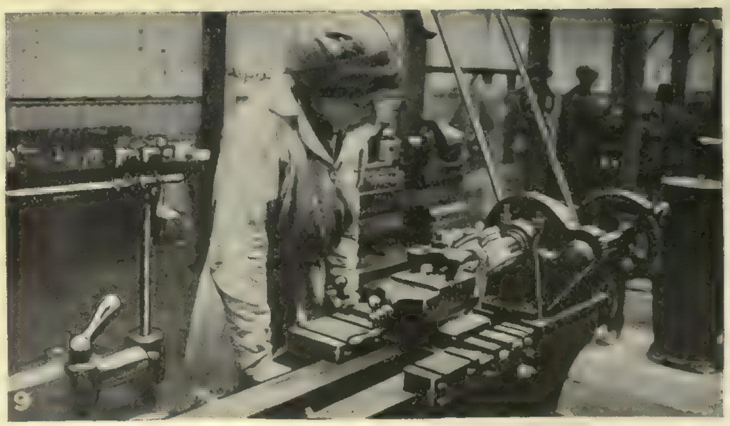












WOMEN IN AERO ENGINE PRODUCTION. PUBLISHED BY PERMISSION OF THE BRITISH MINISTRY OF MUNITIONS

well with the others or to take the same serious interest in the tasks they are assigned. In several respects the firm's practice in dealing with women is slightly different from that usually observed. The women enter and leave at the same time as the men, a one-break day being worked, with a quarter of an hour rest in each shift, giving an opportunity in the afternoon for the tea interval which has generally been found so valuable in connection with the employment of women in England.

As to pay, the piece rates for men and women are alike, and put generally, the women are not segregated, but take their places in the shops beside the men, and are permitted to undertake any operation for which they are found capable. As timekeepers they are at least equal to the males. Rest rooms are of course provided, and, somewhat unusually, the men and women use the same eating rooms.

The works are run strictly according to a planning system, and progress girls are employed in the shops. At one works the stores are kept successfully and completely by women; they even become head storekeepers. Convenient bins or rather sets of wooden drawers devised by C. V. Armitage, the works manager, prove valuable aids. The drawers slope downward, and show the contents of each at a glance.

THE PLATING DONE BY WOMEN

In erecting, stripping down and reërecting the engines, a woman is in each gang; the proportion in the erecting shop being one woman to two men. In the carburizing section the plating is done by women, but here a man is in charge. Similarly in the heat-treatment department: while a man is in charge, women are employed on the smaller pieces for such work as reheating, plunging, etc. Women, too, are engaged for inspection purposes.

For machining and other operations the women are actually trained in the shops, standing by and watching the operation of machines, etc. This is preferred to the instruction of women in schools, even when the school is in the works; as the women thus quickly become accustomed to the general shop atmosphere and conditions; and in particular they are found to appreciate more readily the value and need for care in the use of precision tools, gages, etc., an advantage which the semiskilled laborer often lacks. As is fairly common, the women are found quick in learning one particular operation, perhaps more so than men; but they do not change readily from one operation to another. In short, it is not usually found commercially expedient to attempt to shift them.

Setting-up is commonly done by men, with few exceptions. The factory is run almost throughout with single-operation machines, even the ordinary lathe being so used. The product of the automatic has not been found sufficiently accurate to pass the official inspection. It is perhaps of special interest to note that the metric system is used throughout the works; it might indeed be difficult to find an ordinary footrule there. The limit of accuracy is 0.01 mm.

The method of machining the Clerget engine varies to some extent with the shop, and while as mentioned, Gwynnes, Ltd., have more than one works thus engaged, theirs is not the only firm producing the engine. For the cylinder, all systems however may be said fairly to be based on the following schedule: the cylinder is approximately of shell form, of 40 to 45 tons tensile steel. The rough forging weighs 80 lb. to 84 lb., the bore is about 120 mm. and the finished piece weighs 3980 g., or 8.8. lb.

OPERATIONS

1, 2 and 3 (often combined in one). Face, bore and rough-turn; time, 3 hours.

4. Bore, turn at end, face to depth and face collar; limit, plus or minus 0.1 mm.; capstan lathe; time, $1\frac{1}{2}$ hours.

5. Turn taper and turn shoulder at back end; limit, 0.1 mm.; capstan lathe; time, 1 hour.

6. Bore and thread inlet and exhaust holes; capstan lathe; time, $1\frac{1}{2}$ hours.

7. Bore, face and thread for sparking plugs; time, 1 hour.

8. Rough-turn webs, except on sparking-plug zone; limit, plus or minus 0.2 mm.; four cylinder tools held in a single toolholder are employed in center lathe; time, 45 minutes.

9. Rough-mill webs on sparking-plug zone; time, 30 minutes.

10. Finish-mill webs to diameter; limit, 0.05 mm.; time, 30 minutes.

11. Mill slot between sparking-plug holes; time, 15 minutes.

12. Mill end of grooves in sparking-plug zones to complete operation 9; time, 30 minutes.

13. Drill and tap stud holes of cylinder top, and drill for milling slots on top; radial drill; time, 45 minutes.

14. Rough-mill top webs; time, $1\frac{1}{2}$ hours.

15. Taper-mill top webs; time, 30 minutes.

16. Mill 5 mm. slots in top; time, 20 minutes.

17. Mill radius, round inlet, valve hole; time, 20 minutes.

18. Mill radius, round exhaust, valve hole; time, 30 minutes.

19. Turn radius at bottom of webs; limit, plus or minus 0.5 mm.; time, $1\frac{1}{2}$ hours.

20. Finish-turn taper of webs; time, $1\frac{1}{2}$ hours.

21. Bore cylinder ready for grinding; time, 30 minutes.

22. Grind, rough and finish bore; limit, plus 0.025 mm.; time, $1\frac{1}{2}$ hours.

23. File up and remove burrs.

24. Finish-turn to weight and to center of gravity; limits, weight, plus or minus 5 g.; dimension, plus or minus 0.02 mm., time, $2\frac{1}{2}$ hours.

25. Mill clearance for connecting-rods; time, 15 minutes.

26. Mill for stop pin; time, 10 minutes.

27. Drill oil holes and holes for valve spring; sensitive drill; time, 10 minutes.

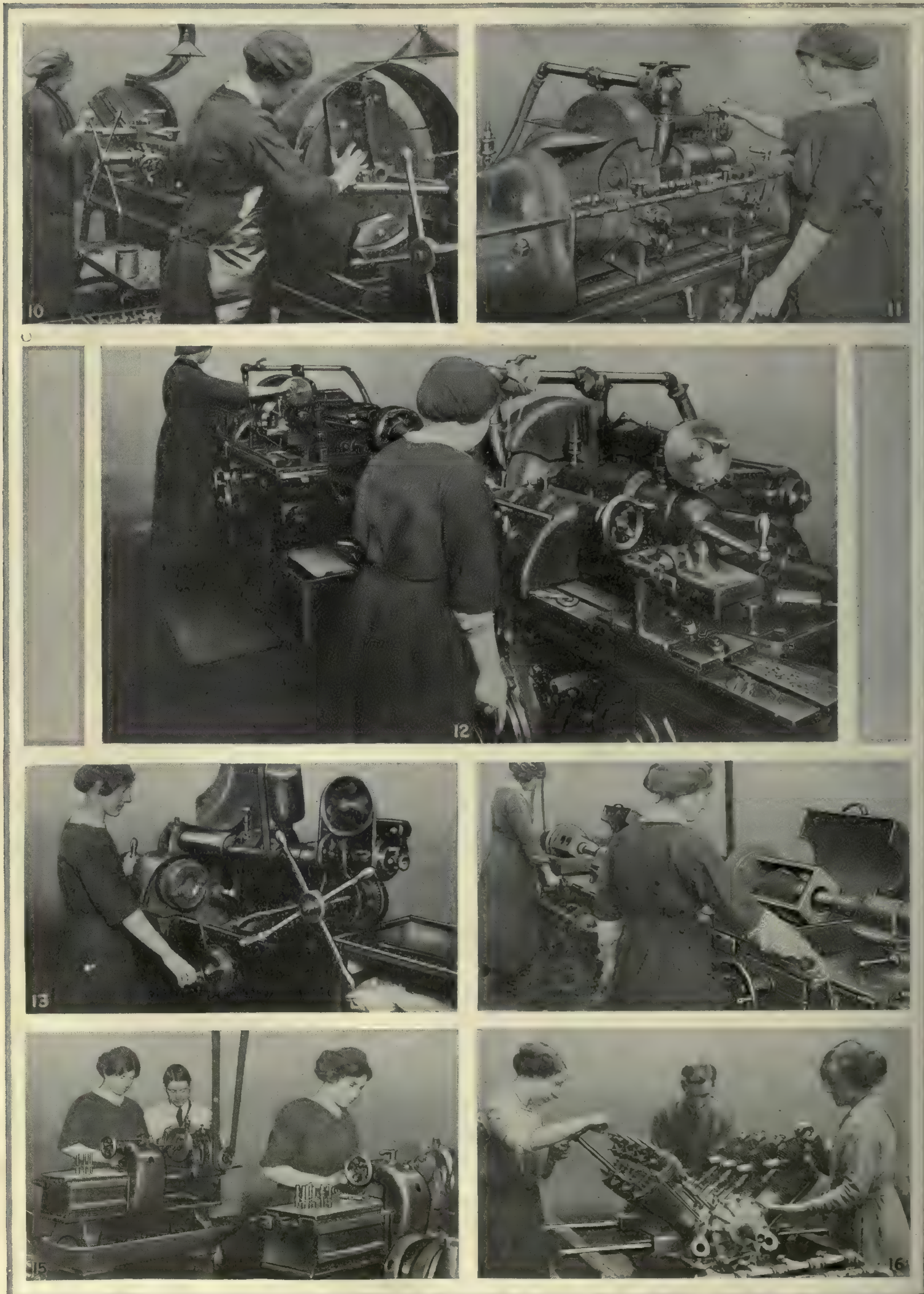
28. Lap bore by hand; time, 30 minutes.

Some of these operations are done by men as a rule, and this has applied to operation 24: finish-turn to weight, etc.; but at any rate in one of the works, as this article will show, a woman is now successfully undertaking the operation. According to what may be regarded as standard practice, operations 4, 5, 6, 7, 9, 10, 14, 15, 16, 17, 18, 19, 20, 22 (with skilled men;) 27 and 28 are regularly undertaken by women; and in fact, only on operations 13, 21, 24 (sometimes by women) 25 and 26, were skilled men required. The total machining time is 22 hours 45 min.

WOMEN OPERATING BORING MILLS

Fig. 1 illustrates women operating Webster & Bennett duplex boring mills, rough-turning the cylinders. An interesting point here is that women are found much more ready than men to work a duplex machine to its full capacity, the prime object of the women being to earn as much money as possible. This type of machine is found specially suitable for women; for the lift to the table is fairly direct, with very little overhang of the weight. For this machining process extreme accuracy is not required; the product may vary $\frac{1}{16}$ in. in diam. provided it is on the plus dimension.

Fig. 2 shows the operation of a No. 9 Herbert combination lathe, finish-boring cylinder and facing accurately to length. This is finished internally to a locating diameter and the cylinder is also finished at the bottom. Fig. 3 shows the roughing of the radiation ribs on the cylinder, a comb tool being employed. Fig. 4 shows a Dean, Smith & Grace lathe, woman-operated, for finishing the cylinders. This was formerly the work of a specially skilled man. The cylinder has to be brought both to weight and to balance, with the center of gravity in a given position. The work is particularly well done; the operator here was trained in the works and can really be termed skilled. Another skilled



WOMEN IN AËRO ENGINE PRODUCTION. PUBLISHED BY PERMISSION OF THE BRITISH MINISTRY OF MUNITIONS

piece of work is shown in Fig. 5. Here the top of the cylinder is being milled in a No. 2 Becker machine, the woman setting-up her own tools and working to limits of 0.05 mm.

Turning from the cylinder, readers will recognize in Fig. 6 the Potter & Johnston machine engaged on the production of pistons of an aluminum-copper alloy, the whole of the turning and grooving here being done. The operator runs two machines. In Fig. 7 a Herbert 2-spindle sensitive drill is shown, the work consisting in jig-drilling holes for exhaust-valve seats. Two sizes of drill are used and such setting-up as is necessary is undertaken by the woman herself. Incidentally the view shows the method by which the cutting lubricant is conveyed to the small tank below by means of a vertical channel.

Women engaged in filing-up induction pipes and on fitting work necessary on pistons and cylinders, are shown in Fig. 8. Generally, however, the fitting work done by women is not of a specially skilled order, but an exception is to be found in the air pump. The aluminum casing, as shown in Fig. 9, is being turned in an ordinary lathe, the work being jigged and set to locating plates for every operation. A separate and complete department is allocated for this detail, and here all the machining and all the fitting is entirely the work of women, who show special skill.

The remaining illustrations are intended to supplement the foregoing so as to give a fairly good idea of the complete range of machining work undertaken by women in airplane engine manufacture. They do not apply to the Clerget engine, but refer in fact, to the work of several firms. Fig. 10 for example, illustrates women engaged on Bardons & Oliver turret lathes, boring and reaming the gudgeon-pin holes and recessing the crankshaft end of engine connecting rods. In Fig. 11 a woman is seen operating a Landis grinding machine on airplane engine camshafts, the limit being 0.02 mm.; while Fig. 12 shows another Landis grinding machine being used for the production of exhaust valves, the stamping being roughed down and finished to limits of 0.01 mm. on the stem and radius. As another example of grinding, Fig. 13 shows a Bryant chucking grinding machine operating on ball-bearing sleeves to limits it is said, of 0.0005 in., and in Fig. 14 the woman is undertaking the internal grinding of a cast-iron cylinder to limits of 0.001 in. In Fig. 15 women are employed on center lathes where they are turning valve guides for engines and working to 0.002 in. on four diameters. Finally Fig. 16 illustrates a gang of two women and one man "stripping" airplane engines for inspection after they have gone through their 3-hour endurance test.

WOMEN IN AERO ENGINE PRODUCTION. PUBLISHED BY PERMISSION OF THE BRITISH MINISTRY OF MUNITIONS

New Chief of Production Division

Guy E. Tripp, of New York, heretofore chairman of the Westinghouse Electric and Manufacturing Co., has been appointed by the War Department as chief of the Production Division of the Ordnance Department, intrusted with the task of supervising and stimulating the production of all ordnance supplies.

Mr. Tripp was selected because of his experience in the manufacture of munitions of all kinds, the Westinghouse company having obtained large contracts from the British and Russian governments immediately on the outbreak of the European war. Mr. Tripp is credited with bringing to the department the highest obtainable type of experience and ability to insure speedy and careful production of munitions. The board of directors of the Westinghouse company has given him a leave of absence for the duration of the war.

A Correspondence Course for Employers

BY HARRY'S UNCLE

IN ANTE bellum days, seeing the crowds of applicants for work lined up every morning, I have often wondered by what system the sheep were separated from the goats, and the most promising candidates selected for the coveted jobs. Though I can make but a very small contribution to the sum of human knowledge on this recondite topic, I have accumulated a little information concerning the methods adopted by a few shops.

One large manufacturing establishment has appointed as monarch of the "hiring-on" window, a gentleman who had the misfortune to lose a leg in the company's

employ, while loading machinery upon a freight car. Not, of course, in consequence of the withdrawal of his suit for damages, but in mere casual synchronism therewith, he was given his present life job, which he certainly performs to the queen's taste. In consideration of certain glasses of beer, paid for by a friend of mine, he revealed his methods as follows: "On Mondays I turns down all the men with white collars, on Tuesdays all with blue eyes, Wednesdays all with dark eyes, and so on," to which lucid exposure of the secret of his position he added in a burst of candor, "red-headed men I never hires, and there do be days when I has a grouch and just hires every tenth man." The superintendent of this shop has often complained that there are no longer any good men obtainable, and bemoaned the sad necessity of firing within a month 65 per cent. of the men hired. I'm unable to conjecture why he should have any such trouble, but there must be some reason.

Far preferable, and far more successful, is the system of a near-by shop, employing some two hundred machinists. Here the seekers for work are lined up on anxious seats and inspected by a female "stenypewriter" who unhesitatingly relegates some to the discard, causing the others to be conducted to a Higher-up for his examination. This worthy damsel bases her choice on the good looks, or lack thereof, of the seeker; consequently this shop is noted throughout the length and breadth of the city it adorns for the personal pulchritude of its machinists, whose goings-out and comings-in are watched with profound interest by the girls of a department store across the street. Proud as I might be were the facts otherwise, I humbly confess that I have never been employed in this shop.

In another shop the superintendent, himself a machinist, deems it no derogation from his dignity to make in person the selection of his employees. He gets good men and plenty of them, and the fact that one has worked for him is accepted by all the neighboring employers as prima facie evidence of skill and capacity.

But all of these varying methods, whatever their respective merits or defects, are soon to be abandoned in favor of one that has lately burst in full effulgence on a delighted world.

You don't know what I mean? Why, son, don't you ever see the magazines? Haven't you read of scientific psychology? Its coming may not be "that far-off event toward which the whole creation moves," but it's a long step in that direction.

Soon the crude methods of a bygone age will be cast into oblivion, as "waking science breaks her rusted chain." No longer will the man-out-of-a-job approach with anxious mien the autocrat of the employment bureau. With body erect, as a man should walk, he will be ushered into the presence of the psychologist, courteously invited to a chair, and given a set of blanks to fill out, while assistants of the presiding genius record his facial angle, cranial index, dental equipment and other data important in their bearing on his ability to run a lathe or to rule and govern the movements of a height-gage. The very paper of the forms to which his eyes are directed will tend to remove his thoughts from the grimy surroundings of his daily labor, and rejoice his æsthetic soul by their beauty. Far be it from me to give a false idea that my erudition familiarizes me with écru, mauve and ashes-of-roses. These mystic words convey no meaning to my darkened understanding; but such, a female fount of wisdom assures me, are the rightful designations of the beauteous hues of a set of blanks presented for her verdict. I don't know what they are, but take it from her, they are all in the "deck."

Now I sincerely hope that no light-minded reader will spring the old tale, absolutely without pertinence to

our subject, of the boy to whom the phrenologist revealed his fitness for exalted station, basing his diagnosis on the unusual development of a certain "bump," only to hear his unappreciative client yell "Leave be of that. That's where Johnny beaned me with a ball."

What we are talking about is science. An acquaintance of mine, who at thirty-odd, has attained a responsible executive position in a large business, had his prepossessions in favor of this newest development strengthened, when an expert, on the evidence of his careful examination pronounced him "of great, really phenomenal executive ability." However, just to "make assurance doubly sure," he had himself examined by a second expert, and this time sinfully suppressed the answers to questions (on the mauve blank, I think)

which would have revealed his various places of former employment and his rapid promotion. This time, alas! he was placed among the inglorious goats, as one who "may do for a subordinate position, but is utterly devoid of initiative." We may smile, but need we be surprised that science must creep before it can walk? Even our dear friend, Scientific Management, had its salad days; when the alleged expert, knowing a lathe from a drop hammer only by their pictures in his book, ordered every one of a long line of lathes provided with new feedworks—as the feed which the book prescribed for a certain cut, 0.0625 in., could not be obtained, the nearest approximation provided by the benighted designer of the machine being $\frac{1}{16}$ in., and the lathe hand admitted it.

Let us not be too critical, but rather fix our thoughts on the joyous fact that a serious attempt is to be made to abolish the present luck-and-chance, systemless system of hiring men; and instead of criticizing, let us consider the benefits derivable from the change. Not only will the employer be freed from the incubus of incompetence in his men, and the men be sure of finding employment in the capacities to which they are best fitted, but think of the load of foreboding to be removed from the anxious soul of little Johnny's fond papa, who knows from the lad's liking for his toy train, that kindly Mother Nature has bestowed on him talents that will make him a successful railroad manager, if he has a chance; yet papa sadly reflects that his boy's abilities may remain undiscovered and he be doomed to spend his days not in swaying the sceptre of authority over toiling thousands, but in the more prosaic and less remunerative swaying of the pick over the reluctant soil.

Even if his life work brought no other reward, imagine the joy of the psychologist as he reflects that he has made the heart of little Johnny's dad leap with gladness, even as leapeth the wild roe of Mt. Ararat when, peradventure, a burr lodgeth beneath his tail. Will the gladsome day dawn when this system is extended to cover "firing" as well as hiring—when a man need have no fear of losing his job till he is summoned to the inquisitorial chamber to fill out blanks printed in sombre black with wide margins of the same funereal hue? We all know something of the reasons which now condemn us to "get the gate"—such as voting the wrong ticket, being of a race or religion deemed undesirable by the powers that be, belonging or not belonging to a union, omitting the "Mr." in addressing some functionary, etc. Will questions on these fateful points be included in the dread list whose truthful filling out dooms us to exclusion from the shop where we have been privileged to earn our weekly stipend?

All this is hidden from our eyes on the laps of the gods, but on one blank, whose delicate tint I'm told conveys no slighest hint of its possible fell purpose, I read this: "State fully your membership in or affiliation with any secret orders or associations," and thereby hangs a tale.

The "big boss" of a certain corporation which boasts that it "gets good men and keeps them, no employee ever being discharged, save for adequate cause and after patient investigation," chanced to notice that from one department employing about one hundred men, eighty had been discharged within three months; all, according to the records, for "gross incompetence."

He asked an old friend whom he knew to be a good workman, to seek employment in this department and endeavor to discover why this thusness. During his first noon hour the new man was advised by a neighbor who had recognized him as a member of a "secret order or association" to which the superintendent and every foreman in the works belonged, not to let anyone outside the fraternity know of his membership, as eighty men were believed to have been discharged solely for belonging thereto. Investigation showed that several of the "incompetent" did belong to it, and the superintendent, though incredulous, asked his friend to wear an emblem on his watch chain the next day. He did so, and was promptly discharged for the same incompetence that had caused his brethren to be cast into outer darkness. It transpired that the sub-foreman was not a member of the association, having unfortunately been black-balled.

Concrete Mix vs. Wooden Blocks for Foundry Floors

By J. V. Hunter

The inquiry which a writer made on page 536, Vol. 47, regarding floors to withstand heavy trucking for the gangways of his foundries, shows a prejudice against the use of wood blocks for this purpose, which

FIG. 1. SECTION OF GANGWAY FLOORING

I believe to be wholly unfounded upon experience in so far as the question of their inflammability for this service is concerned. We are not so fortunate as to have this type of flooring in our present shops and foundries, but I have put them in other shops, where I have been connected with the construction of the plant, and consider that where the cost is warranted the wood-block floor will stand the heaviest traffic in better shape, will provide a smoother running for truck wheels, and lastly, will prove less tiring on the workmen's feet.

There is always a great deal of dampness connected with a foundry, principally from the immense quanti-

ties of water used in wetting the sand, and creosoted blocks will seldom rot under these conditions. Referring to the inflammability of the wood-block floor, I have seen whole foundry floors made of this material; and when any quantity of molten iron is spilled upon them it may flash or blaze around the edge for a moment and possibly char to $\frac{1}{16}$ in. or more directly under the spill, which is probably all that will occur. If a molder is careless enough to spill iron on such a floor, there is no reason why he should not be trained to cover it with

FIG. 2. CROSS-SECTION OF GANGWAY FLOOR

sand or remove it; no molder with the proper training would ever think of permitting a spill, or run-out to remain on his wooden flasks or bottom-boards, a moment longer than necessary before removing it.

Experience shows that spilled iron spatters less from a wood-block floor than from any other, excepting a sand floor, which proves it to be less dangerous. In Chicago at the present time there are a number of foundries that have been built upon the top floor of high buildings, always the top floor for a variety of reasons. I visited a number of these foundries and found floors of wood blocks, which proves their practicability for this purpose.

Our present gangways are composed of cast-iron plates with diamond-checkered tops to reduce the liability of slipping, and this type is probably the most common in use in this country. A $\frac{1}{2}$-in. thick, cast-iron plate for this purpose will weigh in the neighborhood of 20 lb. per sq.ft. Even with the present high prices of iron, these plates can be produced for a cost of little over two cents per lb., since large quantities of scrap may be used in the mixture. In Fig. 1 is an illustration of a piece of this type of gangway, built of one standard size of plate, which has been set into a thin concrete foundation, to support it and aid in preventing a tendency to become uneven.

A cross-section of this plate is shown in Fig. 2 which shows the deep narrow ribs around the edges, and sometimes across the middle to strengthen the casting, and add to its stiffness. These plates present a smooth hard surface to the truck wheels, decreasing the labor for propulsion, so that a man can easily handle a much greater load than he could on almost any other type of floor. Another advantage of this type of flooring is the fact that should a plate be broken by any accident, the foundry can cast a new one the next day, and the repair is rapidly accomplished.

A floor-plate cupola mixture to be really cheap, may be composed about as follows: 10 per cent. of $3\frac{1}{2}$ to 4 per cent. low-grade, high-phosphorus pig iron, 65 per cent. stove plate, or cheap high-phosphorus scrap, and 25 per cent. of mild steel scrap. The high-phosphorus pig and scrap is used to insure greater fluidity of the metal for running this thin section.

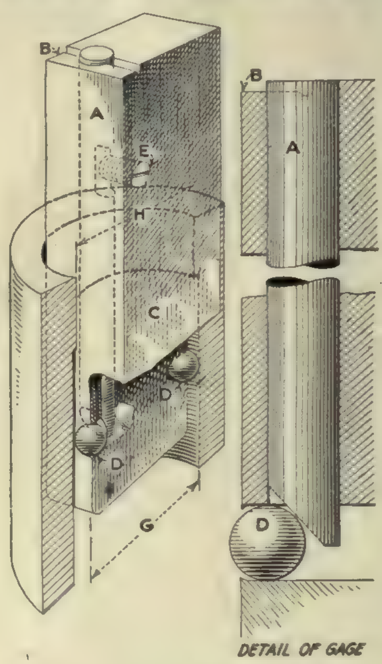
The observation of the inquirer regarding his yard that has been coated over with a layer of cast-iron chips, is similar to our present yard for the storage of car wheels. These were put on because they would not grow muddy; unlike a cinder yard they would not carry in a grit that would be hard on the machine tools. This material feels hard under foot, but I have noticed that rolling the wheels upon it quickly cuts deep ridges, and should judge that a walk made of this material would quickly become impassable when subjected to heavy trucking. Concrete made up with a large percentage of cast-iron chips will soon become worthless, due principally to the rapid rusting of the chips showing on the surface. As these chips with the relatively large surface will oxidize very rapidly, they will speed up and literally push the concrete into a state of disintegration.

If concrete must be used for such a walk, then build it up the full thickness of six or seven inches of the same consistency as concrete without a top dressing, which ordinarily soon chips and peels off from the base; for strength this concrete must be of a strong rich mixture. Another feature of this concrete that merits consideration is the nature of the crushed rock of which it is composed; this to avoid rapid cutting away by heavy truck wheels should be of a hard nature, and crushed granite or trap-rock is preferable for that reason. Limestone and crushed rocks of that nature will not have near the life for the service desired.

Feeler Gage for Recesses

By Henry Dayton

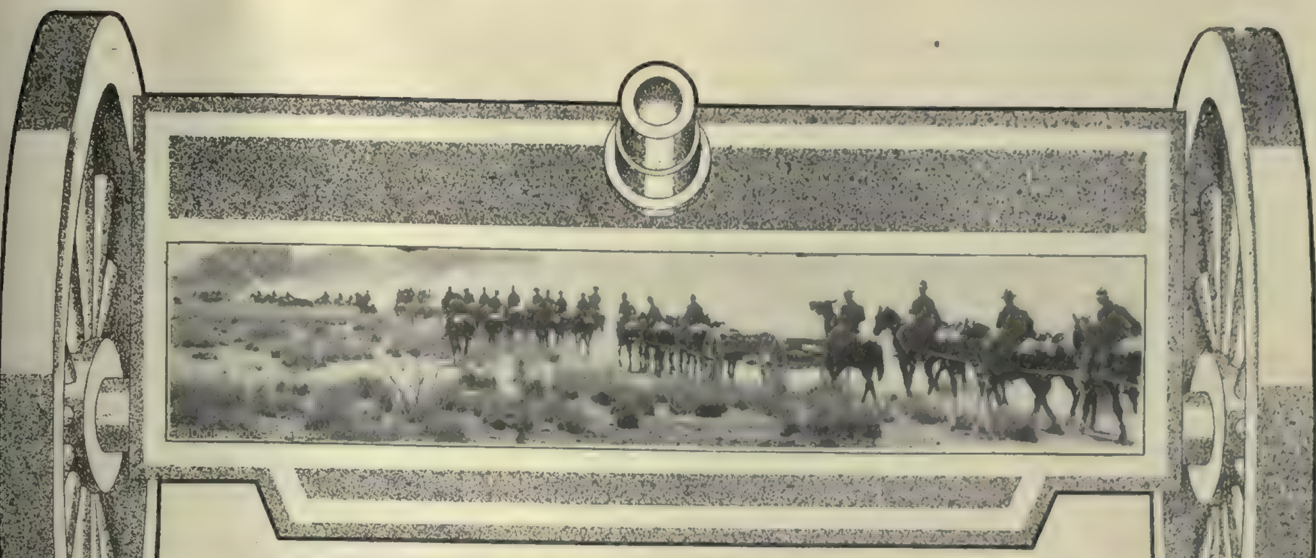
The illustration shows a gage for measuring the diameters of recesses. The recesses in the case on which the gage was employed had a limit of 0.010 in. The illustration shows the gage at the low limit. When at the high limit the end of the pin *A* is flush with the face *B*. The angle at the other end of the pin *A* is 45



FEELER GAGE FOR RECESSES

deg. Pockets are formed in the gage *C*, to receive steel balls *D*, and the edges of these pockets are peened over to prevent the balls from dropping out.

The end of the pin *A*, having the angle face, abuts against one of the balls, and moves it outwardly in the desired degree. A setscrew *E* is provided for holding the pin *A* in place. The distance *G* should be less than the distance *H* to permit the passing of the gage.



BUILDING CARRIAGES, CAISSONS and LIMBERS FOR 75-MM. GUNS

By W. J. Larson

IV. Brake Crankshaft

This installment deals with some of the most interesting specialized work in connection with the construction of the brake crankshaft. Some of the parts are of such a secret nature that it is not possible to give full descriptions of all the machining operations, nor to show drawings or illustrations of the completed parts.

THE method of making the brake crankshaft is the result of experiment and the trial of other methods, which, while producing satisfactory work were prohibitive in cost, and it was not until Pratt & Whitney rifling machines were adapted to this work that satisfactory cost reductions were made. Owing to the length of these pieces and the small diameter (0.875 in.) of the bore considerable experimenting had to be done before a satisfactory slotting tool was developed.

As shown by the accompanying operation sheet, this piece is made from 1½-in. round stock 45 in. in length. This (No. 3F) stock contains from 50 to 60 points carbon which does not add greatly to the ease of the machining operations.

BRAKE CRANKSHAFT

Operation number and description; material required, forged steel, No. 3F 1½ in. diam. by 45 in.

1 Forge end as per dies.
2 Give necessary heat treatment.
3 Pickle and neutralize.
4 Do necessary straightening.
5 Center drill ends.
6 Do necessary straightening, take light cut off body, and spot for steadyrest as per machining drawing.
7 Drill hole through center.
8 Spot outside diameter true with hole, rough turn outside diameter, and spot for reaming.
9 Ream hole through center as per drawing.
10 Turn outside diameter for grinding.
11 Finish grind outside diameter as per drawing.
12 Finish the inside face of 2-in. boss and inside face of crank, and face the shaft to length.
13 Finish outside face of 2-in. boss and crank.
14 Finish slots as per drawing.
15 Drill and ream hole in crank, then drill for steel pin.
16 Do necessary filing and finish for inspection.

The forging operation is handled in the dies shown in Fig. 27. The punches are shown in Fig. 28. After

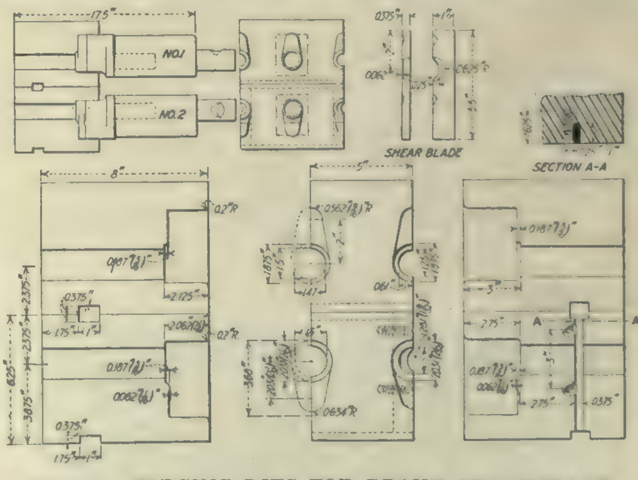


FIG. 27. FORGING DIES FOR BRAKE CRANKSHAFT

forging the pieces are heat treated, pickled and straightened. The ends are then centered and the piece again straightened between centers, and a light cut taken off of the body for holding in the steadyrest for the first drilling operation as shown in Fig. 29.

After the drilling operation the outside is again turned, carefully spotted true with the drilled hole, and the hole spotted, or bored true for a short distance to start the reamer as shown in Fig. 30. The outside diameter is now finish-turned and then ground, after which

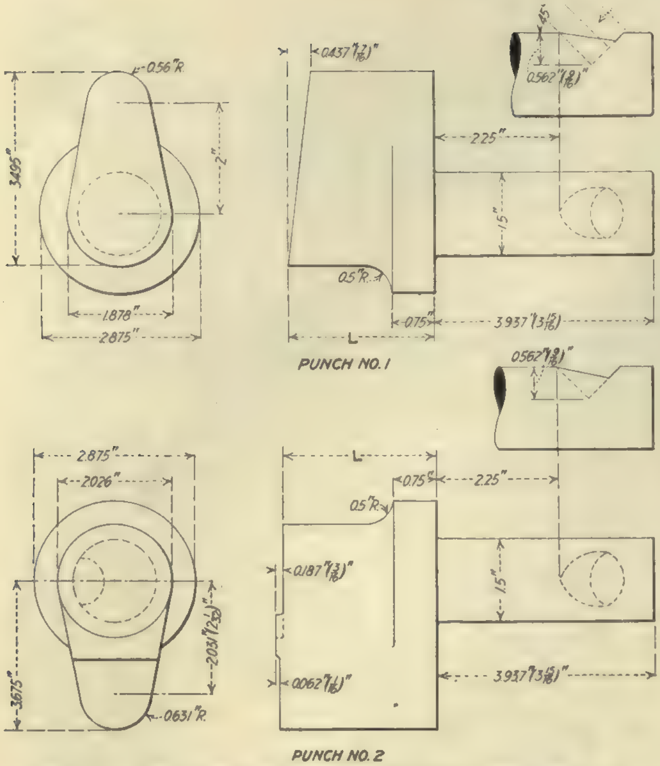


FIG. 28. PUNCHES FOR THE FORGING DIES, FIG. 27

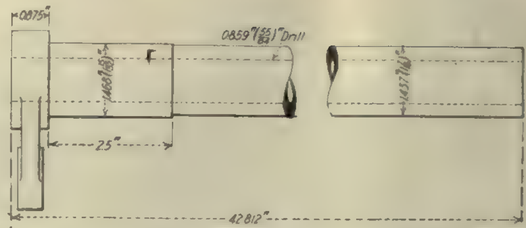


FIG. 29. BRAKE CRANKSHAFT, FIRST DRILLING OPERATION

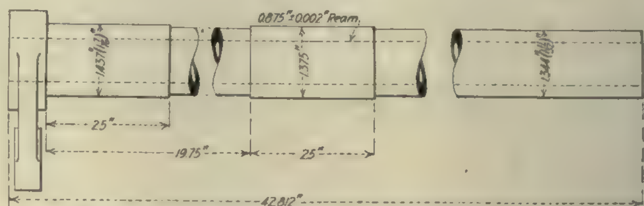


FIG. 30. BRAKE CRANKSHAFT, SECOND TURNING AND FIRST REAMING OPERATION

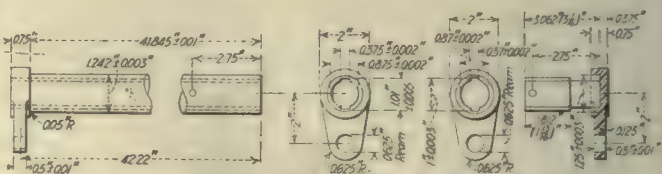


FIG. 31. FINISHED BRAKE CRANKSHAFT

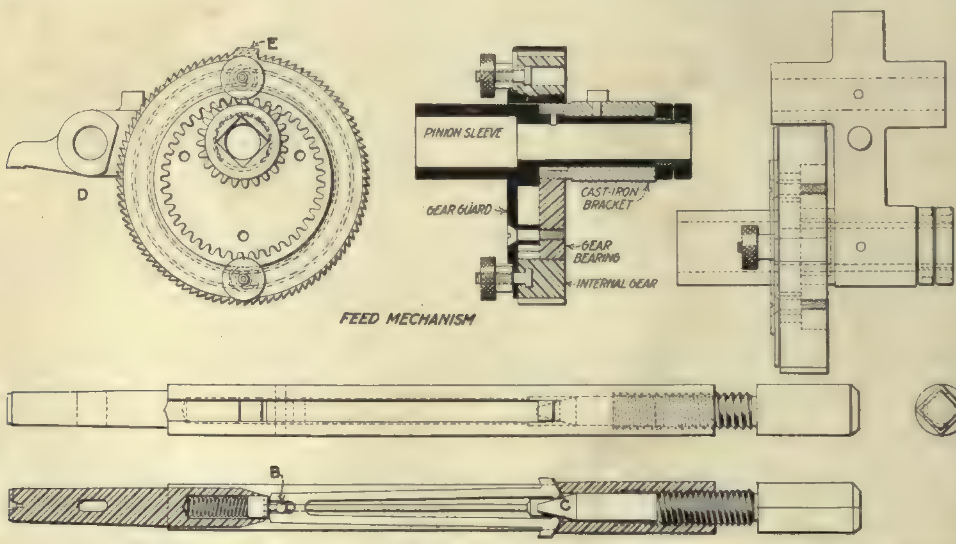


FIG. 34. INDEXING MECHANISM AND TOOLHOLDER FOR SLOTTING BRAKE CRANKSHAFT

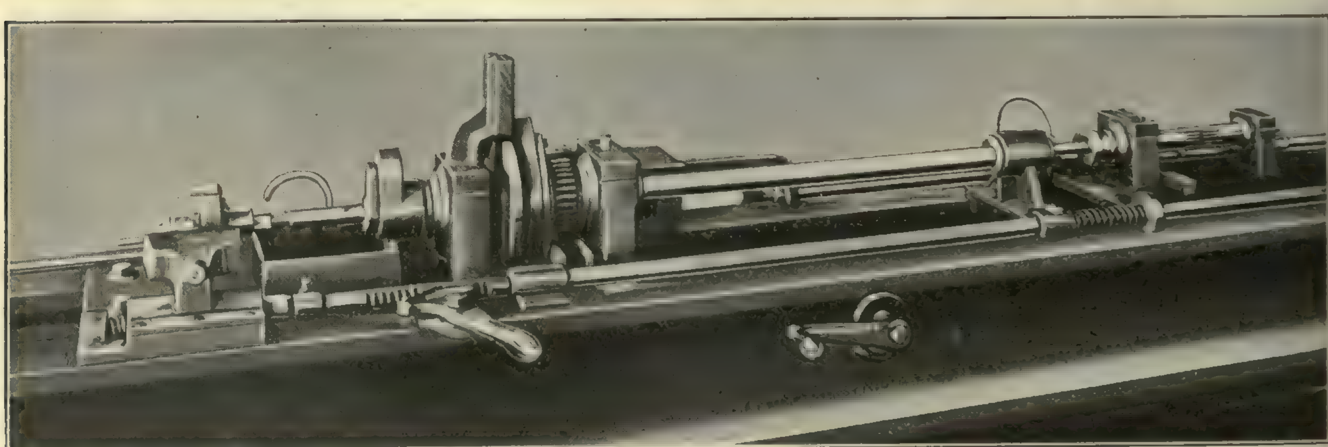


FIG. 32. PRATT & WHITNEY RIFLING MACHINE FITTED FOR SLOTTING BRAKE CRANKSHAFT

the boss and crank are faced, and the shaft finished to length, as shown in Fig. 31. This brings the piece up to the slotting operation.

This slotting operation is handled on a Pratt & Whitney rifling machine on which the feeding mechanism

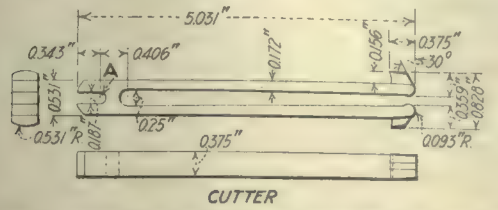


FIG. 33. SLOTTING TOOL FOR BRAKE CRANKSHAFT

has been modified to meet the requirements of the work. Fig. 32, shows the work in place, with the machine head in the extreme forward position, with the end of the feed screw *A*, Fig. 34, entered in the feed ratchet illustrated at *B*.

The Cutting Tool

Illustrations of the cutting tool are shown in Fig. 33, and of the tool head and feed ratchet mechanism in Fig. 34. Illustrations of slotting tools and tool head are shown in Fig. 35.

Referring to Fig. 33, it will be noted that the cutting tool is so made that both slots are cut at once, and the spring of the tool allows it to clear itself on the back stroke. The slot *A* when engaged with the pin in Fig. 34, holds the cutter blades in correct position. A slight amount of end play allows the cutter to recede from the screw point *C* and so clear on the return stroke, a feature which is, of course, necessary.

The indexing mechanism is shown at *D*, Fig. 34. An adjustable plate *E* on the ratchet may be set so that when the tool has cut to full depth the ratchet pawl slides over it and is prevented from engaging the ratchet and so stops the tool feed.

Three Centers Used

Three cutters are used on this work, the first one is 0.125 in. wide; the second is 0.280-in. wide; and the third, 0.375-in. wide, finishes the slot to width and depth. The length of cut is 40 in., and owing to the carbon content of the stock, high-speed steel was found desirable for the cutters; Rex AA being used.

As the finishing tool wears under size it is used for the second roughing cutter, and the second roughing cutter in turn used for the first, etc., which gives a great tool saving. These rifling machines are automatic, and one operator handles several on this piece of work.

(*To be continued*)

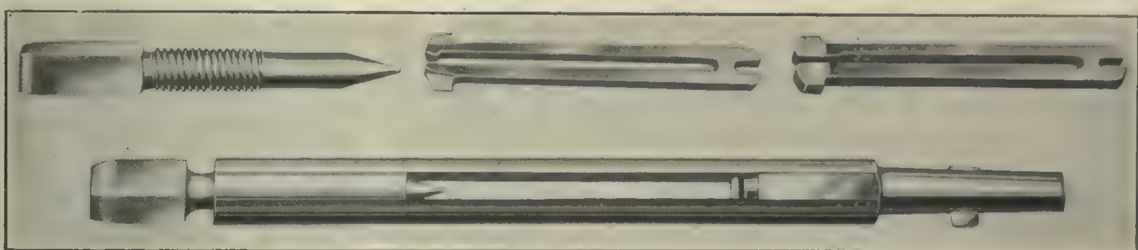


FIG. 35. PARTS OF SLOTTING TOOL AND HEAD

The Use and Abuse of Gages

By Fred H. Korff

Present day manufacturing with its large output, duplication and standardization of parts has caused methods of manufacture, processes and machining devices to be developed to an advanced stage, in order to keep pace with—and if possible ahead of—the great demand for the various mechanical contrivances which business of today not only asks for, but demands.

The necessary accuracy of manufactured parts is obtained by a measurement factor or limit of error, as it might be called. If a steel scale is used for measuring, this factor is reduced to one one-hundredth part of an inch; if a micrometer, to one one-thousandth or possibly one ten-thousandth part of an inch, and so on until a measuring machine is reached where the limit of error will be near one one-hundred-thousandth part of an inch.

This limit-of-error factor is vitally important in manufacturing of any description, especially if duplicate parts are to be obtained.

In order that parts may be interchangeable it is necessary to establish limits or tolerances. These limits cannot be derived by a snap judgment, so the operations should be analyzed, methods of tooling and machining investigated in order to determine what will constitute fair, yet at the same time correct, working limits for the piece at hand. Often in a factory, through the application of incorrect or hastily determined limits, quantities of work have been spoiled, operators discouraged and a general feeling of distrust created toward all limits or tolerances.

Gaging Carried Too Far

Gaging, like many other things, can be carried too far, and while close accuracy is always greatly desired, too great a degree of accuracy may be the foundation for trouble and incidentally a large overhead expense, causing scrap, due to an unnecessarily too rigid inspection. Parts which might have an allowance of three thousandths of an inch, are held to one thousandth. This makes a great difference to the operator and will result in decreased production. Ask any machine-tool operator and he will tell you how much a difference of 0.002 in. will make to him, especially if he is working on a bonus or piece-rate basis.

Too little thought has been given to the question of gaging and the limits involved, and if more time was spent on this before the work reached the point of manufacture, a great number of difficulties, plus spoiled work, incident thereto, would be obviated.

Two gages of the same nominal size made by the same

man for the same operation, will not be exactly the same. This statement seems far fetched, but it is a proved fact; and this discrepancy in size, however small, is the starting point of the questions and often heated discussions which later arise in a factory as to the relative correctness of the gages.

After being used for a short time, gages start to wear, but this wear is never the same in any two gages due to the hardness and finish of the steel, and to the fact that no two men use the same gage in the same manner. Operators and inspectors should exercise the greatest care when handling gages, and should be extremely careful how they apply them to the work. A gage should never be forced, for it requires but a small amount of pressure to spring or distort it, and then it is valueless as an instrument of measure until it has been corrected by a gagemaker. Gages are often dropped on the floor or machine, and instead of being checked immediately, continue to be used. This is bad practice and should not be tolerated.

Sets of Master Gages

Every factory should have a set of master gages; one master gage for each gage in use in the factory. These gages to be kept in the gage room and in no circumstances used for checking the product. They should be used only as a measuring standard or means to check the other gages. These masters are necessary, for it is not always possible to have the same man check all the gages; neither is it probable that this man will live forever nor that the same measuring instrument will always be used. These master gages are checks against discrepancies in both the men and the measuring machines.

When new sets of gages have been finished and the final measurements taken, they should be graded according to the sizes obtained as follows: the gage measuring the closest to the desired size should be set as the master gage; the one with the next highest grading given to the final inspectors; the next one, to the shop inspectors and the last or lowest on the graded list, to the operators.

Instruction Relative to Use

The next step to be taken is the proper instruction relative to the use and care of these gages. Time and money have been spent in producing them and a little of each should be expended in instructing the men, both inspectors and operators, in their proper care and uses. Gages are among the most valuable items in a factory and one cannot be too careful when using them.

Gages, like the piece parts in the stock room, should receive a perpetual check, in order to be assured of their constant accuracy. Those which are used but once or twice a week do not need to be checked as often as those which are used every day. No set rule can be established for this, but the checking periods must be determined by the executives in control of operations.

Various tolerances should be established for limits of error when checking the gages. For example a gage with working limits of one hundredth of an inch might be allowed a wearing limit of one thousandth part of an inch, while one with working limits of two thousandths of an inch might be allowed a wearing limit of two and one-half ten thousandths. As these tolerance factors are established, so the gages should be graded accordingly and discarded, repaired or placed in the next grade as the case may be.

The above contains five salient features, which if followed will greatly assist manufacturers with their gage difficulties:

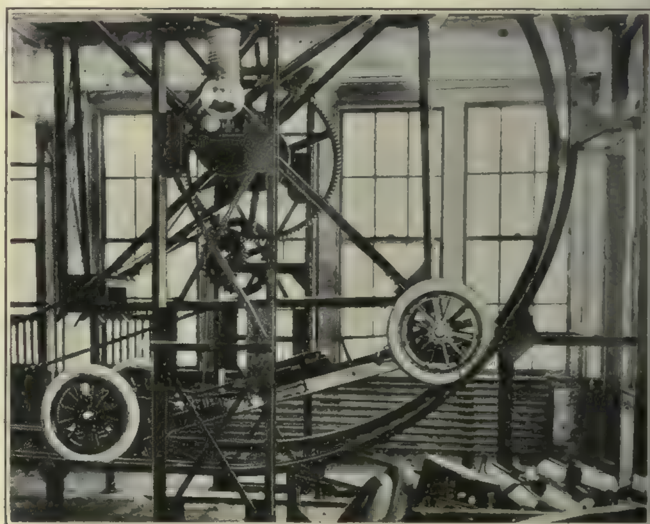
First, establishing master gages; second, grading of gages according to limit of error; third, perpetual check for maintenance of standard sizes; fourth, rechecking of gages to tolerance factor; fifth, proper instruction in their uses.

Elevator Reverses Automobile

By C. L. Edholm

Reversing the position of an automobile while elevating it to the second floor of an assembling plant, is the ingenious method by which the Chalmers factory makes it possible for the mechanics to work on the lower side of the car without getting under it.

Anyone who has had to crawl under a car to repair it will understand the loss of time and energy caused by working in a strained position, and even a pit



AUTOMOBILE REVERSING ELEVATOR

does not entirely overcome this. The system described here avoids the difficulty by beginning the assembling of the car in the reverse of the normal position.

After adding to the frame the parts that are most accessible in that position, it is sprayed with paint, dried in an oven, the wheels attached and the chassis allowed to proceed on its conveyor to the elevating wheel. As the illustration shows, this mechanism takes the car and carries it to the upper floor of the plant, causing it to move in the arc of a circle, so that it reaches the upper floor in a position the reverse of its original.

On the second floor the conveyor takes it in a direction opposite to the first and all the parts are assembled that are handled most conveniently in the new position. These, include engine, steering gear, body and radiator. The time of assembling the machine is three hours, and it is driven off the conveyor under its own power. By allowing the men to work in a natural position instead of getting under the machine, a great deal of time is saved.

Abolishing Secrecy in Army Contracts

SPECIAL CORRESPONDENCE

Secrecy in the placing of army contracts for various classes of supplies, has resulted in trouble which should not have occurred.

SECRET buying of many classes of supplies for the army has been under fire in Washington for nearly a month, at hearings held by the Senate Committee on Military Affairs. Although the newspapers have reported some of the testimony, the importance of this investigation is little realized. There have been general complaints from contractors and from manufacturers of construction machinery, building supplies, clothing and munitions, that they were given no opportunity to do business with the army on account of its policy of secrecy, although there was no such difficulty in bidding on navy and marine corps supplies.

So long as only manufacturers grumbled, the public attributed the complaints to the chagrin of disappointed business men. But when thousands of young men sent to cantonments and camps wrote home that they had inadequate clothing, when it became known that there was an insufficient supply of certain classes of arms to enable the men to receive prompt training in their use, then the public took the matter in hand. During the recent recess of Congress, some of its members have been making personal investigations at camps and cantonments, and others have been corresponding with men who know about the conditions of these young soldiers; and as a result the Senate Committee on Military Affairs, which is one of the strong committees of Congress, has been trying to find out why the young soldiers have had to put up with deficient equipment and defective living conditions.

However, what is really on trial before the committee is the system of secret contracting adopted by the Secretary of War at the instance of the Committee on Supplies of the Council of National Defense.

Reason for Present Policy

In the first annual report of the Council of National Defense, just made public, there is a detailed explanation of the reason for the adoption of this policy; and the text of the order issued Apr. 12, 1917, by the Secretary of War is given. It directs that contracts "for the supply and equipment of the army, for fortifications and other works of defense . . . will be made without resort to advertising for bids in the letting of the same." Further information concerning this order, was given in the testimony of Charles Eisenman of the Committee on Supplies, before the Senate Committee. He went to New York "to do a job" and found that news of what he was after had already reached the trade, hence he could not accomplish his purpose. He accordingly urged the adoption of a policy of partial secrecy concerning the work of his committee, so that while the trade would receive advance notice of the letting of contracts for materials in which he was particularly interested it would not get enough information to enable combinations to be formed to advance the price of products or corner any market. This policy was adopted. Under it, and by order of the Secretary of War, the committee designated what grades of supplies should be bought and who should get the contracts for them—the Quartermaster Corps merely to draft the form of contracts, sign them and inspect the materials. Specifications for different classes of materials were prepared by the committee and submitted to manufacturers. In many cases the price which the Government would pay was fixed, and all the manufacturer could do was to agree to furnish a certain amount of goods of specified quality at a price fixed by the Committee on Supplies. Mr. Eisenman testified under oath that this policy saved the Government large sums, furnished supplies of good quality as rapidly as needed, and that shortages which might exist at camps were due to other causes than to the system of buying without public advertising. A large amount of testimony was introduced to the effect, that this system prevented the early delivery to the Government of the supplies it needed, failed to utilize the manufacturing capacity of the country, caused a deterioration in quality of certain supplies, and did not in fact, furnish supplies as promptly as claimed by Mr. Eiesenman nor as promptly as was the case with the Navy Department.

At this writing the Senate Committee has not finished its hearings and its official report will probably not be ready for some time, but some members of the committee have already introduced bills which, if passed, will radically change the present system of purchasing army supplies; consequently the time has come when there can be no objection to a public discussion of a policy which has caused great dissatisfaction among leading producers of army supplies of many classes.

Reason Against Present Policy

The claims for the present policy have already been stated. In favor of the policy of awarding contracts only after public advertisement, there is, first the statutory requirement for the use of this policy on Government work, which, it is held in some quarters in Washington, has been violated by the War Department's order of Apr. 12, 1917. A second claim in favor of publicity is that there can be no complaint of collusion or favoritism, such as is now rife over many army contracts. A third claim is that under existing statutes, the products of any manufacturing plant can be commandeered if bid prices are considered too high. A fourth claim is that where great difficulty is experienced in getting goods of a desired quality at an early date—as was the case with cloth for uniforms about eight months ago—the fact would become known publicly, and available supplies of a better quality which could be delivered more quickly could be bought at a slightly higher price without challenging public condemnation.

The objection most frequently urged against the policy is that it will entail a serious loss of time, which is met by the assertion that purchasing by the Navy Department under this policy has been far more prompt, efficient and satisfactory to the sellers than the policy

of the War Department, although the purchasing for the latter was done by leading men drawn from many lines of business, while that for the navy was directed by a former newspaper man.

The general opinion is that Congress will favor the abolition of the present purchasing system of the War Department, and will not only require publicity regarding contracts, but will give back to some Government agent or agencies the power over contracts now vested in various subcommittees working under the Council of National Defense. Whether that agent should be a Director of Munitions or of the several large divisions of the War Department, is being warmly debated in Washington. The recent changes in the Ordnance Department would point logically to a trial of the latter plan for ordnance, while it is quite generally held that so far as the Quartermaster Department is concerned, the record of General Goethals at Panama warrants giving him an opportunity to show if that department can be sufficiently freed from red tape as to become an effective organization. The result is awaited with considerable interest.

Congress will certainly take some action, for the families of the boys in the camps and cantonments will insist on reform, and the changes under way are evidently a response to the public protest against past conditions.

Suggestions for Machine-Tool Salesmen

Special Correspondence

The importance of the machine-tool industry in all the present activities of war makes the following suggestions by the Kearney & Trecker Co., Milwaukee, Wis., of especial interest at this time; copies of these suggestions have been sent to dealers and to salesmen handling their product:

War Emergency Sales and Distribution of Milwaukee Milling Machines

The necessity for the rapid equipment of plants for the making of munitions of war has led to an acute shortage of milling machines, which will doubtless be of brief duration. While it lasts we ask your fullest coöperation to the end that machines may be placed where they will be of the greatest service in helping to win the war.

A prominent European machinery dealer said to us over a year ago: "The American machine-tool manufacturers saved the Allies cause." It is now our opportunity to be a great factor in making our own cause triumph. We are establishing prices in moderation, having in mind our duty to secure the maximum production by maintaining an efficient, contented, working force with the highest patriotic interest in results and the part played by our product in the great issue.

It is the aim of this company that all representatives participate in the distribution of our product in proportion to the size and importance of the territory they cover. In ordinary industrial booms great effort would be made to secure this result, seeing to it that efficiency and loyalty during the off-years were properly rewarded. In the present emergency this must be subordinated to the best distribution that can be made regardless of present profit or future advantage.

We look to the Priority Committee of the War Industries Board for guidance, but their efforts will be of no value without your and our enthusiastic coöperation, and in order that we may so coöperate we ask that you carefully note the following:

1. Assist customers in every way possible to secure maximum production on present equipment regardless of make. Doubtless there are many cases where the purchase of a machine may thereby be avoided.

2. Ignore entirely advantages that may accrue by placing machines in hands of "desirable customers" with reference to future business, considering only the most urgent need.

3. When a customer requires several machines, endeavor to have these scattered through two or three lots as they are coming through; otherwise many machines may be standing idle which might be used to get other manufacturers started at tool making or some other preliminary work.

4. All inquiries for delivery to private concerns must contain: (a) Name and address of the user; the address may be omitted where the concern is an old and large one likely to be known to us, but must not be omitted, where there is a possibility of the machine being shipped to a branch not located in your territory; (b) in all cases give the grade of priority, customers can secure. This should be mentioned no matter how far down the scale, and unless mentioned we must assume use not essential to the war or the maintenance of necessary industries; (c) when order is placed have customer send us official priority certificate.

5. (a) All inquiries from the United States Government will be handled directly by us; (b) One-half your regular commission will be allowed on all machines shipped into your territory; (c) you will give Government officials all the information possible, regardless of destination, concerning capacity of machines, tentative prices, delivery, etc.; sending information to us immediately in the way of specifications or otherwise, that will enable us to make an intelligent proposal. If you help out with information as to where machines may be shipped into another representative's territory, he will, with the same patriotic zeal, return the compliment.

6. In order that we may escape possible speculative orders at this time of stress, no order will be subject to cancellation except under the following conditions: (a) Failure on our part to make shipment at the time specified; (b) in case our consent to cancellation is given; (c) we shall be glad to coöperate fully in regard to this during the present emergency as we do not wish anyone to keep a machine while the emergency exists unless he has urgent need of it, and we must have no machines tied up in the hope that they may be needed or resold at a profit.

7. No stock orders will be accepted.

8. The prices contained in price-sheet "P" will apply to all machines shipped before July 1, 1918, but will not apply to any machines promised for shipment after July 1, 1918, unless conditions stated herein are extended by us in writing to some later date. In event of our not being able to ship before July 1, 1918, by reason of superior priority rating or other causes beyond our control, then price will be on the basis of that which prevailed at date of shipment, customer having option to cancel the order in case he so desires.

9. In case you find that a customer does not require a machine ordered you are not permitted to assign this machine to another purchaser even if they have A-1 priority, without our consent, as we may have older and more urgent orders carrying the same priority. By following this rule strictly you can be of the greatest aid to the Government at this time.

10. Selling by one representative into the territory of another will not be permitted. No self-respecting representative would continue our line if we did not protect him in his own territory. Wherever an order is inadvertently taken for shipment to branch plants in another agent's territory, it may be expedient to have the order go through as taken, but this only with the consent of the representative in the territory to which the machine is to be shipped, and the full commission to go with it to the representative in the territory to which it is shipped or by coöperative agreement between the representatives interested.

11. Prices quoted must always be list f.o.b. Milwaukee; or if f.o.b. destination is desired, with freight added.

Making TYPEWRITER PARTS

by

M. E. Hoag

II. Type Making

The making of type for typewriters and other similar purposes involves some very accurate and interesting work, and while many articles have been published covering typemaking, some new and interesting methods are found in the Woodstock shops.

THE making of the type itself is a rather simple matter after all the tools, dies, etc., are completed, for standard type-making machines are used. The greatest difficulty seems to be in making tools, dies and gages that will insure absolute duplication of parts and perfect alignment of all the 84 or more characters used.

The first thing done is to make a set of master type to use for reference, next, to make the matrix from which the type is finally made. The master type is engraved on small bars of special steel, and after hardening the sides of the bars are ground dead square and at fixed distances from some predetermined point on the characters. The gage for measuring these locations is shown in Fig. 6. The holder *A* carries two master type, one upper and one lower case, for with the shift type of machine each block carries two characters.

The knife-edge pointer *B*, which is operated by the micrometer head *C*, indicates the desired location of the master type, the location being taken from the edge of the character itself as seen under a high-power glass.

If the master type do not line up correctly in the holder *A*, shims are placed at each end until they do. This is very important as the success of ensuing operations depends on the accuracy with which this part of the work is done. It is this holder that locates the master type properly for the matrix-swaging operation. The micrometer gage with typeholder removed is shown in Fig. 7.

The next operation is making the type matrix shown in Fig. 8. The stock for these parts is of special square steel, lime annealed, and after it is sawed into blanks the blanks are ground to exact size both in lateral dimensions and length.

The fixture shown in Figs. 9 and 10 is used for holding the master type and matrix, while the swaging is done in a hand-screw press. Fig. 9 shows the fixture with typeholder and matrix blank in place, ready for swaging. Fig. 10 shows the typeholder partly removed and the plunger with matrix blank in place.

The pins *A*, Figs. 9 and 10, act as guides to locate the matrix and type, with relation to each other. The hardened and ground ring *B* is adjustable and acts as a positive stop—that when it registers against the body of the fixture the depth of the impressions in the matrices will all be exactly the same and no gaging will be necessary in setting up the type-making machine.

The clamping levers and screws *C* bring the holder and master type firmly in position in the base of the swaging fixture. The knurled ring *D* on the end of the plunger makes removal easy.

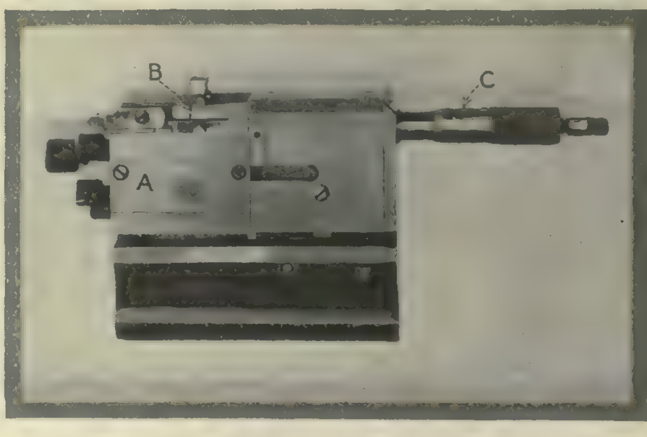


FIG. 6. MICROMETER GAGE FOR TYPE MATRICES

The matrix as it comes from the swaging machine is shown at *A*, Fig. 8, but on account of the rocking motion of the type-making machine, clearance must be given it on each side of the character impressions as shown at *B*. This radius is obtained by grinding in the simple fixture shown in Fig. 11. Both ends of the matrix carry impressions, and the fixture is located with relation to the grinding wheel, consequently a slight flat is left over that part of the matrix containing the characters. This completes the making of the matrix except for hardening.

The Woodstock typewriter has the double-shift keys, each type block carrying two characters as is the practice on all standard typewriters using the Universal keyboard.

The type *A* are slotted as shown at *B*, Fig. 12, and are slipped over the end of the type bar and soldered in place.

The type stock is received in rolled bars of proper width and thickness, and after being sawed to length the blanks are slotted in the double fixture shown in Figs. 13 and 14.

This fixture consists of four principal parts. The body *A*, the two swinging jaws *B*, and the end plate *C* which acts as a stop to prevent the blanks from slipping out, aids in setting up, and gages the location of the slotting saws.

The two jaws *B* are hinged to swing open as shown in Fig. 14 and receive the type blanks, the whole fixture being clamped in a standard milling-machine vise as seen in Fig. 13. A number of these fixtures are made interchangeable, which makes it possible for the workman to keep three milling machines running at once on this job.

After slotting, the blanks are taken to the type-swaging machines which swage the slotted end of the blank to shape and form the characters as shown at *C*, Fig. 12. This leaves a flash around the head of the type that is trimmed off in a simple die which leaves a little surplus stock at each end for grinding, *D*, Fig. 12.

When assembling the type and type bars, the proper location of the type with relation to the type bar is obtained by locating in a simple clamping fixture, location being taken from the ground end of the type; hence it is quite important that the distance from the character to the end of the type be held to close limits, otherwise the type will not be in alignment when assembled in the machine. In order to bring the character the correct distance from the end of the type, the surplus metal left by the flash-trimming dies is ground off by hand. A simple grinding head, with a rest, which carries at right angles to the side of the wheel a blade slightly thinner than the width of the slot in the type, handles

FIGS. 7 TO 12. GAGES, FIXTURES, TOOLS, ETC., USED IN THE MAKING OF TYPE FOR TYPEWRITERS

Fig. 7—Gage with matrix holder removed. Fig. 8—Type matrices. Fig. 9—Swaging-fixture for type matrices. Fig. 10—Swaging fixture with parts removed. Fig. 11—Fixtures for grinding matrices. Fig. 12—Type in various stages of manufacture

this work very rapidly; the girls who operate them becoming so expert that very seldom do they have to touch a type to the wheel more than once.

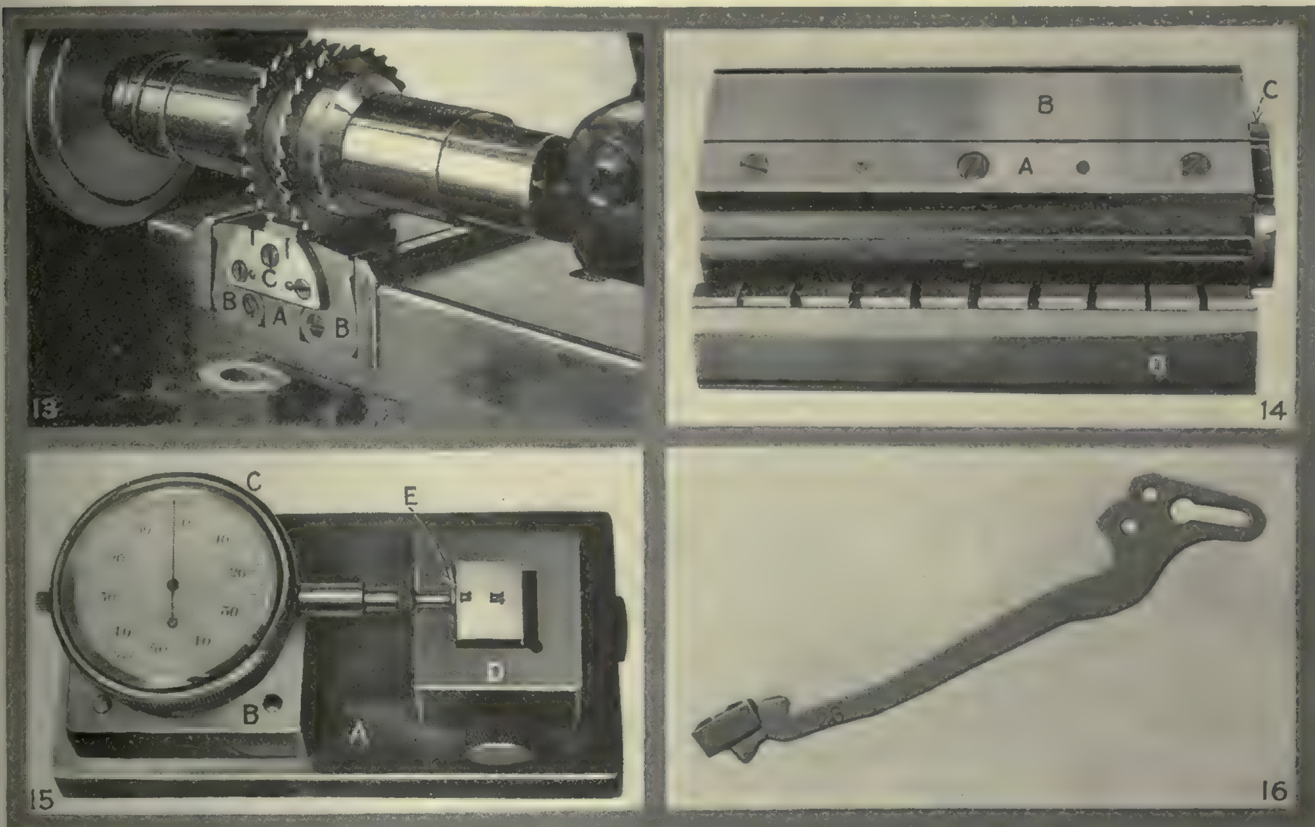
The dial gage shown in Fig. 15 is used to gage the distance from the character to the end of the type. This gage is simple in construction and consists of a base *A*, superbase *B*, which carries the dial indicator *C*, and is attached to the base by dowels and screws; this base *A* also carries the matrix holder *D*.

In gaging the type, the characters are pressed into the impressions in the matrix, and the end of the type pressing against the end *E* of the indicator causes it to show the amount of surplus metal to be removed.

As the distance from the impression in the matrices to the edge touched by the plunger of the dial indicator is always constant, it is a very easy matter to set up and use this gage, and very satisfactory results are obtained, the work being held to within 0.001 of an inch.

After burring and inspecting, the type are hardened and are then ready to pass to stock, from which they are sent to the assembling department, where they are soldered to the type bars as shown in Fig. 16. Fig. 12 shows the type in various stages from blank to finished part.

(*To be continued*)



FIGS. 13 TO 16. SOME OF THE PARTS AND METHODS USED

Figs. 13—Milling slots in type blanks. Fig. 14—Jigs for hold-ing type blanks. Fig. 15—Type gage. Fig. 16—Type and type bars assembled

Gage for a Shell Timing Device

By Gus Haessler

Accurate gages are required in manufacturing the timing device for Russian shells.

The gage shown in Fig. 1 is of interest in the making, owing to the facility with which the problem in hand lends itself to solution with mathematical precision. Having no master gage to work to, I proceeded to establish the angle 7° 49′ 45″, using a 5-in. sine bar, which was set up as shown in Fig. 2 and 3.

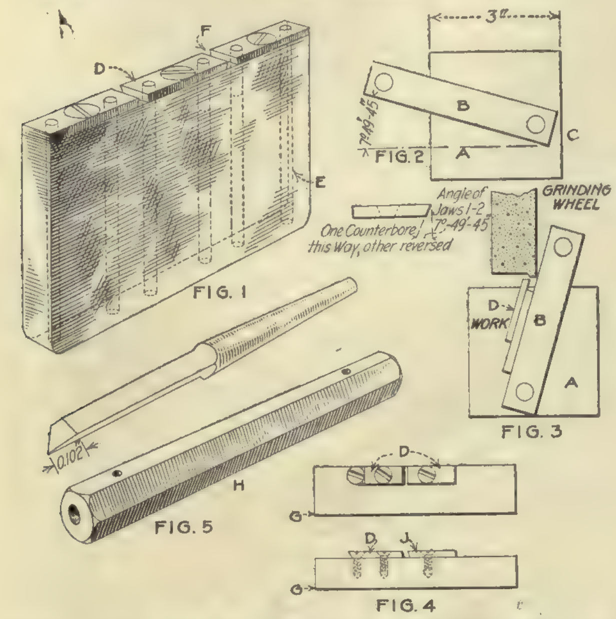
The angle iron *A* was ground square, and all edges parallel. One central rib was cast in the iron, that no difficulty should be met in clamping the sine bar *B*. The angle plate rested upon a Brown & Sharpe surface plate while the buttons were adjusted by means of a vernier height gage; of course, blocks could be used if available.

It will be noticed in Fig. 2 that the sine bar *B* is set to the required angle from the horizontal—this being in favor owing to the shorter distance between the height of the buttons. As the angle iron was true it was only necessary to swivel it so that the edge *C* rested upon the magnetic chuck of the surface-grinding machine as in Fig. 3. The work shown in Fig. 3 represents one of the angle pieces *D*, which is shown also in Figs. 1 and 4. These were drilled and counterbored then hardened, ground and lapped. After truing the wheel, as in Fig. 3, and clamping the work parallel to the sine bar, it was ground carefully so as to eliminate practically all lapping.

The angle pieces *D*, Fig. 1, being ground, they were placed in position on the base of the gage, while the screw holes and dowel pins *E* were transferred. In order to avoid as much delay as possible in the final adjustment of the angle pieces, they were located as accurately as possible and the pieces *F* inserted between them while the dowel-pin holes were drilled. The thickness of these blocks was determined as follows:

After the base was hardened, it was ground and lapped on its upper edge. The angle pieces were now placed in position for final adjustment with the blocks inserted, then soldered to the base, while the dowel-pin holes were lapped out; these were then provided with hardened and ground pins.

In making the male gages, the fixture *G*, Fig. 4, and the holder *H*, Fig. 5, were employed. Two sides of the holder were ground parallel on the magnetic chuck. When the hardened tapers were placed in the holder, the parallel sides of the male gages were ground to di-



FIGS. 1 TO 5. GAGES AND OTHER DEVICES USED FOR SHELL TIMING

mensions, while the other two sides were ground to 0.0975 and 0.102 in.

The gages were then removed from the holder and were copperplated on the sides to be ground off in the fixture, Fig. 4. The angle pieces *D*, of Fig. 4, are duplicates of *D*, Fig. 1, and were made to pinch and release the gages readily; they were also interchangeable so that both sides of the gages could be easily ground. The fixture was clamped to the platen of the grinding machine, and a 3-in. red vitrified wheel was used. By observing the disappearance of the copperplating when grinding, the gages were ground practically to size, leaving but a minute amount for fitting.

Navy Contracts and the Guarding of Plants

The Bureau of Supplies and Accounts, Navy Department, has sent the following circular letter to all contractors:

Navy Department, Washington, D. C., Oct. 16, 1917.
From: Secretary of the Navy.
To: Chief of Bureau of Supplies and Accounts.
Subject: Adequate guarding of plants and surveillance of employees of plants having contracts with the Navy Department during the war.

1. In view of the fact that the conditions in regard to the guarding of the plants and the surveillance of the employees of a number of companies having manufacturing contracts with the various bureaus of the Navy Department have been found to be most unsatisfactory, it is directed that you address a letter to all companies having contracts with your bureau, requiring them to insert the following provisions in all contracts already made and to have inserted the following provisions in all contracts to be made by your bureau for the duration of the war.

2. The following is a copy of the provisions above referred to:

"In addition to the ordinary precautions heretofore adopted by the contractor for the guarding and protection of his plant and work, he shall provide such additional watchmen and devices for the protection of the plant and property and the work in process for the Navy Department, against espionage, acts of war, and of enemy aliens, as may be required by the Secretary of the Navy. The contractor shall, when required, report to the Secretary of the Navy the citizenship, country of birth or alien status of any and all of his employees. When required, he shall refuse to employ, or if already employed shall forthwith discharge from employment and exclude from his works any person or persons designated by the Secretary of the Navy for cause, as undesirable for employment on work for the Navy Department."

(Signed) JOSEPHUS DANIELS.

In case the Navy Department directs the contractor to provide additional watchmen and devices for the protection of his plant and property, special arrangements shall be made in each case for a suitable modification in existing contracts so as to provide for such expense. In each such case, contractors shall be consulted by the Director of Naval Intelligence, and mutual satisfactory arrangements perfected.

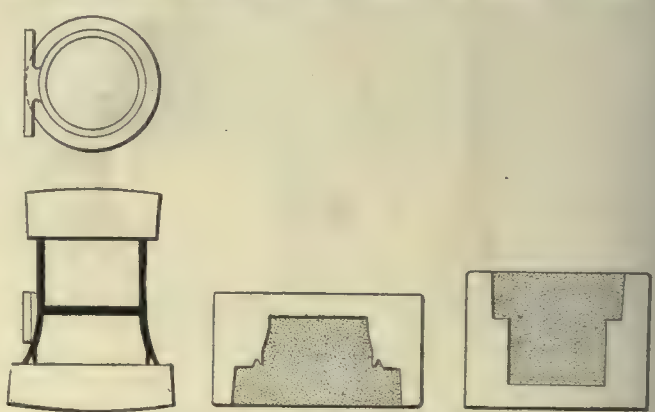
All contracts, bureau orders and Navy orders issued to you by Supplies and Accounts are, therefore, modified in accordance with the provisions stated above. A copy of this letter is made a part of the record pertaining to each contract, bureau order, and Navy order on file in this office.

Very respectfully,
SAMUEL MCGOWAN,
Paymaster General of the Navy.

Setting Cores Accurately

BY J. L. GARD

The illustration shows section of casting together with core prints and core boxes. Such jobs are usually made with a long print of the same diameter as the core, and the results are not always certain. By mak-



METHOD OF HOLDING CORES IN MOLD

ing as shown, a shorter print was possible, with but a slight increase in diameter.

The cores were set in the mold to a positive position lengthwise, the shoulders preventing tipping. The bevel on the inner sides of prints, together with the rounded outer ends, prevented a crush in placing the cope. The taper on the prints allows for the draft in the core boxes. The boxes were turned from a solid block in order to show no parting line in casting. There being a quantity of these, the results justified the extra time required.

Laws Regarding Women in Shops

SPECIAL CORRESPONDENCE

THE continued increase in the number of women working in shops, and the probability that this will be largely extended, makes it necessary for the manufacturers in different states to have at least a general idea of the laws governing women's work in their particular locality.

We are, therefore, reproducing in a condensed and convenient form a brief *résumé* of the laws of the various states, according to the latest information obtainable at this time.

The ruling in regard to the minimum wage will be found very unsatisfactory, and the rates given are of little value at the present time. It must be remembered that a number of these laws was passed from five to ten years ago under very different conditions than the present ones. We must also take into account the kind of work done by women in the different states, before we attempt to compare the wages paid. In Arkansas, California, and Colorado, for example, there is almost no factory or shop work for women, most of the employment being domestic service or packing fruits and agricultural products. The figures given are described by the law as being based on economic principles which is abbreviated to B.E.P.

It will be noted in Ohio for example, that grinding and polishing are forbidden occupations. This prevents women from being employed on work for which they seem to be especially fitted, according to experiences in many other localities. This law was probably passed with the best of intentions, but evidently it does not take into account the modern exhaust equipment of all good grinding and polishing departments. It would seem far better to enforce a law requiring proper exhaust systems in connection with grinding than to make it a forbidden occupation for women.

Any more detailed information in regard to the laws of any state can be had by applying to the Commissioners of Labor at the capitols of the states.

State	Maximum Hours		Night Work Laws	Minimum Wage	Weights Limit	Forbidden Occupations
	Day	Week				
Arizona P.C. Sec. 717, 1913	8	56	....	....	......	Mining; all work that requires constant standing
Arkansas Code, 191 1915	9 Six-day week	54	....	B. E. P. $1.25 per day	......	Mines
California Amended Law, 1913 (Com.)	8 10 For six-day week	48 60	....	B. E. P. 16c.-13c. per hour; pound scale of wage also	......	....
Colorado 1912	8	..	....	B. E. P. (limited) $20 per month; $1 per day	......	Mines
Connecticut Amended Law, 1909	10 Varied according to pursuit	55	After 10 p.m. prohibited in mercantile establishments	....	......	Saloons
Dist. Col.	8	48	....	....	......	....
Delaware Law, 1914	10 Exceptions in interest of certain conservations	55	Limited to 8 in 24 hours if any part falls between 11 p.m. to 7 a.m.	....	......	....
Georgia.. Amended Law, 1911	10	6	....	....	......	....
Idaho, 1913	9	..	....	....	......	Saloons
Iowa.....	..	..	....	....	......	Saloons
Illinois Amended Law, 1911	10	..	....	....	......	Mines
Indiana, 1901	..	..	Forbidden from 10 p.m. to 6 a.m. in manufacturing	....	......	Mines
Kansas Law, 1915 (Com.)	9	..	Forbidden after 9 p.m. in mercantile establishments	B. E. P. (inoperative)	......	....
Kentucky, 1912	10	60	....	....	......	....
Louisiana Law and Amendments: 1908, 1914, 1916	10	60	....	....	......	Saloons; cannot clean moving machines
Maine, 1915	9	54	....	....	......	....
Maryland Amended Law, 1916	10	60	8 hours in 24 if work falls between 10 p.m. and 6 a.m.	....	......	Mines: saloons
Massachusetts Law and Amendment: 1909, 1913, 1915, 1916	10 Six-day week	54	6 p.m. to 6 a.m. in textile manufactures; 10 p.m. to 6 a.m. in all other manufactures	15c. per hour $8 a week.	Below 75 lbs.	....
Michigan Law and Amended Law: 1909, 1911, 1915	10	54	....	....	......	Saloons
Minnesota Law, 1913 (Com.)	9	54	....	B. E. P. $9 to $8.75 to $8.25 to $8 weekly	......	Cannot clean moving machines
Mississippi, 1914	..	..	....	....	......	....
Missouri, 1909; Amended, 1913	9	54	....	....	......	Mines; saloons
Montana, 1913	9	..	....	....	......	Saloons
Nebraska Amended Law, 1915	9	54	10 p.m.-6 a.m. in cities over 5,000 specified pursuits	B. E. P. (inoperative)	......	....
New Hampshire Amended Law, 1913	10½	55	....	....	......	Saloons
New Mexico	..	..	....	....	......	Saloons
New Jersey Amended Law, 1912	10 Six-day week	60	....	....	......	....
New York Law and Amendments; 1909-1912-1913-1914-1915	9 Six-day week	54	10 p.m.-6 a.m. and 10 p.m.-7 a.m. according to classification of work and population	....	......	Mines; cannot bake cores in foundries in certain conditions; saloons; emery and polishing wheels operating
North Carolina, 1911	..	60	....	....	......	....
Ohio, Oct., 1917	9	50	....	....	......	Grinding and polishing emery and polishing wheels
Oklahoma	9	..	....	....	......	Mines
Oregon (Com.)	9 Six-day week; final legislation, 1913	54	Prohibited after 6 p.m. except in specified work. After 8.30 p.m. outside Portland, with exceptions. Law contains special provisions for rest-time	B. E. P. $6-$9.25 weekly to $40 monthly	......	....

State	Maximum Hours Day	Maximum Hours Week	Night Work Laws	Minimum Wage	Weights Limit	Forbidden Occupations
Texas, 1915	9	54	....	....	......	Saloons
Utah, 1911-1915	9	54	Prohibited after 6 p.m. in cities of 10,000 with conservative clause and Christmas time provision	B. E. P. $1.25 and 90c. day	......	Mines; saloons
Vermont, 1913	11	58	....	....	......	Saloons
Virginia Amendments: 1912, 1914	10	..	....	....	......	Mines
Washington, 1911 (Com.)	8	..	....	B. E. P. $6-$10 classified	......	Mines; girls under 18 cannot be "shakers" in laundries
Wisconsin Amendments: 1913 (Com.)	10	55	Work limited to 8 hours per night; 48 per week of nights, if all falls between 8 p.m. and 6 a.m. on more than 1 night	B. E. P. Held up	......	Mines
Wyoming, 1915	10	56	....	B. E. P. Held up	......	Mines
Alabama	....		....	....	......	Mining occupations
Pennsylvania	....		....	....	......	Mines
West Virginia	....		....	....	......	Mines; cannot clean moving machinery
Nevada	....		....	....	......	....

Our Experience with the Employment of Women

BY DAVID S. EARLL

The following extract was taken from a speech made at the New England Manufacturers' Conference:

Prior to the year 1916 I had never considered the relation of woman to the machine shop; and tonight as I contemplate the new conditions which have made women a factor in the machine shop, I seem to be looking upon some strange, moving-picture drama.

In our business, until Dec. 31, 1916, we had been known to the typewriter and comptometer experts as a stag corporation: we did not have even a charwoman for our office work, it being done by the stags; but on Jan. 1, of this year, after much suffering, we replaced our switchboard operator with a woman: thus the ice was broken. That was a red-letter day in our plant, most of the talk centering on the innovation at the switchboard. The Innovation's limit was set at two weeks, but she was still on the job when I started for this win-the-war meeting.

Two weeks after the woman broke into the business, two men resigned and our auditor replaced them with women; then our cost manager added three more to his department. About the last of January our purchasing agent called me in and wanted to know if I could get him a stenographer to replace one of his men who had enlisted in the Navy? I looked over my applications and sent him his first Innovation or Replacement. It seems to me we have got far enough in the new circumstances to need a specific name for the woman-worker. We shall not call her a "Jane!" that name must be left to those who take the woman on the job less seriously than I do.

Two weeks after the replacement, our agent asked me if I could get him another woman just like the first in efficiency; and so it went, from bad to better, till by the last of February we had women working in most of our office departments.

No Men To Be Had

Uncle Sam, by getting mixed up in this fracas with the Kaiser, is responsible for our women in overalls. Our men began enlisting faster than I could replace them. Presently male applicants for work became very scarce, and strenuous days had come for us. I had several department heads clamoring for men, and it was impossible for me to hire them. Finally the general manager wanted to know why I was not filling those vacant places. I stated the situation to him and he sent me out of town looking for help. Every place I went, I found the conditions the same: no men to be had. On my return I told our manager of the situation and advised that he put women on the lighter jobs, thus giving us the chance to move our men up on other work. The proposition met with his approval, and he gave me authority to make all arrangements, and place women wherever I deemed it expedient.

In the factory I met stern opposition to the proposition, but after going over the situation with the department heads, those that could use women agreed to give them a trial. I immediately got in touch with the Department of Labor, stated what I contemplated doing and asked for its coöperation. The chief factory inspector of our district was sent to look over the situation, and told us where we could and where we could not place women, and what the requirements of the Labor Department were in regard to lavatories, rest rooms, and dressing rooms. He advised asking the women to wear overalls on all machine work, and requested that we employ a matron if we placed more than thirty women at work. We have followed the instructions of that inspector to the letter.

One Big Success

I can say this innovation has been one big success from the beginning. We placed seventy-five women in different departments under men instructors, and in two weeks' time they could handle the machines alone. We have found them much more adept at learning, and far better producers than the men were.

At the present time we have women working on Gleason bevel-gear generators, Fellows gear-shaping machines, drilling machines, burring machines, filing machines, bench filing, and inspection work.

We find no choice between the married and unmarried woman when it comes to work, attendance, and disposition. The first women we put on were started at the same rate of wage that we paid our boys. After six weeks, several of them had resigned, with no reason given. Our matron was asked to investigate and locate the trouble if possible. She learned that women could not make both ends meet on the wages they were getting; that it cost more for them to live than it did a man. I went over the situation with the general man-

ager, who took it up with the cost manager, who, finding the production from women's labor was considerably more than from men's, immediately gave all women workers an advance in wages, at the same time setting a new starting rate and a schedule of two raises for all women who made good. Those who have made good are today getting a very fair wage. They are getting, in fact, far beyond what they are able to obtain in any other vocation in our vicinity.

The Same Wage That Men Are Getting

A few of the women have been advanced beyond that second raise, and eventually will acquire the same wage that men are getting for the same grade of work. As some of the women are far in advance of the men in production, I assume they will be given due consideration when they reach the wage limit paid to men.

On our 3-inch Gleason generators, the largest day's production turned out by our best man operator on differential side gears was 91 pieces, and on differential pinions 260 pieces for a nine-hour day. The slowest woman operator in point of production, equals the best man's day's production; and our speed merchants, as we call them, turn out 126 side gears, and 320 differential pinions, for a nine-hour day, an increase of 35 side gears and 50 differential pinions.

On our 24-in. Fellows gear shaping machines, the women turn out from 20 to 30 pieces more in a nine-hour day than the men; and on our burring and filing machine the women are far ahead of the men in production and accuracy. They overrun the men about 250 pieces in nine hours, and the small amount of work from these machines rejected by the inspectors is surprising when compared with the amount that the inspecting department rejected when the same machines were operated by men.

In Drilling-Machine Work Women Have Increased the Production

In one case of our drilling-machine work the women have increased the production 1200 pieces in a nine-hour day. The case I speak of is putting a radius in and reaming out the bore of differential pinions. This requires two operations on a two-spindle drilling machine. The largest nine hours' production turned out by two men was 3200 pieces each. To date, two women have turned out 4400 pieces in nine hours, under exactly the same conditions, and it is hard to tell how much higher they are going.

We have one woman who drills two $\frac{5}{32}$-in. oil holes $\frac{1}{4}$ in. deep, and $\frac{1}{8}$-in. oil hole $\frac{3}{8}$ in. deep, in 246 stem gears in nine hours. This is fifty more pieces than the men ever turned out.

We have women doing hand filing on bench work, and they have become as proficient with a file as our best workman, while in many cases they are showing the men up on production.

We have about twenty-five women doing inspection work, and there is very little material that gets by them. In fact, our chief inspector recently remarked that he had never known his department to be as efficient as it is at the present time.

You can readily see that our experience in the employment of women in overalls has been both helpful to our Government, and profitable to the firm.

Russia's Industrial Decline

One of the most marked signs of the difficult position in which Russian industry has found itself is the increase in the number of works that are stopping manufacture. This being a matter of great importance, the Industry Department of the Ministry of Trade and Industry has collected data through the factory inspectors on works that stopped manufacture after Mar. 1 and did not resume work by Aug. 1.

According to this data, from March to July 568 works employing 104,732 workers were closed, the average number of workers in these factories having been 183. This figure shows that the works stopped were mostly small, and that they suffered chiefly owing to financial weakness, not being able to meet the cost of labor and raw materials and other abnormal circumstances characterizing the post-revolutionary period.

Distributed over months, the number of works closed and of workers dismissed is as follows:

	Works Closed	Workers Dismissed
March	74	6,644
April	55	2,816
May	108	8,701
June	125	38,755
July	206	47,754

Classed according to manufacture these figures are:

Branch of Manufacture	Works Closed	Workers Dismissed
Cotton	49	53,417
Woollen	16	2,305
Silk	8	6,226
Flax, hemp and jute	9	1,152
Filament, divers	19	2,771
Paper and polygraphic	27	1,465
Mechanical woodworking	76	2,971
Metal working	91	10,802
Mineral products	44	5,704
Animal products	15	901
Foodstuffs	196	14,992
Chemical	17	1,596
Divers	1	70
Total	568	104,372

The large number of works closed in the foodstuffs manufacture is to be explained by the fact that a great many mills received no grain for milling, and had therefore to shut up. The closing of the woodworking factories is to be explained by lack of raw material and the increased demands of the workers. The closing of the cotton-spinning establishments is due to lack of cotton and fuel. Unlike other industries, however, in which chiefly small works were closed, in this branch chiefly large works were compelled to stop—the average number of workers employed being 1090 per factory. Since the reasons for the closing of the various works is so important, they are detailed in the following table:

Reason for Closing	Works Closed	Workers Dismissed
Want of cotton	4	8,877
Want of grain	72	6,097
Want of materials, exclusive of cotton and grain	210	14,675
Want of fuel	43	28,573
Want of grain and fuel	16	741
Want of cotton and fuel	4	19,938
Want of material and fuel	18	3,981
Want of materials and workers	8	338
Want of workers	8	350
Want of orders and demand	47	3,893
Want of provisions	3	116
Workers left for agricultural work	17	1,786
Exorbitant demands of workers	49	5,610
Differences with workers	8	2,691
Losses and financial difficulties	22	4,370
Repairs	23	1,483
Proprietors called for military service	4	1,113
Diverse reasons	12	740

These figures show that the chief reason for closing works was partly the lack of grain and other materials. The second place is taken by exorbitant demands of the workers, the third by want of orders and demand, the

fourth by want of fuel, while works closed owing to financial difficulties and repairs, form a considerable contingent. A study of the figures shows that lack of labor on the whole played an insignificant role, only eight works with 350 workers having been closed for this reason. This circumstance confirms the belief that there is enough labor in the market, and that there is no want at any rate of qualified workers; on the contrary, in some parts there is an abundance.

To render the picture clear, figures have been grouped by governments with the following results:

Government	Works Closed	Workers Dismissed
Moscow	71	45,378
Petrograd	63	4,522
Saratoff	48	2,795
Samara	33	4,015
Kaluga	30	2,522
Kuban District	23	2,078
Vladimir	21	14,156

In the Moscow and Vladimir governments chiefly textile works were closed; in the Petrograd government chiefly mechanical works. The tendency to close works is increasing, as are also the difficulties in supplying industry with fuel and raw materials. The pressure exerted on industry by the working classes and revolutionary organizations, who hold all power on the spot in their hands, is increasing. Terrorization on the part of the workers and all kinds of committees and councils that find support from local authorities is robbing Industrials of every desire to continue manufacture.

Experience with U. S. S. and Whitworth Taps and Dies

By C. K. Chapin

President, Murchey Machine and Tool Company

As there will soon be millions of shells and fuses to be made by us in this country for our boys in France, our experience in manufacturing for others may be of value at this time.

The majority of collapsing and self-opening dies which we have furnished on the British, Russian and French shells have been of the Whitworth form of thread: 2 in., 14 pitch; 2½ in., 20 pitch; and 3¼ in., 14 pitch.

We have run the 2-in. taps at about 25 ft. per min.; the 2½-in. taps at 26 ft. per min., and the 3¼-in. taps at 25 ft. per min. These speeds have, of course, varied according to the quality of steel in the shells; also according to the various methods of tapping, but these are good average speeds to use on this work.

We have also worked on the larger sizes up to 9.2-in. British shells for the larger size taps, for which the speed would have to be reduced, this speed being governed by the results. The above sizes apply on fuses for shells, the fuses fitting in the tapped holes.

The lubricant that we have found most successful in all threading, is good, screw-cutting oil. While a good compound in a great many cases will make a satisfactory thread, we find the use of oil to be the best in the long run, as it gives a very much smoother and better thread.

In the manufacture of dies for the Whitworth thread and for the U. S. thread, we have found the U. S. thread easier to make. There is however, no special difficulty in making Whitworth threads when necessary. In fact we have cut large quantities of these threads with very satisfactory results.

From the consumer's standpoint, we think that the U. S. thread is the better. In the Whitworth threads, the rounding of the corners removes a certain amount of the bearing of a thread, while with the U. S. thread you have a full bearing to the top of the thread. There is a tendency of the U. S. form of thread to wear at the corner after constant use; but then it merely becomes like a Whitworth thread. Allowing for this wear, it gives a long-life chaser.

We have found from the experience of shell manufacturers that most of them want the threads to fit along the side. The main requirement has been to get a correct angle on the thread and to see that the hole has been bored to the true size, that none of the top of the thread shall be removed in the cutting, as that would allow a gage to drop through, which would necessarily reject the shell.

As an example of how these threads work, we have one munitions firm in this country that has been using 12-pitch, Whitworth, thread chasers for roughing the shell, and then using a standard, 12-pitch, U. S. chaser to finish with. On account of the round corners of the Whitworth, the bottom of the thread is not cleaned, thereby enabling the U. S. chasers to come in and cut a perfect thread. The firm used these Whitworth chasers because as left-overs they could be cheaply acquired.

Because of our experience with threading operations and in our endeavor to keep tools to a rigid standard, we are much in favor of the use of the U. S. thread in preference to the Whitworth threads.

Brazing vs. Welding Stellite Tips to Machine-Steel Shanks

By Thomas Fish

President of the Ready Tool Co.

Under the above title, on page 43, the writer has noticed with interest an article by Howard M. Bogart, that makes a discussion of certain experiments seem much to the point.

We have spent about two years experimenting on this work, and when it comes to brazing stellite, I have checked up these experiments with the inventor, Mr. Haynes, and he had some very thorough tests made of stellite after brazing, finding that the strength had materially depreciated.

There is no question but what stellite brazed, is not commercially practical, especially in view of the improved methods of welding by the electric process. As far as we can see this process has no effect on the stellite or high-speed steel, when properly done, but it took us a full year of experimenting with tests to get it right.

In the electric-welding process, especially on stellite, such a small section is heated that the large part of the stellite is not affected by the heat used in making the weld. It is done too quickly to spread, and the result is a perfect union of the two metals, without at all affecting the stellite.

We are now using this method commercially, and have been for some time. The welding of high-speed steel is an entirely different matter, as it requires special treatment after welding; the area next to the weld is affected by the high heat used, and has to be tempered.

Building Up the Ordnance Inspection Department

BY GLENN B. HARRIS

The inspection of ordnance and ammunition, and the hurrying of production so far as is humanly possible, involves an organization which is little understood, and the proportions of which are not realized except by a few of those having intimate business relations with this important branch of the Government service.

THE outbreak of war found the ordnance-inspection department in New York, which also had jurisdiction over contiguous territory, very small and relatively unimportant; but when the edict went forth that we were actively to aid in securing and maintaining the freedom of the world from tyranny and despotism, and contracts for war munitions amounting to more than $1,500,000,000 were let, it became a matter of absolute necessity that an efficient, and up-to-date inspection and hurry-up department be organized. The regular army could not spare its officers for such detail, and members of the United States Reserve, were brought into this service, as a consequence. While to say that this inspection department grew over night is not literally true, it is a fact that no time was lost in completing an efficient organization. The whole matter was placed in the charge of Lieut. Col. G. W. Dunn, who immediately called to his aid in the formation of his department, such trained industrial engineers as observation, experience and an intimate acquaintanceship had shown him to be most available; men, who by their proved ability in different lines of manufacture were best fitted to meet their country's requirements. In turn the industrial engineers chosen had a large acquaintanceship, and through their solicitation and personal influence they were enabled to bring to the service of the country men of unquestioned ability, who had been in touch with the manufacture of any and everything in the metal line, from their first induction into business.

In some departments the initial appointments and designation to commissions in the army, were not made with that care which should have been exercised in filling positions of this character. The default was in a measure due to hurry, to lack of investigation. This is now entirely changed, and those receiving appointments are in the first rank in character and ability: a fact strongly in evidence, since private concerns are constantly offering high salaries to the U. S. Reserve officers, in an effort to secure their service. As a rule, however, these men are extremely patriotic, and the number of defections from the service is negligible; few seeming to care more for the dollar than for the service they can render their country. Obversely there are men serving in the inspection department of New York, who had been drawing salaries running to as high as $10,000, per annum, who voluntarily relinquished their positions in civil life to accept commissions under the Government, and at a pay equal to perhaps only one third of that of which they had been in receipt. It was patriotism pure and unadulterated, which induced them to make the sacrafice.

The maximum of production of munitions will not be reached for a period of eighteen months or two years, should the war last that length of time; and with everything under full headway, the force of the ordnance inspecting department in New York alone will number several thousand. This, be it understood, is but one branch of ordnance inspection, and when other branches of Governmental inspection are taken into consideration a vague idea may be formed of the magnitude of this very important branch of the Government's war service. In the large department under the control of Lieut. Col. Dunn there are but two regular army officers acting as his assistants, the remainder of those engaged being drawn from civilian ranks. The organization is most complete in all respects, and running as though organized and in active operation for years. Undoubtedly, this in a large measure is due to the high efficiency of the aides Col. Dunn has been able to call to his assistance.

It has not only been suggested, but strongly urged that the law be so amended as not only to permit, but to compel those who receive a commission in the U. S. R., to enlist; this, for the twofold purpose of retaining the services of those who might be tempted to leave the service for civilian employment, and to allow of the reduction in rank even down to the grade of a private's pay those of known incompetency, or who by their personal habits might be deemed unfitted acceptably to fill their positions.

PRODUCTION IN A CHAOTIC CONDITION

At the beginning of the war and for a considerable length of time thereafter, matters so far as production was concerned were in a more or less chaotic condition. Ordnance plants had been manufacturing under British, Russian and French specifications; and their equipment in the way of tools, jigs, and gages, was not adapted to U. S. requirements. It was only by the use of absolute brute force that any headway in manufacturing munitions for our army was made.

Delays were due not only to the lack of proper and adequate manufacturing facilities, but also to an inability to obtain material; and material was scarce, partly owing to the excessive demands of our Allies, partly to priority shipments made to certain favored contractors. These difficulties under which the manufacturing industries have labored for so many months, are being removed as quickly as possible, and all requirements will be met soon and promptly.

The New York Ordnance Department is particularly gratified at the willingness shown in meeting Government requirements and the desire expeditiously to turn out contracts.

In some instances exception is taken to inspection requirements, and complaint is made that too little is left to the discretion of the individual inspector as to

tolerances. It is quite true that in a large number of Government specifications, the requirements as to exactness are entirely too rigid; yet in numerous instances when the tolerance is a liberal one, the manufacturer is not satisfied, and he attempts to persuade, if not to force, acceptance of a defective product.

It is not possible while safeguarding the country's interests to allow too much latitude, nor leave too much to the discretion of an inspector, as the possibility of his being swayed by personal feelings, or perhaps by ulterior motives, is always present.

In a certain plant an inspection of material or product had never been carried on by the manufacturer, and when it was suggested that primary inspection be made by a duly delegated employee in order in a measure to relieve the Government's inspector of arduous and unnecessary duties, a flat refusal was given. On the matter being taken up with Washington, the decision was reached that the manufacturer must only submit for inspection such articles of manufacture as seemed reasonably sure of passing. The work of Government inspection was thus considerably lightened, and the inspector permitted more time in other plants requiring his attention.

It is now definitely settled that the Bureau of Standards, will pass on all checking gages and that this bureau will be placed in control of most thoroughly competent and experienced men. If this bureau is efficiently and rationally administered, it will indeed prove a boon to the Government and the manufacturer alike. Exacting specifications when not essential, will not be required and the unnecessary expenditure of both time and money will be reduced to a minimum.

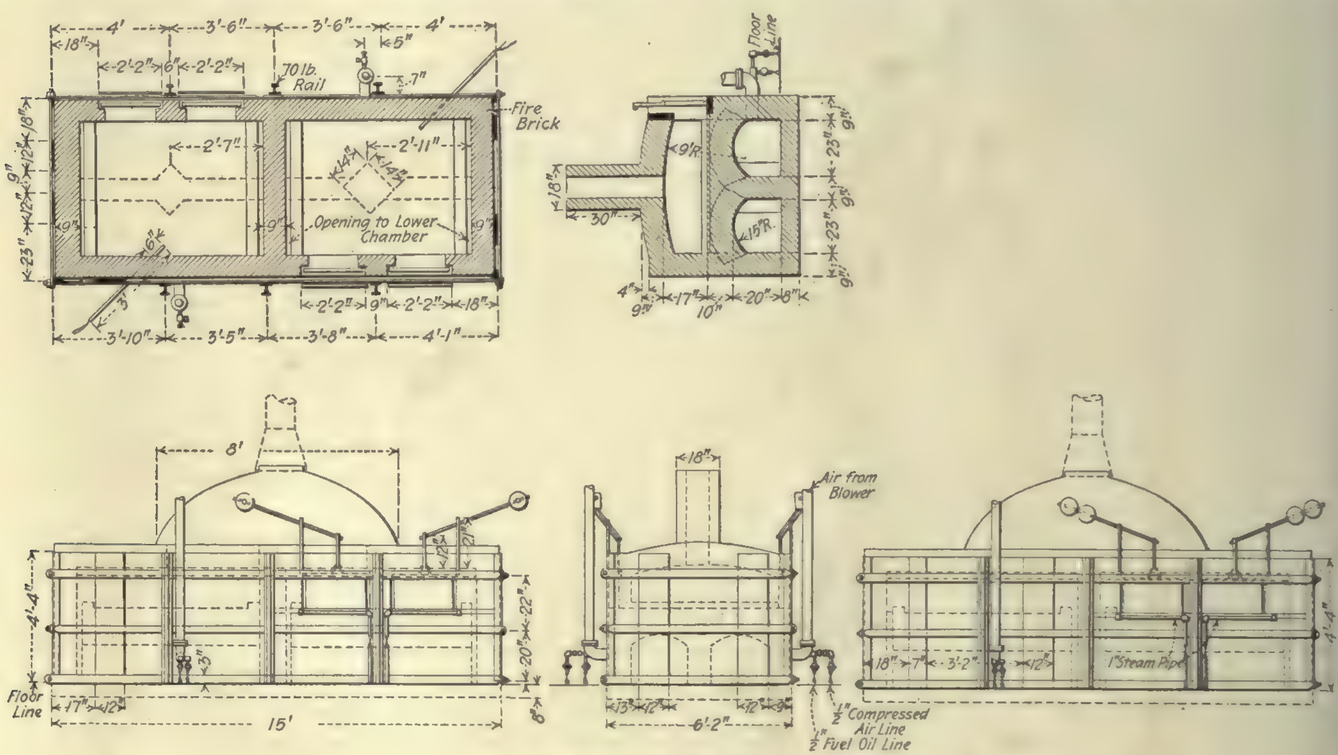
The services of General Crozier, for a long time Chief of the Ordnance Bureau in Washington, will be of material benefit to the war board to which service he has been designated, and the appointment of General Wheeler as his successor will give unbounded satisfaction to those having business relations with the Ordnance Department. General Wheeler is everywhere recognized as an ordnance expert of exceptional attainments and ability, and coupled with this he is an executive of a high order.

A Spring-Heating Furnace

By Joseph K. Long

The accompanying illustration shows a furnace for heating and tempering the leaves of springs, and by the use of which excellent results have been obtained in the Renovo Shops of the Pennsylvania Railroad.

The furnace is 6 ft. 2 in. by 15 ft. over-all, and the corners are made rigid, and further reënforced by means of angle irons, which are held by three horizontal sets of bands or strips extending the length of the sides and ends of the furnace, and connected at the corners. The horizontal strips hold in place vertical plates, which are disposed at suitable points on the sides and ends, and serve to materially strengthen the latter.



A SPRING-HEATING FURNACE

The side walls of the furnace are further reënforced by the use of 70-lb. steel rails, vertically located at required intervals.

Large pipes for supplying air from the blower enter the sides of the furnace in a straight line, as this has been found more satisfactory than when the pipes are led in on an angle.

The furnace can be supplied with air from the compressed-air system by means of a connection entering at the same point as the fuel oil. This arrangement is made to provide against a possible breakdown of the blower system. The blower pipe line is 3 in., and the oil and compressed-air lines, each ½ in.

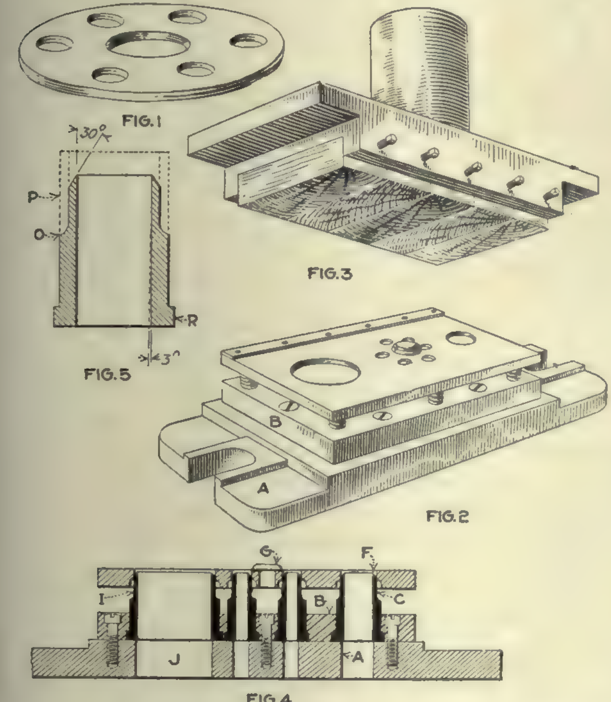
The doors of the compartments, of which there are two on each side and at opposite ends of the furnace, are

raised and lowered by pivoted levers having ball weights, and which hold the doors in an open position when raised. Each of the compartments is equipped with a Thwing electrical pyrometer.

Progressive Die for Rubber Washers

By Hugo F. Pusep

The design of a die for punching hard-rubber washers illustrated in Fig. 1, embodies some interesting, and novel features of construction. The die as it appears when assembled is shown in Fig. 2, and it can be seen that it is of the progressive type, or as it is sometimes called a "follow" die. The die shoe *A* Figs. 2 and 4, of cast iron, has the plate *B* mounted on it and held with seven fillister-head screws. The cutters are mounted on the die shoe, the punch proper consisting of five blocks of hard maple glued together, and held with screws to the cast-iron punchholder as shown in Fig. 3. The construction of this being so



FIGS. 1 TO 5. DETAILS OF THE RUBBER WASHER AND THE DIES USED IN PRODUCING IT

simple that no further explanation is necessary. Hard rubber was the material worked on and it came in strips 3 in. wide.

The operation of the die is as follows: The stock is placed on the stripper plate, Fig. 4, over the first punch *C*, Fig. 3, and held against the stock guide. The punch block on descending, forces the rubber strip and the stripper plate down over the cutters till the sharp edge *F* has cut clear through the rubber and slightly into the hard maple block of the punch. On the upstroke of the press the stock is stripped by the aid of the six springs, and being moved further over, the stripper plate is located over the next position by the pilot *G* entering the 1-in. hole pierced by punch *C*. In this position the six $\frac{3}{8}$-in. holes are pierced, while with the same stroke of the press another 1-in. hole is added, which in turn is located over the pilot *G*, and the punch block on descending cuts out the finished washer by forcing it through the hollow punch *I*. Now a complete washer will drop through the opening *J* of the die shoe.

Fig. 5 gives a few more important dimensions of a cutting die, all of which were made of a good grade of tool steel, hardened and drawn to dark straw on the cutting edge, and made similar in proportion. It will be noted that the cutting angle is 30 deg., which was found to give entire satisfaction in hard rubber. The shoulder *O* accommodates the bushing *P*, shown in dotted lines, which is for the purpose of pressing the cutters out of the punch plate, when the cutting edges need regrinding. Three of these bushings were made, one for each different size of punch. The diameter of these bushings is a few thousandths less than the hole for the corresponding punch in the punch plate.

In all rubber-washer punching, but especially for those of larger size, a progressive die made as the one just described, is much easier to make, and of longer life than a complicated compound die. It is also easily set up and operated in the punch press. When the punches become dull, they can be reground, and put back in a short time.

Care should be taken to have the bottom faces of the small cutters marked with a corresponding figure on the plate in order that each cutter may be put back in its proper place after grinding. Of course, this would not be necessary if all the cutters were made interchangeable as regards the outside diameter and depth of shoulder *R*, Fig. 5, but this would hardly be practicable on account of the extra time needed to accomplish this result.

Simple Calculation of Cutting Time

By F. J. Fishleigh

A great deal has been said and written upon this subject; elaborate tables have been compiled; constants involving the calculation of speed expressed in terms of feet per minute have been worked out until the subject would seem to be exhausted.

The average mechanic does not take kindly to calculations of this kind, and cutting speed thus expressed does not appeal to him, but if he be a wide-awake fellow he will give the tool what it will reasonably stand—expressed shall we say, in certain lever positions, belts on certain cone-steps, or more briefly in revolutions per minute.

The mechanic however, is interested in knowing how long it is going to take to finish the piece in hand; and if his lathe or milling machine is supplied with index plates showing revolutions per minute and feed constants for the various lever positions, the following simple calculation will suffice:

Let us say he has a cut 8 in. long (diameter does not matter) and his index plates show the spindle speed to be 55 and the feed 32, he simply multiplies the length of cut by the feed, and divides by the revolutions per minute thus:

$$\frac{8 \times 32}{55} = 4.65+$$

indicating that the tool will make this cut in approximately 4.65 minutes.

The Effect of the War on the Engineering Education

BY C. R. MANN

Doctor Mann has been engaged for three years in making a study of engineering education for the four national societies of civil, mechanical, electrical, and mining engineers, and the Carnegie Foundation for the Advancement of Teaching. He therefore speaks with full knowledge of methods now employed in the schools.

THREE years ago most of us thought that a world war could not last long because, however much kings and kaisers might wish to continue, the banker would stop it. But the financiers have not come up to our expectations in this matter, and we have therefore been compelled, unwillingly perhaps, to recognize that money is not the ultimate measure of national strength. National credit is the result and not the cause of intelligent industrial production: the engineer, not the banker, is the real power behind the throne.

This fundamental fact now seems so simple and self-evident that it is rather hard to remember the time when we thought otherwise. But though the rugged outlines of this fact are now sharply silhouetted against the ruddy dawn of the new age, the details of its meaning are but dimly discernable through the haze of speculation over the significance of the struggle. Naturally the engineer is intensely interested in the development of the details of the picture, for on him devolves the duty of interpreting the coming conceptions in terms of materials and organizations of men; and if education makes men, engineering education must be the first to feel the thrill of the dawning day.

Three elements in the picture can now be plainly perceived. These indicate that the engineer is henceforth vitally involved in the control of credit, in the interpretation of the daily news, and in the organization of industry and commerce to make goods eheap and men dear.

In performing the first of these new functions, the engineer becomes the partner of the banker to determine which projects are worthy of financial support and which not. As the engineering spirit is more and more infused into this dispensing of credit, public service rather than excess profit becomes the inspiration for enterprise; intelligence in production becomes the best security for loans; ability to deliver the goods becomes the sure basis of financial success; and the control of tools gradually passes from the hands of those who own them legally into the hands of those who can use them effectively.

Newspapers and periodicals already sense the expansion of the engineering spirit in the struggle to make the nation strong. The distribution of wheat, the supply of sugar, the transportation of coal and the price of bread are now subjects which occupy an amount of space in the daily press that only a Thaw trial formerly could command. The public has never before realized how vital and how interesting factories, freight cars, warehouses, terminals, trucks and ships really are. Some faint conception of the necessity of organization for the common project of liberating life by winning the war, seems to be taking shape; while an impelling desire to serve and to subordinate personal preferences to community interests appears to be dimly developing. These faint feelings of fraternity may grow into driving impulses, if editors continue to extol engineering enterprise rather than private profit, in their interpretations of the daily news.

In many communities chambers of commerce or groups of engineers have organized to build up business and boom the town. Through their efforts living conditions have been improved and many a city is being made a better place for homes. But the progress has always been hampered by the vested rights of individuals and of corporations, so that none has yet dared to envisage an entire community as a single working plant for the purpose of organizing it for the most intelligent production of human wealth. This can now be done. The war is opening many hitherto blind eyes to see that each gains more than he loses when he merges his strength with the might of all in an organization that is constructed for the purpose of releasing creative energy by giving each the work he is best qualified to do.

An Organization in Every Community

The time has come for such an organization in every community and every state, because the Federal Government is struggling to shape the nation into an organization of this type. Only so may the nation be strong; only so, may communities add their utmost to the nation's strength. The responsibility for this work must finally be shouldered by engineers who are both masters of the mechanic arts and molders of men.

For many years this country has been drifting toward the realization of these requirements. The war has but accelerated the process and precipitated conclusions that were bound to come, otherwise men trained by experience to meet the present crisis could not now be found. Continuity demands that the same conclusions remain valid long after the war is ended. Therefore, engineering schools will render service in proportion as they grasp the implications of these conclusions and express themselves effectively in the daily work of instruction.

The possible conclusions for engineering education are many and complex; but two stand out in bold relief: namely, there must be closer coöperation between school and industry, and there must be more attention to the appraisment of values and costs.

The essential feature of the coöperation with industry is not the skill, the knowledge of workmen, nor the feel of the machines which the student acquires from shop experience. Important as these are, they cannot compete with the spirit of investigation which must develop if the coöperation between school and industry is real and vital. There are thousands of unsolved problems in even such rough shop work as freshmen are permitted to do. The boy should be trained to discover these un-

solved problems and to bring them back to school for discussion and solution. By making shop work in industrial plants the source of problems for solution in school, and by relating the class and the laboratory work in some degree to the problems raised, conditions most favorable to the self-development of the student may be realized. As he progresses, the problems become more and more intricate; until in his last year, if he has shown real engineering ability, he may be assigned as helper in industrial research, either at the plant, or in the school laboratories. After such a training in defining and solving problems, closely coördinated with instruction in science and drill in mathematics, he should be able on graduation to take a responsible position without serving several years as an apprentice, as is usual under present conditions.

Creative Work in Production

To the faculty, this type of coöperation with industry brings incentives for creative work in production and in education; for coöperation makes the school the source of solutions of industrial problems, not only with respect to the technique of manufacture, but also concerning the correlation of the community's productive processes with the training of its citizens as intelligent workers. Hitherto manufacturing companies have stood aloof and regarded one another with suspicion—and the Federal Trade Commission discovered that 200,000 of them are not paying expenses; but now they are ready to coöperate. Similarly in education, many manufacturers are supporting corporation schools to train their own help, while more than half the children in the entire country quit school at the sixth grade without being trained to earn a living; but they too are now ready to coöperate. If the men who are teaching in engineering schools rise to the responsibility and organize for the systematic study of community production, they could soon create a true university, with its feet firmly planted in industry and its soul consecrated to the task of utilizing science and literature to liberate the creative energies of men.

Close Coöperation Between School and Industry

While close coöperation between school and industry gives that practical experience which is essential for mastery of the mechanic arts, it is not in itself sufficient to enable the schools to meet adequately the fundamental requirements of engineering in the new epoch. The Germans are technically well trained in the mechanic arts, yet they are but brutally strong. In order to strengthen the nation by infusing the engineering spirit into the control of credit, the interpretation of the daily news and into the organization of industry for the production of human wealth, the engineer must have sound judgment in the appraisement of values and costs. This requires not only an understanding of finance and the meaning of money, but also a sympathetic appreciation of the things humanity holds to be most worth while. Even a practical project like building a bridge is ultimately controlled by some man's decision that the resulting value is worth the cost; and this decision is more difficult and subtle when it concerns profoundly the production of human wealth and the appraisement of human values and costs. The engineer is too often obliged to be only the employee of the bank, the corporation, or the state commission, because he believed that engineering is wholly a matter of technical skill; when control in this, as in everything else, is really vested in the decision of the question whether the game is worth the candle.

Training in the appraisement of values and costs does not require the addition of formal courses for that purpose, but rather the injection of this point of view into every branch of school work. For example, experiments in chemistry need not always be of the type: analyse this baking powder. The project: make baking powder and find out if it is cheaper and better than any you can buy, is vastly more effective as a training exercise. Presented as a personal effort to appraise the human values and costs in life's experiences, literature fascinates engineering students. Economics delights them when it is a critique of proposed solutions of the social problems defined by their daily coöperation with labor. Such exercises also foster the development of those homely virtues, which always make the working people the bulwark of a nation's strength—the sense of justice, feelings of neighborly kindliness, devotion to right, and respect for God and man.

War Has Hastened the Transformation

Thus because the war has revealed a profounder appraisement of human values and costs, and because the war has hastened the transformation of the individualistic man, selfishly seeking his own personal profit, into a community man willing to do his best for the common welfare, the ideal that was set for the engineering schools in the passage of the Morrill Act in 1862 may now be achieved. For many of the first schools founded under that act were called "Industrial Universities"; but they soon dropped the "industrial" from their titles, fearing lest they lose caste in academic councils. But now, if they gladly grasp the opportunity opening before them, they will claim with pride their abandoned surname and proceed to demonstrate that the engineer, the creator of a new earth, is also the prophet of a profounder philosophy of life.

Thread-Lead Gage

By E. Amos

The thread-lead gage shown by Leonard M. Thorn on page 1092, Vol. 47, does not look practical to me, inasmuch as when applied to a threaded piece, the disks would stand at an angle with the threads being tested, this angle depending both upon the lead and the diameter of the tested piece, and being emphasized by an increase in the diameter of the disks.

Let us suppose an extreme case, where large disks are applied to a screw of small diameter and of comparatively rapid lead: the disks would touch, or rather ought to touch the thread angle at a point forward (toward the observer) of the center line on one side, and back of it on the other side; furthermore the point of contact would be a curve and not a straight line. Of course, this departure from accuracy would in ordinary cases be very slight, yet not permissible in gage work; and if one desires to get an approximate test it could be secured without entailing so exact a piece of tool work as this gage would seem to be.

Sidelights

EDITED BY D. BACON

The distribution of the appropriation for the proper establishment of conditions of life for men in shipbuilding centers, has begun. The Newport News Shipbuilding Co. has received $1,200,000, while about $1,000,000 of the fund will go to the Maryland Steel Co.'s plant for housing its workers at Sparrow's Point. Eight thousand homes are to be built in Philadelphia for the Government plant at Hog Island, and this is a joint expense of the Emergency Fleet Corporation and the city of Philadelphia.

Our War Aims

"An evident principle runs through the whole program I have outlined. It is the principle of justice to all peoples and nationalities, and their right to live on equal terms of liberty and safety with one another, whether they be strong or weak. Unless this principle be made its foundation no part of the structure of international justice can stand. The people of the United States could act upon no other principle; and to the vindication of this principle they are ready to devote their lives, their honor, and everything that they possess. The moral climax of this, the culminating and final war for human liberty, has come, and they are ready to put their own strength, their own highest purpose, their own integrity and devotion to the test."—*From President Wilson's Address, Jan. 8, 1918.*

New Working Hours for England's Workmen

The exhaustion suffered by laboring men because of the intensive labor demanded of them during four years, has induced the British Health of Munition Workers' Committee to publish new memoranda on weekly hours of employment. The former hours of work per week included a maximum of 67 for men and 60 for boys and women; but the steady, high-pressure activity in the factories of England for four years, with the awful push of war behind it, has made these hours inimical to workers, while the increase of women workers makes it possible to reduce the laborer's time.

The same executive body has decided that the best hours for labor on different kinds of work and for different persons, are not identical, and a new schedule with these differences in mind, will be made.

How High Brak Papa Flew

The wonderful performances of the Italians reached their air-height last month, just before Christmas. Flight Lieut. Brak Papa (who already held a record for high flying with a passenger) broke his previous performance by mounting 28,040 ft., carrying a useful load of 792 lb. besides his passenger. He did the work in a Sia-Fiat biplane, with a 300-hp., 6-cylinder, water-cooled engine.

Brak Papa rose from the Turin aërodrome and attained 3280 ft. in the first 2 min. and 30 sec. The next rating was of 6561 ft. at the end of 5 min.; then 9842 ft. at the end of 9 min.; 12,123 ft. in 15 min.; 16,400 ft. in 24 min.; 19,685 ft. in 37 min. 30 sec.; 21,325 ft. in 45 min., and his maximum of 28,040 ft. in just over an hour. The Sia-Fiat engine has 4 valves per cylinder and a direct-mounted propeller.

Adjustment of Prices to Cover a Longer Period

The maximum prices fixed upon ore, coke, pig iron, steel and steel products by the President, are to be maintained at least until Mar. 31. No new contracts which shall call for the delivery of any of these articles on or after Apr. 1, are to specify a price, unless they are coupled with a clause which shall make such contracts subject to revision by an authorized agent of the United States Government. This means that all deliveries after Apr. 1 may not exceed the maximum price then in force, even though the goods to be delivered have been contracted for in the interim. The maximum prices now made, will probably be observed by all manufacturers.

Scientific Firing: Economic Coaling

The firing of stationary boilers consumes 42 per cent. of all the coal mined in the United States. Last year 252,000,000 tons were burned and cost $1,260,000,000, at a calculation of $5 a ton. Very nearly half of all the coal thus fired, is wasted.

Recently *Power* presented this wastage on the simple lines of comparison, which method goes farther to convince the mind, than would a mere arithmetical calculation. *Power* declared that if but 10 per cent. of this coal were wasted, the cost would supply the complete uniforms of more than 3,000,000 of our soldiers. A fireman who is firing his boilers unscientfically, may assume that he is burning the very pants off his boy who may be "somewhere in France."

There are some economic "don'ts" to be borne in mind by the fireman.

Don't cover the entire live area of the fire deeply with coal. When the bright, burning area is covered, there is a temporary lowering of temperature is there not? Don't smother the fire: feed it. Dead areas in a firebox mean less temperature than a man is entitled to get from the amount of coal he is feeding to his furnace.

Don't permit holes in your fire. A hole means that air has sought and found its way plum through an isolated space, has burned up your fuel and through the hole is cooling your boiler. It is better to fill the hole with ash than to leave it. Ash at least will prevent the air from finding its way to your boiler.

Keep a shallow bed of fire. A clean-kept fire is the secret of coal economy. Keep your fire level because an unequal thickness makes an independable result. Keep the ashpit empty. Scatter your coal evenly, shallowly and frequently, upon your fire; slice with discretion and do not turn your fire over.

If you are a fireman, specialize! Be a scientific fireman for the good of your country and in the name of common sense.

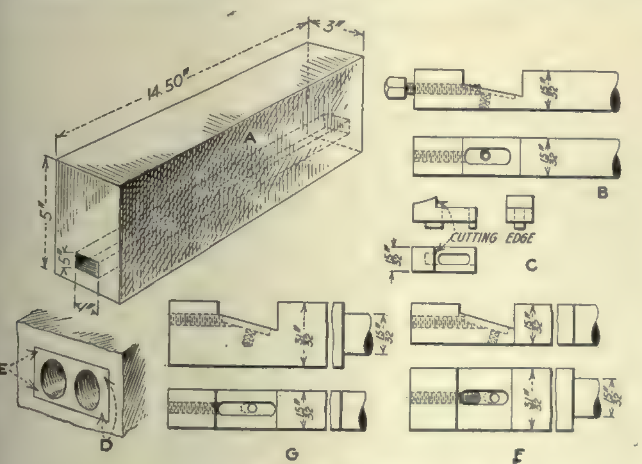
Machining a Long Rectangular Hole

By Frank H. Jennings

I was recently confronted with a peculiar problem, and I thought it might interest some readers of the *American Machinist* to be told how I accomplished it.

I had a block A of $3\frac{1}{2}$ per cent. nickel steel $14\frac{1}{2} \times 3 \times 5$ in. Through this block I was required to machine a hole 0.50×1.0 in. with an allowance of 0.0005 in. in the sizes. The hole was to be straight throughout its length, parallel with the block, and the short sides of the hole square with the longer sides.

The proposition looked terrible to me, but it was not permissible to cut the block in half, and mill the hole in the two parts. Making a series of long broaches, and broaching it, was out of the question as it would be an expensive operation, and I had no facilities for hardening and grinding the cutters, and no press that I could use to push the broach through.



THE WORK AND THE TOOLS

The only machines I had that I could depend upon to help me out where a 12-in. lathe, and a 16-in. shaping machine. With these two machines my purpose was accomplished. I bolted an angle plate to the faceplate of the lathe, and drilled two parallel holes $\frac{15}{32}$ in. diameter through the block. Before running the $\frac{15}{32}$-in. drill through I first drilled two smaller holes half-way through the block and then reversed it on the angle plate. In this way I kept the holes parallel. I then clamped the block down on the shaping machine table and made up a bar as shown at B. This bar was a few thousandths smaller than the hole and on it I had put a tool somewhat similar to those used for rifling gun barrels. This tool was held down on the inclined plane by a small machine screw, and was held back by the setscrew in the end of the bar. The chip tended to force it up the plane and the reverse stroke tended to push it down the plane, thus making it safe to back out at any time. I made up a series of these tools of different heights, as the amount of adjustment for each was limited.

Starting with the smallest tool, and cutting on the back stroke of the shaping machine I squared out the two corners D $\frac{15}{32}$ in. wide. I then changed the bar to the other hole and repeated the operation on the corners E. I then turned the bar 180 deg. and cut the wall between the holes half-way through, then placed the bar back in the other hole and removed the remaining wall.

This gave me a roughly squared hole $\frac{15}{32} \times \frac{31}{32}$ in. I then made up bars F and G which employed the same principle as bar B. I roughed out the short size of the hole with the bar F turning the bar 180 deg. several times so as to gradually correct what wave there might be in the length of the hole until the hole measured 0.490 in.

I then used bar G, and sized the opposite sides of the hole until it was within 0.0100 in. of size. Then changing to the bar F I finished the hole to 0.50 in., and then changed once more to bar G, and finished to 1.00 in.

It was necessary to make about four tools for each bar, and though this process might seem somewhat elaborate to some, it allowed me to accomplish results with the means I had at hand.

Breakage of Roughing Tools

By H. James

On page 1049, Vol. 47, of the *American Machinist*, Charles L. Yost speaks of his experience in breaking roughing tools, due to the unevenness of the bottoms of the tools. This would be quite an ordinary occurrence but that its cause is common knowledge to most mechanics, and most shops of any size employ men who do nothing but see to it that all tools are ground and redressed and put into correct shape for the men who can not do it. This saves time by enabling the machines to run without stoppage for repairs.

Failures of the kind mentioned are particularly noticeable on large tools of perhaps 2×2 in. and $1\frac{1}{2} \times 3$ in. Most good mechanics however, extend the tool the least possible distance from the edge of the toolpost as they know this practice will tend to lessen the chance of fracture.

The paragraph referring to vibration in relation to crystallization arouses the old argument as to whether

or not crystals do grow when subjected to vibration. Some persons, including the writer, think there is no change in the size of crystals when temperature is not a factor in the use of the material; and that the crystalline face on the fracture is due to the method in which failure was made; that is, the path of fracture has been altered from that which it would have taken had the metal been broken before it was used.

Cut a piece of steel almost through, then grip it in a vise just below the saw cut. Strike a sharp, heavy blow and examine the fracture; it will be crystalline, though the crystals will be small if the steel is good and if it originally had a fine grain. Now take the same piece of steel, saw it nearly through and break it very slowing by light blows, and the fracture will be silky.

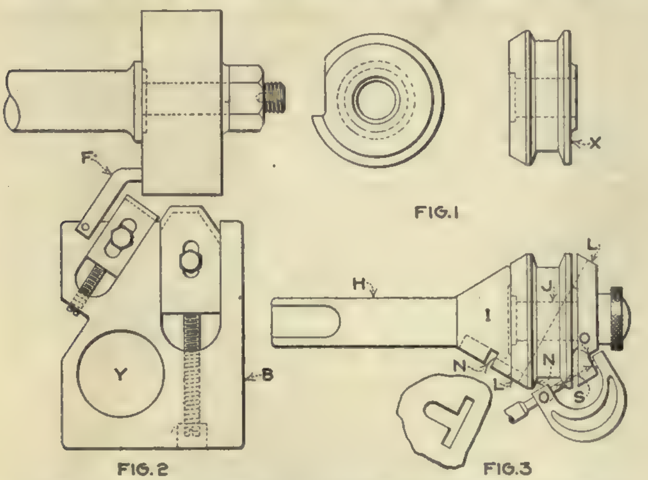
If steel be heated to a high temperature and cooled, the grain will be coarse, and if samples are taken and these simple tests are made the difference in the fractures will better show the cause of crystallization than will any argument.

Making a Circular Forming Tool

By L. C. Blomstrom

A large number of circular forming tools like Fig. 1, and which were required in turning the base ends of shrapnel fuse bodies, called for accurate machining and with the exception of the surface *X*, were to be ground all over. To get the blanks ready for the forming operation was an easy proposition; however, the method of putting on the form may be interesting.

As shown in Fig. 2 a block *B*, having an opening *Y*, was placed on the toolpost and rigidly clamped in position on the tool rest. This block had two slots milled in it at proper points, in which were located the cutting tools. Each of the cutting tools was provided with a slot to receive a stud to which the cutting tool was secured. Adjusting screws in the block were provided to engage the outer ends of the cutting tools, and hold the latter in position against rearward movement from the work. The depth of the cuts on the blank, as well as their position, was provided for by means of a guide piece *F*, which contacted with the side of the blank, and also with the flange on the mandrel.



FIGS. 1 TO 3. MAKING A CIRCULAR FORMING TOOL

Fig. 1—Circular forming tool. Fig. 2—Fixture for shaping forming tool. Fig. 3—Forming tool held for grinding and measuring.

After the milling and hardening operations, the forming tools were trued up on the internal grinding machine faceplate by slipping them over a removable plug piloted in the hollow spindle, clamped and then ground to size in the holes. The end faces were then ground while on centers—the larger surface first, and then the smaller end—on the surface grinding machine. The various surfaces that made up the form came next.

Probably the most common method of checking angular forms is the use of a thin profile gage, trusting to the operator's sense of sight, and his guessing ability as to where and how much stock is to be removed.

The combined grinding mandrel and gage shown in Fig. 3 provided means for measuring with a micrometer and overcame the objectionable feature of guesswork as in profile gaging. The mandrel *H* was hardened and carefully ground all over. The tapered portion *I* formed a continuation of the front conical section of the forming tools, with the diameter, before rounding the same as on the finished tool. The circular forming tools were slipped on the spindle *J*, of the mandrel bearing against the portion *I* and held in place by the nut. As shown, the surfaces *L*, *N*, and *O* were made parallel to directly opposing edges of the three angular surfaces. The measurements were taken from these parallel surfaces with micrometers.

The table of the universal grinding machine used was swung to suit each angle so that the face of the wheel could be used. Considerable time was saved by running through a large number at each setting, and with this method of checking, the production was unusually high-class for this character of work.

A Piston-Ring Slitting Fixture

By H. E. McCray

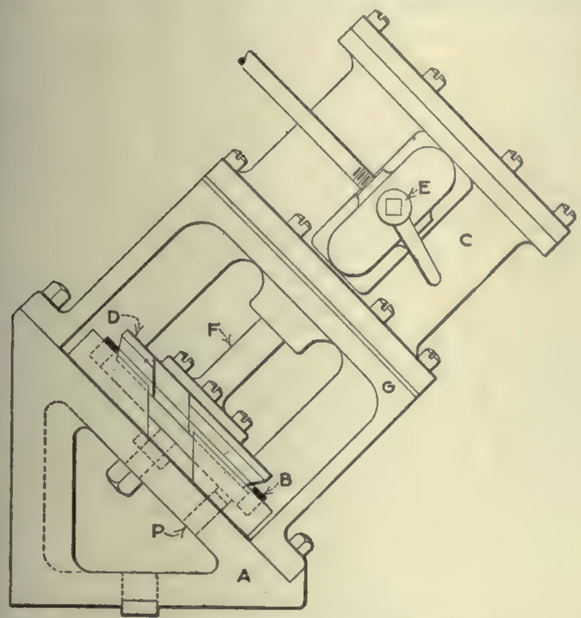
In the illustration is shown an assembled view of a piston-ring slitting fixture. The piston-ring blanks or pots are trued up by the inside, and the chucking flange turned and faced ready for the piston-ring machines. Here they are turned and parted off, then sent to the ring-grinding machines for rough- and finish-grinding. The next operation is slitting on a hand milling machine, equipped with the fixture shown.

The rings come from the machines with considerable variation in outside diameter, as the tools are crowded to their limit. If the 45-deg. angle slots are to be of uniform width, when the rings are compressed to the size of the cylinder, it is evident that either the outside diameter must be held to close limits, or some compensating mechanism be employed. About 0.030 in. is allowed for re-turning, using a hinged ring-pot and flanged mandrel holding six rings for the re-turning operation. This is on centers in a small engine lathe.

The slitting fixture consists of three parts, the 45-deg. base *A*, the frame *G*, and the air cylinder *C*, with the clamp *D* attached to the piston rod *F*. The base is bolted to the table of a small hand milling machine, and is located by two gibs in the T slot. The ring holder *B* is of steel, pack-hardened and ground on all bearings, a boss on the under side locating it on the 45-deg. surface of the base. It is slotted to clear the milling cutter, as is the clamp *D*. The clamp is also pack-hardened and ground, and attached to the air piston-rod end by four capscrews and held central by a boss on the rod.

The air cylinder C is of the usual construction, and needs no description. It is controlled by the four-way cock E, and is double-acting. By pulling down on the handle, the clamp D is forced down on the ring, and by reversing the valve the clamp is withdrawn. Two stops are fitted on the cross-slide of the milling machine, limiting the travel in each direction. A $\frac{1}{16}$-in. slitting saw is carried on the machine arbor for slitting the ring.

The operation of the fixture is as follows: the operator is provided with a ring gage of the proper diameter to allow for re-turning and still give the correct width of the slot when compressed. A ring is placed in the holder, the air turned on, and the ring clamped down. The table is then moved against the stop on one side, which throws the cutter in the center approximately



PISTON-RING SLITTING FIXTURE

half the width of the slot. The table is then moved toward the cutter, and one cut taken through the ring.

The split ring is slightly smaller in outside diameter than the inside of the ringholder, and consequently is forced out by the bevel of clamp D against the sides of the holder.

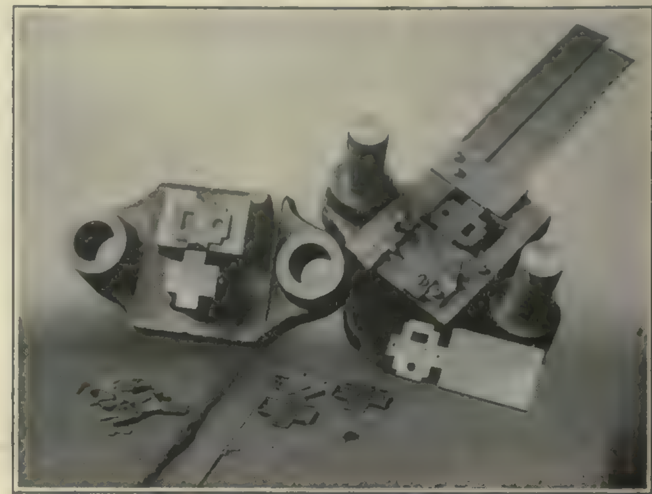
The table is then backed away, moved over to the other cross-slide stop, which is adjusted to give the required width of slot. It is evident that the rings may vary a considerable amount in outside diameter without detrimental effect, as the result is exactly the same as if they were the exact size of the ringholder. The rapidity of operation may be judged from the piece rate which is 25c. per hundred for all sizes from 3½ to 6½ in. in diameter.

Forming Die for Lock Backs

By E. Shaff

This die was designed to make suit-case lock backs from scrap metal. The finished piece is made in one operation and any piece of metal having one straight edge, can be utilized.

On the first stroke of the press, the stock rests against a stop at the edge of the blanking die. The die is then stripped from the cutting punch by means of a spring pad. Such a blank is shown lying against the die in the illustration. After the scrap is removed from the blank, it will pass the first stop and thus reach the second stop below the forming die. On the next stroke of the press the blank is cut off and the lock back formed;



THE FORMING DIE AND ITS PRODUCT

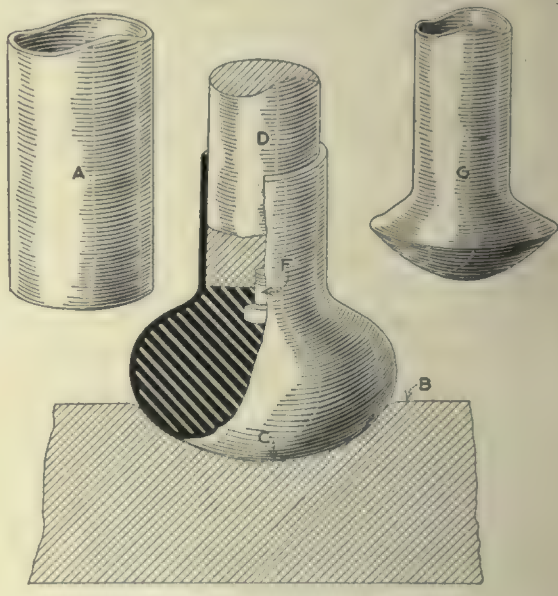
simultaneously, the first perforates and trims another piece.

This die is not difficult to make, is easily ground and gives excellent results in service.

Producing a Bulge in Tubing

By G. R. Smith

On page 860, Vol. 47, I read with some interest an article by W. S. Quimby, giving a method for bulging metal tubing. Mr. Quimby's article states that he uses soft-lead slugs inside the tubing to do the bulging which he afterward melts out. I think he would save much



METHOD OF BULGING SHELLS

time, cost and labor, and get just as perfect a bulge by the use of cushion rubber slugs in the place of the lead slugs, and the rubber slugs can be used over and over again. After the pressure is relieved the rub-

The Reorganization of the Ordnance Department

THE reorganization of the Ordnance Department is a long step forward. The plan has been worked out under the direct supervision of the new Chief of Ordnance, along carefully tried-out lines, and there is reason to believe that it will prove advantageous in every way. No one dreams that it is perfect, but from our knowledge of the new Chief we are confident that changes which seem to be necessary or desirable will be made promptly.

FEW realize the expansion which has been forced on the Ordnance Department during the past year. On Apr. 1, 1917, the staff consisted of 9 commissioned officers and 227 civilians. It occupied 15,000 sq.ft. of floor space. On Sept. 1, this had been increased to 450 commissioned officers and 1400 civilians, and the Department occupied 100,000 sq.ft. of floor space.

On Jan. 1 of this year there were 1601 commissioned officers, 122 enlisted men and 4830 civilians, occupying a floor space of 521,000 sq.ft.; and this is by no means the high limit, as the estimates for June 1 of this year are: 4400 commissioned officers, 2600 enlisted men and 12,300 civilians. The estimated floor space needed is 1,425,000 sq.ft.

The old form of organization could not stand the stress of such expansion. It would have strained even the most modern business organization to the utmost. But with the new spirit which is evident, and which is utilizing the best experience obtainable, there is every reason to believe that striking improvements will be seen in many directions.

THE new plan concentrates the work by functions, in accordance with modern methods. It brings the work of letting contracts, of securing production, of inspection and of keeping track of supplies, all under one head for each functional division of the work. This will eliminate a vast amount of lost motion and prevent competition between different divisions.

THE reorganized Ordnance Department should have the loyal support of every citizen, and the plan adopted should be given a fair trial. Whether or not we feel that the centralization might well go further, our present duty is to help make the new plan a success. After that, its extension or expansion will be easy should it seem desirable. This is no time to let personal ideas or a tinge of partianship interfere with a hearty support of the new plan. We are glad to point out the good work which has been accomplished in the manufacture of rifles, in spite of the initial delay. The output is now in excess of the original schedule, so that if any deficiency exists it must be blamed on those who decided on the number required, not on those who are securing the production asked for.

We also commend the changed attitude regarding unnecessary refinements and interchangeability; the readjustment in these ways must not be construed, however, as indicating the acceptance of an inferior arm, for such is not the case; the rifles now being supplied probably have no equal in any country. Men now in the National Army, and who have served in foreign armies as well, are high in praise of the new rifle as to convenience, accuracy and shooting power. More rational inspection is in a measure responsible for the very gratifying increase in production.

THE section of the new organization which deals with complaints or disputes is sure to prove of great value. The work in such a department will require great tact on the part of the officer in charge, but it will smooth out many a difficulty which might prove troublesome. It may also prove advisable to establish an outside arbitration committee or trouble board to consist of well-known engineers; such a board might be more unbiased owing to lack of definite personal interests or connections on either side. The establishment of this section, however, indicates a keen desire on the part of the Department to secure and to maintain the best possible relations with the manufacturers, and is, in itself, a long step toward improved conditions.

NOW that the reorganization has been made, now that coördination in the securing of munitions for the army is well under way, let us put our shoulder to the wheel and help the new plan forward in every possible way. Helpful suggestions are always in order and will be welcomed by the officers in charge of the various divisions.

No matter what we may feel as to the past, the future is what we have to meet. Now that the way has been opened we can help make it brighter by coöperating in every way possible. We urge that every reader of the *American Machinist* shall do his utmost to uphold the new Chief of Ordnance and his organization.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Currier-Koeth Grinding Machine for Valves and Reseating Tools

The Currier-Koeth Manufacturing Co., Coudersport, Penn., is now marketing the machine illustrated which is used for reseating the poppet valves for gasoline engines and also for grinding cutters used for resurfacing the

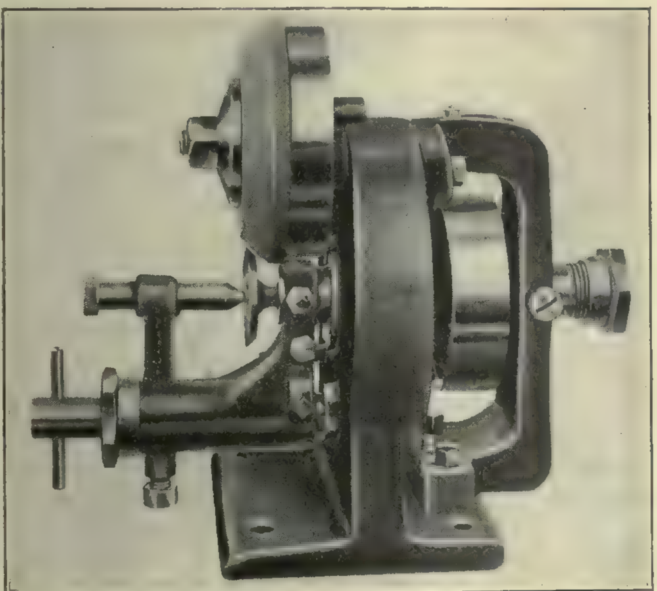


FIG. 1. THE MACHINE WITH A VALVE IN PLACE

valve seats. Fig. 1 shows the machine with a valve in place. It will be noticed that the axes of the work and the wheel spindle are parallel, the wheel being faced off

FIG. 3. THE VARIOUS TOOLS AND ATTACHMENTS

at the proper angle to secure the correct slope on the valve seat. It is claimed that the machine will quickly reseat the hard, tungsten-steel valves which are often difficult to handle with the usual type of reseating tools. When reseating cutters are being ground they are held on centers. Fig. 2 shows the device that is used to dress the wheel at the proper angle. The dressing tool slides on two rods that are inserted in holes in the frame. Fig. 3 shows the various tools and attachments. The grinding wheel is of carborundum. The two spindles of the

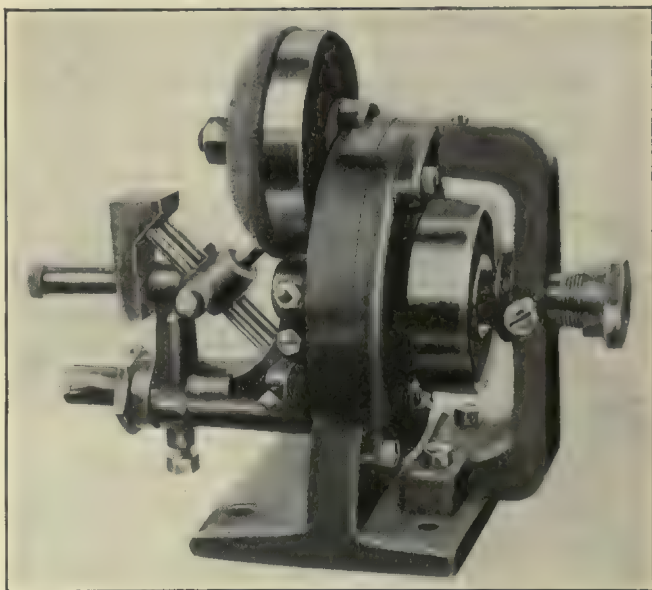


FIG. 2. THE METHOD OF DRESSING THE WHEEL

machine are interconnected by gears, the ratio of speeds of the machine and wheel spindles being 14 to 1. All gears are inclosed and run in a bath of oil. The feed is controlled by means of a micrometer screw.

LeBlond 38-In. Gun Boring Machine

The machine shown in Figs. 1 and 2 was designed to bore from solid forgings, tubes and jackets for guns up to and including 6 in. in diameter; also to finish-bore these parts from rough-bored forgings. The bed is of box section, the center portion being cast to form a reservoir for collecting cutting lubricant, no seperate oil pan being required. The shears are flat and the boring tailstock, boring-bar support and steadyrest are square gibbed to same. Beds 32 ft. and shorter, are made in one piece; beds longer than this are made in sections and bolted together.

The headstock is of the all-geared type. Two mechanical changes of speed are obtained through sliding gears operated by a lever on the front of the headstock. The main driving gear on the spindle is pressed on and keyed to the spindle; it is 34 in. in diameter, 7½-in. face and 2½ diametral pitch. The headstock is 49⅜ in. long and bolted to the bed by means of six bolts 1¼ in. in diameter. The spindle has a flange 12 in. in diameter and 1⅜ in. thick, and is provided with four 1-in. bolt holes to hold the driving chuck.

The boring tailstock is square gibbed to the shears, and has double bar supports provided with counterbalanced hinged caps; the holes in it are bored 5 in. long and 7½ in. in diameter. It is provided with rapid power traverse and a rack and pinion for hand adjustment. Feed to the boring tailstock is obtained through a screw 3½ in. in diameter ¾-in. pitch, located and supported in bearings in the center of the lathe bed. This screw engages a bronze half nut which is made a separate piece and is easily renewable. The screw is driven through a wormwheel, provided with ball thrust bearings. The feed changes are obtained by means of change gears: range of feeds 0.004 in. to 0.064 in. per revolution of spindle.

The boring-bar support is square gibbed and clamped to the shears. It is provided with a counterbalanced hinged cap and is bored 8½ in. diameter and bushed down to suit the boring bar used.

The carriage for starting the bore is operated through a bronze half nut. It has automatic feed, quick power traverse, and a rack and pinion for hand adjustment, the same as the boring tailstock. It is also provided with a plain tool slide having cross adjustment operated by hand only. Two steadyrests are furnished, one of 18-in. capacity and one of 24-in. capacity. Each is provided with five bronze-faced jaws and a removable cap.

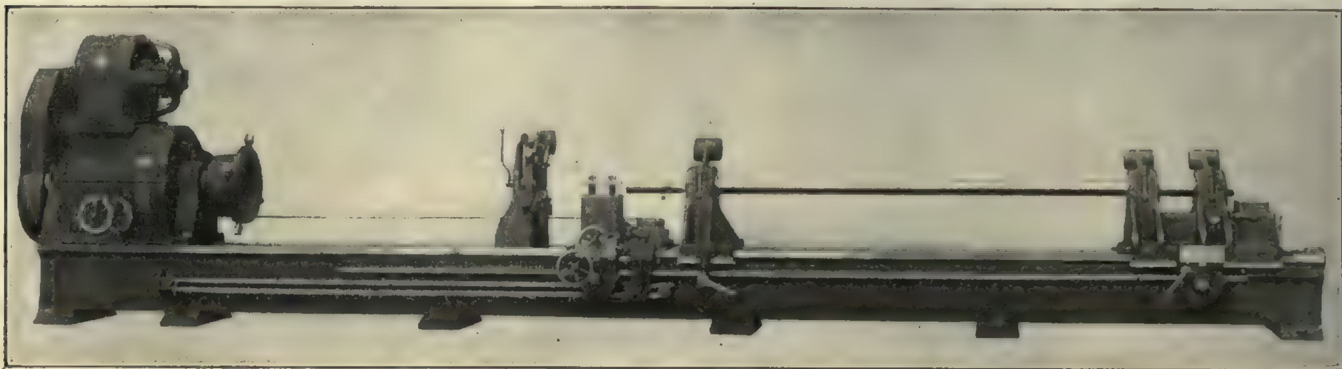


FIG. 1. FRONT VIEW OF LEBLOND 38-IN. GUN-BORING LATHE

Both boring tailstock and carriage have rapid traverse in either direction obtained through a central screw in the bed driven from an independent motor mounted at the rear of the lathe. This motor is 5 hp. running 1150 r.p.m. It is controlled by a special E C & M controller and solenoid brake operated by a lever located on the carriage. The same lever also starts and stops the feed.

This lathe is made by the LeBlond Machine Tool Co., Cincinnati, Ohio.

Universal Cylinder Reboring Tool

The cylinder reboring tool shown is made by the Universal Tool Co., Detroit, Mich. It is comparatively simple in design and operation. There is a cutter head carrying six cutters which are readily adjusted in unison. A beveled expansion ring fits into the cylinder to be rebored, and the beveled pilot head on the tool is placed in

FIG. 2. REAR VIEW, SHOWING PUMP AND AUXILIARY MOTORS

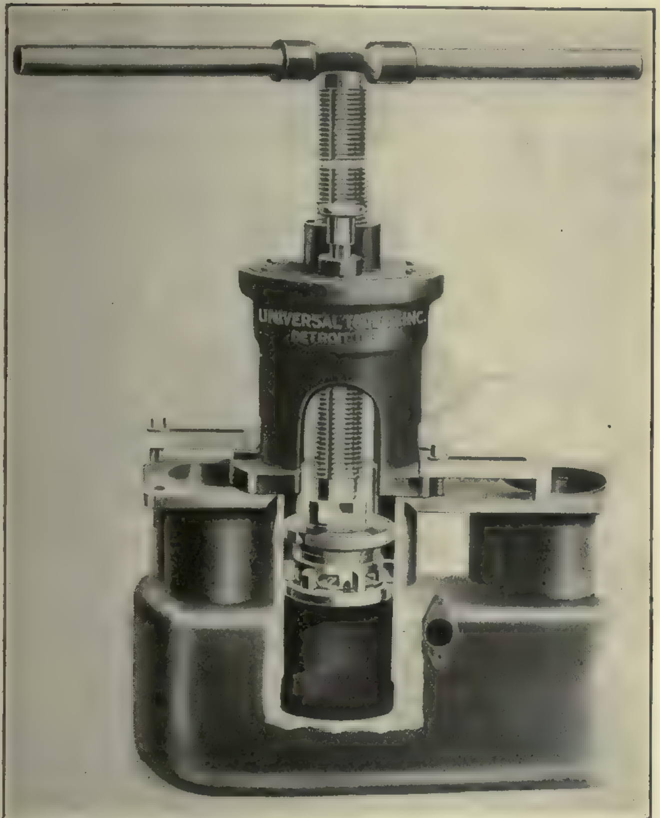
Swing over shears, 38 in.; machine with 32 ft. bed bores holes 8 ft. long; for each extra foot of bore add 2 ft. of bed; range of boring-bar feeds, 0.004 to 0.064 in. per revolution of the spindle; length of boring-bar support bearing on shears, 16 in.; bar support bearing is 8½ in. diameter by 8¾ in. long; carriage for starting bore has a bearing of 24 in. on the shears, is 38½ in. wide, the width of the dovetail is 6½ in. and it will take a tool 1 x 2 in.; pump is a triplex single-acting, direct-connected to a 3-hp. motor, and will deliver 32 gallons at 40- to 50-lb. pressure, operating at 50 r.p.m.; no boring bar is furnished, but boring tailstock is arranged with piping from pump to connect lubricant to boring bar; motor drive is from a 25-hp., 3 to 1, 500 to 1500 r.p.m. motor, mounted at the end of the lathe and driving through spur gears and pinion. Spindle-speed range is 5 to 60 r.p.m.

this ring in such a way that it acts as a centering device. An oversize securing ring follows in the new cut and insures a straight central cut all the way. Deep scores or connecting-rod clearances have no effect on the operation of the boring cutter as it was designed to overcome these difficulties.

One of the features of the tool is a feed screw cut with square threads so that it may be journaled in bearings 5 in. long, which hold it against any undesired movement without injury to the thread.

The feed mechanism is so arranged that a feed movement of from 6 to 30 turns to the inch may be had.

The tool may be used by hand or in a drilling machine. It is made in several sizes to suit various makes



PORTABLE CYLINDER REBORING TOOL

of cylinders. The No. 2 size has a range of expansion from $2\frac{1}{2}$ to $3\frac{3}{4}$ in., and the No. 4 size, from $3\frac{11}{16}$ to $5\frac{1}{16}$ in. The No. 5 size is more expensive than any of the others but has a range from $2\frac{1}{2}$ to $5\frac{1}{16}$ in.

Southwark Hydraulic Presses

The illustrations show a number of hydraulic presses that are now being marketed by the Southwark Foundry and Machine Co., Philadelphia, Penn. Fig. 1 shows a vertical plate-bending press. With this machine, plate can be bent to the extreme end, and may also be bent to form a complete cylinder, as the upper tension member may be arranged with a hinge bolt so that it may be swung up allowing the finished work to be lifted off the machine. It will be noticed that the ram operates through an inclined plane and roller mechanism, which construction, it is claimed, makes the machine more economical of water than if a direct-operating ram were used. It is claimed that the machine is much more economical in space and operating cost than one of the roll type of like capacity.

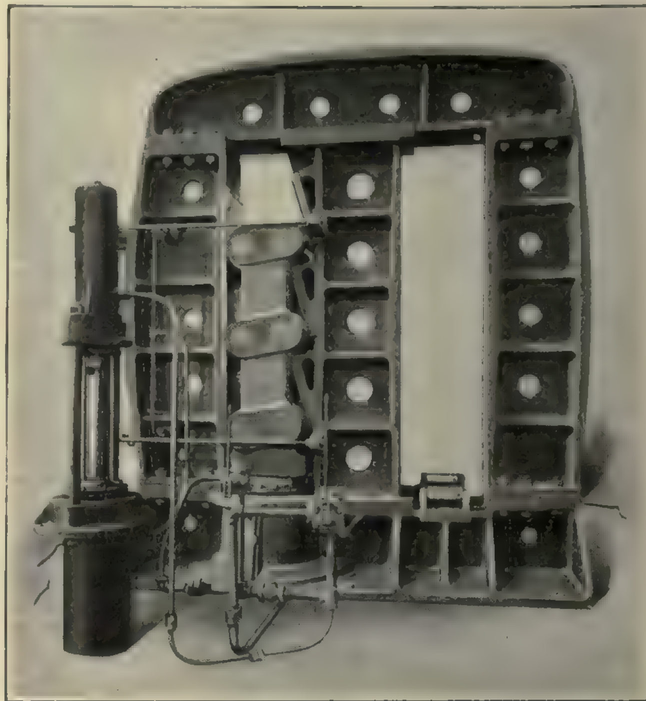


FIG. 1. PLATE-BENDING PRESS

Fig. 2 illustrates a 500-ton billet shear. It has a knife 24 in. long and will shear two 6-in. billets simultaneously. A 5500-lb. pressure is used on the 16-in. ram, this pressure being obtained through a steam-operated intensifier, supplied as a part of the machine. The stroke is 10 in. The pull-back is at a pressure of 650 lb., the water in the working cylinder being returned to the intensifier. All castings are of steel except those for

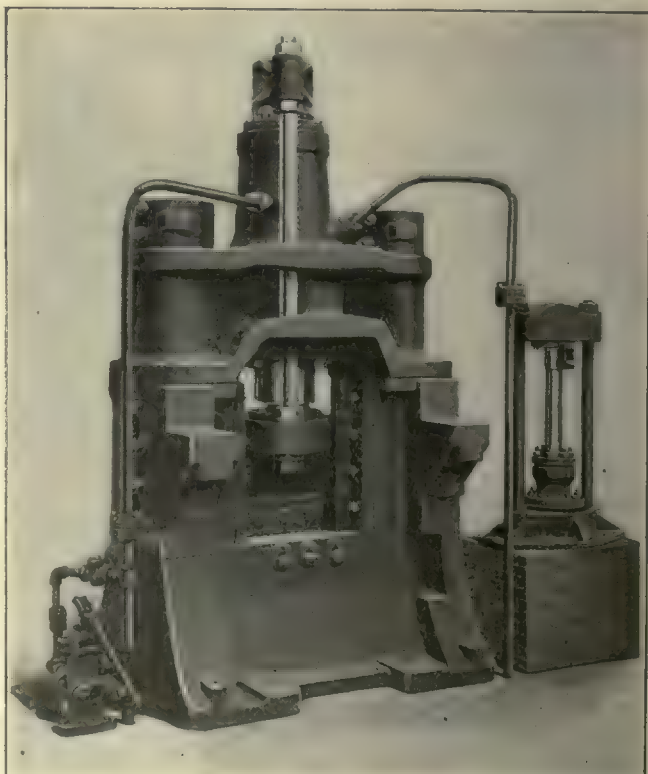


FIG. 2. HYDRAULIC BILLET SHEAR

the rams, which are of cast iron. The slide is equipped with bronze liners which bear on steel liners on the frame. The weight of the machine, including the intensifier is 140,000 lb.

Fig. 3 shows one of a line of presses intended for testing projectiles. These are built in sizes suitable for 75-mm. (3-in.), 4.7-in., 6-in., 8-in., 9.5-in. and larger shells. As will be seen, the machines are of the 3-station type: the first shell being placed in position and filled with water, the second being tested, and the third being inspected and removed simultaneously. The control is centered in a single operating valve. When the valve is operated, the line pressure of 1500 lb. per sq.in. is admitted to the lower cylinder. This forces the open shell nose into a sealing device, and when the full pressure has been reached the pressure is automatically admitted to the top cylinder. The intensifying ram of the top cylinder projects into the open nose of the shell which has been filled with water, thus acting as the high-pressure intensifier cylinder. It will thus be seen that the only parts subjected to the high pressure are the shell, the sealing device and the high-pressure ram.

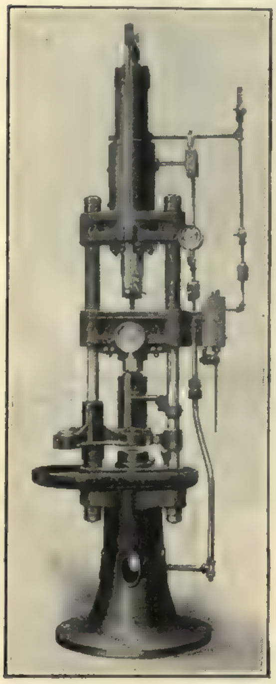
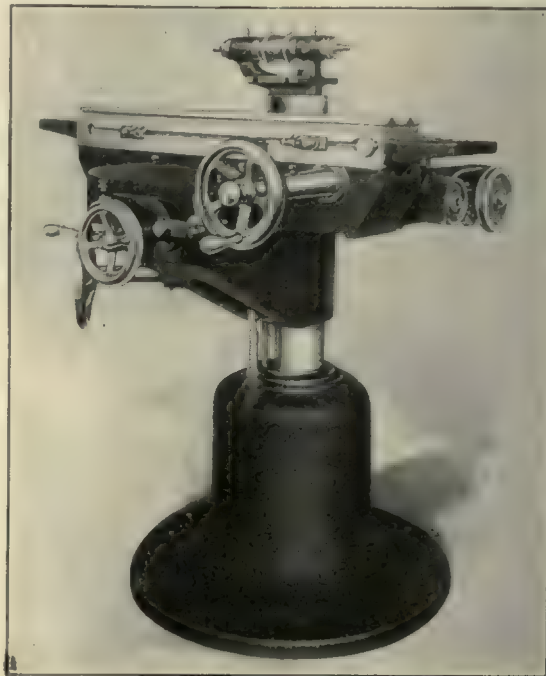


FIG. 3. PROJECTILE TESTING PRESS

Woods No. 2½ Universal Tool- and Cutter-Grinding Machine

The universal tool- and cutter-grinding machine illustrated, is the latest product of the Woods Engineering Co., Alliance, Ohio, being known as their No. 2½. It is of the swivel-head type and is intended to meet the various requirements of the tool room. The base and column are circular in form and are internally braced to insure rigidity. The base is of such size as to inclose the elevating screw. The knee is of box section and entirely encircles the column, sliding on a V-key. The saddle slides on the knee on one V- and one flat-way, the construction being such that the bearing surfaces are not exposed at any position of the table. The head may be swiveled 180 deg., and may be set and clamped at any angle by means of graduations and a clamping device. Adjustable gibs and dust guards are provided for the table, the bearing surfaces consisting of one V- and one flat-way. The top table swivels on a center pivot and is provided with binding bolts at each end, and with graduations indicating taper in $\frac{1}{16}$ in. per ft. The top of the table is provided with two T-slots. For grinding operations which require the top table to be held at a greater angle than is possible to obtain with screw adjustment, two dogs are provided for clamping the two tables. Phosphor-bronze bearings, adjustable for wear, are used for the spindle, which is of tool steel ground to size. The universal headstock, swivels both horizontally and vertically and is provided with graduations indicating movements in terms of degrees. The tailstock is provided with a spring center—a positive lock being also incorporated. The internal grinding attachment has two speeds, and is so constructed that the spindle has a bearing next to the emery wheel. In order that work may be held in any position, the universal vise swivels in three directions. A self-contained countershaft is provided which gives three work-spindle speeds and two wheel-spindle speeds. The machine may be had either with or without automatic cross-feed, and with tables swinging either 22 or 28 in. between centers. It can also be furnished either with or without self-contained, direct motor-driven countershaft.



WOODS NO. 2½ UNIVERSAL TOOL AND CUTTER-GRINDING MACHINE

Longitudinal travel, 22 in.; cross travel, 7½ in.; vertical travel, 10 in.; distance between centers, 28 in.; swing on centers, 9 in.; number of speed changes for table, 12; vise jaws, 1¼ x 5¼ in.; open, 2¾ in.; weight, 1275 pounds

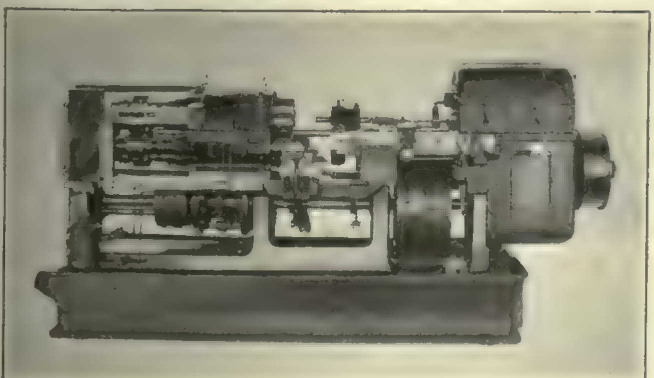
New Britain Automatic Multiple-Spindle Chucking Machine

The New Britain Machine Co., New Britain, Conn., has recently placed on the market the new automatic multiple-spindle, chucking machine illustrated. The machine is known as the company's size 3 and is of the revolving-work type. The work is held and revolved by the spindle, the tools being fixed in the tool slide. This renders possible the use of cross-slide tools, a feature lacking in the regular type in which the work is held stationary.

The six spindles are hammer-forged from chrome-nickel steel; are heat-treated, hardened and ground; and run in bronze bearings, ground straight inside and taper outside. In order to retain the original accuracy of the machine, provision is made for taking up any wear in the bearings without disturbing their alignment. Ball thrust collars are provided on the spindles

to receive the end thrust due to tool pressure. Change gears provide five rates of spindle speed, and twelve variations of feed. The spindle cylinder is always indexed at constant speed irrespective of production and spindle speed. The spindle cylinder housing is split horizontally and has a loose cover which gives access to the spindle-bearing adjusting nuts. An indexing mechanism gradually accelerates the spindle cylinder at the time of indexing, and gradually checks its motion without shock, the final indexing being by means of a rectangular latch which engages notches in the spindle cylinder. A differential motion is fitted which indexes the spindle cylinder and operates the tool slide at high speed when the tools have finished cutting. Draw-in spring collets are employed, which will handle work that does not show variations exceeding $\frac{1}{32}$ in. in diameter. A handwheel is provided for operating the spring chucks. If desired, the machine can be furnished with an air-chucking attachment. As a safety feature the spindle is automatically disconnected from the drive during loading and unloading.

A threading attachment may be installed in the fourth tool-slide position. For work which is handled from a chucking lug, and which requires no threading, the machine may be arranged to index in the opposite direction (clockwise), thus bringing the finished piece to its final position opposite a cross-slide to which the cutting-off blade is fastened. The tool-slide cam is laminated—this patented construction permitting adjusment of one cam to all lengths of work within the capacity of the machine. The camshaft is driven through a large internal gear on the inner circumference of the feed-cam drum, and the thrust of the tool slide against the feed cam is taken by a hardened steel roll fixed to the frame and bearing against the edge of the drum. The direction of spindle rotation being right-hand, standard tools are used. All gearing is machine-cut, and all chains and bevel gears are eliminated. The control levers are brought out to the



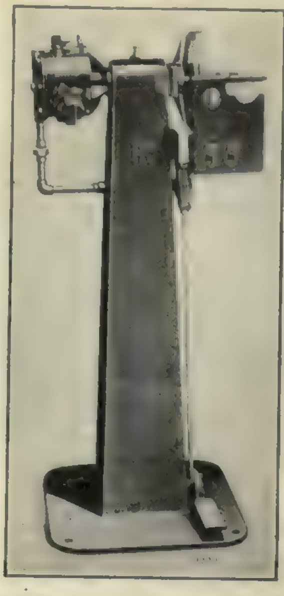
AUTOMATIC MULTIPLE-SPINDLE CHUCKING MACHINE

operating position and a hand feed crank is provided for testing all feed movements and tool positions. Oil is distributed by conveying it through the underside of the tool slide into a chamber at the center, which surrounds the driving shaft bushing, and from which it is tapped off at the circumference, through short tubes to the individual tools. The oil pump is driven at constant speed.

The portion of the bed directly beneath the work has a 45-deg. slant toward the back of the machine, so that the chips are carried to the side. The chip pan slopes toward the rear where there is an oil well from which the oil is distributed to the work. This construction permits the oil to drain before chips are removed, and makes it possible to rake out the chip pan endwise without stopping the machine or removing the splash apron. Either belt or motor drive is furnished as desired.

"Little David" Pneumatic Grinding Stand No. 8

The Ingersoll-Rand Co., 11 Broadway, New York City, has recently placed on the market the pneumatic grinding stand illustrated, which is known as the "Little David" No. 8. The machine is designed for general



PNEUMATIC GRINDING STAND

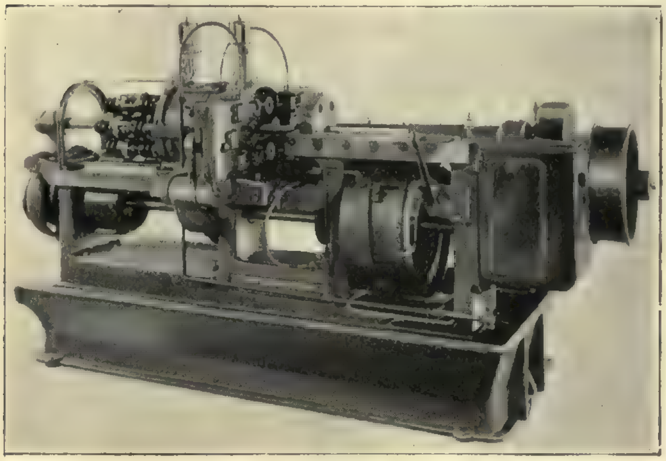
use where a stationary machine is more convenient than one of the portable variety. The air motor is of the three-cylinder type with rotary valves integral with the crankshaft. Three sets of ball bearings are used on the spindle which is rated to operate at 3400 r.p.m., with air at a pressure of 80 lb. The control is effected by means of a foot lever, and the grinding wheel is 8 in. in diameter with a 1-in. face.

New Britain Sextuple Automatic Bar Machine

The New Britain Machine Co., New Britain, Conn., is now marketing the sextuple automatic bar machine shown in the illustration. The spindle cylinder does not index, the machine being designed to feed, drill, chamfer and cut off in each position. Hammer-forged, chrome-nickel steel is used for the six spindles which are heat-treated, hardened and ground. The spindle bearings are of bronze, ground straight inside and taper outside, and are provided with a means for taking up wear without disturbing the alignment. End thrust due to tool pressure is carried on ball thrust collars. Six spindle speeds are provided by means of change gears. Change gears are also used for obtaining changes in feed, this feature being effected by varying

the speed of the camshaft. The spindle cylinder housing is split horizontally and has a loose cover which gives immediate access to the spindle-bearing adjusting nuts. By withdrawing the locking pin the cylinder may readily be revolved into any position. The tool slide is so placed that the thrust above and below the center line is balanced, thus eliminating cramping stress on the tools. A differential motion is fitted, that operates the tool slide at high speed when the tools have finished cutting. The tool-slide cam is laminated, this construction permitting the adjustment of one cam to all lengths of work within the capacity of the machine.

The camshaft is driven through an internal gear on the circumference of the feed-cam drum, the thrust of the tool slide against the feed cam being taken by a hardened-steel roll which is fixed to the frame and bears



SEXTUPLE AUTOMATIC BAR MACHINE

against the edge of the drum. All gears are cut, and chains and bevel gears have been eliminated. All control levers are brought out to the operating position and a hand-feed crank for testing purposes is provided. An oil distributing system is incorporated, the oil being conveyed through the under side of the tool slide into a chamber at the center surrounding the driving-shaft bushing, from where it is tapped off at the circumference through short tubes, to the individual tools.

The portion of the bed directly beneath the work has a 45-deg. slant, so that the chips and work are carried to the side. The chip pan is widest at this side and slopes toward the rear where there is an oil well and strainer. This construction permits the oil to drain off before the chips are removed and makes it possible to rake out the chip pan endwise, without stopping the machine or removing the splash apron. The machine is equipped for either single belt or motor drive.

Navy Wants Engineers and Mechanics for Aviation Work

The Navy Department announces that men soon will be selected for aviation service. Men of suitable qualifications who report now to the navy recruiting offices are eligible for examination for commissions and ratings. The rates of pay and duties assigned in this aviation work in the navy, will make this oportunity highly attractive to mechanical engineers and draftsmen, mechanics and others who are experienced in gasoline-engine design or operation.

The following announcement is sent out by the Navy Department:

Officers from the Department will, within a very short time, report to you for the purpose of making a selection from the personnel of your district, of men to equip for special work in connection with aviation as follows:

1. Experienced engineers for engineer officers at the various naval air stations: these men will be commissioned in Class 5, and sent to Columbia University for further engineering training, thence to Packard Motor Co., Detroit, for special instruction on Liberty engines.

2. Experienced gasoline-engine men for further instruction at Columbia University, and special instruction at Packard Motor Co. on Liberty engines: these men will be given ratings in Class 5 in accordance with their qualifications.

3. Graduate mechanical engineers and men of experience along engineering lines for special duty in Bureau of Steam Engineering, and in connection with work of this bureau at various places: such men will be commissioned immediately in Class 5.

4. Aëronautical and other gasoline-engine draftsmen for work in the Bureau of Steam Engineering: these men will be given ratings of Chief Petty Officer and Petty Officer in Class 5, in accordance with their qualifications.

5. Men who have had experience in compressed gases, especially hydrogen: a limited number of these men will be given commissions in Class 5; and others, ratings in Class 5. These men will be used in connection with hydrogen generation for lighter-than-air craft.

6. Mechanical engineers for special work under the Bureau of Construction and Repair: these men will be used in connection with the development of air craft. It is not anticipated that men of previous suitable aëronautical experience will be found, but it is desired to select the best material available and give them further training. Those suitable will be commissioned in Class 5.

7. Mechanical draftsmen for duty in Bureau of Construction and Repair on aviation work: these men will be given special aëronautical training as needed. They will be given ratings of Chief Petty Officer and Petty Officer in Class 5.

8. Suitable men for training for Quartermasters' (aviation) and carpenters' mates (aviation), and such other specialists as are not covered in the foregoing announcements: men for training as Quartermasters (aviation), should be experienced in fabric work, wire working or any form of light rigging. For carpenters' mates (aviation), boat builders are especially desired, but any men with woodworking experience will be considered.

Full information may be obtained at any Navy recruiting office.

Amount of Wood in an Airplane

According to the United States Forest Service, about 200 b.ft. of wood is used in the actual construction of the average airplane. To obtain this material it is ordinarily necessary to work over about 1500 b.ft. of select lumber, which often represents all that can be used for airplanes of 15,000 b.ft. of standing timber.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Feb. 2, 1918—As an interesting example of how easy it is for errors to creep into a report, one paragraph of the annual report of the executive committee of the National Advisory Committee for Aëronautics is interesting. This says that on recommendation of the Advisory Committee in December, 1916, the War, Treasury, Interior and Commerce Departments adopted the metric system of weights and measures for all drawings and calculations of aëronautical matters, for use with the accompanying English equivalents.

This statement is perfectly true, but it entirely overlooks the fact that in June, 1917, the decision was overruled at the recommendation of the Society of Automotive Engineers, for it was unanimously decided to use English measurements in all cases; even reversing their former decision, on account of the innumerable difficulties which would arise from attempting to substitute metric measurements at a time like this. Even ardent advocates of the metric system protested against making this change at the present time, fully realizing that considerable confusion is certain to occur, and not wishing to be responsible for a moment's delay.

The attention of the National Advisory Committee for Aëronautics has been called to this omission, but, so far as known, no public announcement of it has yet been made.

A War Policy for Aliens

The question of safe and at the same time considerate treatment of the aliens within our gates, is one which requires careful study, as it is one of our most trying problems. It involves a goodly percentage of our labor supply, and affects our productive capacity more than many realize.

As a suggestion for some of the rules to be considered, the National Americanization Committee has issued the following outlines of a war policy:

Internment of alien enemies who are anti-American.

Probation of alien enemies not unfriendly to America, in charge of native-born loyal citizens.

Elimination of alien enemies from the army, and inclusion of friendly aliens in the draft.

Admission to citizenship of aliens serving in the military forces of the United States, upon taking the oath of allegiance.

Alien enemy women to be subject to the same regulations as men.

Compulsory registration of all alien enemies and prohibition of their movement from place to place without permits.

Systematic transfer of alien enemies from war industries to nonwar industries.

Location of alien workmen in war industries at points where they will not be fire and accident risks, endangering life.

Correspondents on alien matters to be selected in each war industrial plant to handle all matters affecting alien workmen.

Plant-protection corps in Government departments to facilitate protection of industries, and safety from alien enemies.

Labor priority board to direct the placement of workmen, establish labor exchanges and regulate private employment agencies.

Alien enemies debarred from war zones to be immediately interned or placed at work, transfers to be by permit.

Care of dependents of alien enemies evicted from war zones, interned or unemployed through Government action.

Counteraction of anti-American propaganda and activity in riots, strikes and labor disturbances, by education on the causes and conduct of the war.

Creation of adequate facilities for aliens friendly and loyal to America, to learn English and become citizens.

Committee of the Council of National Defense to direct americanization work.

Americanization representatives of State Councils of Defense to direct the intensive state work.

Appointment of an aliens' administrator with full authority to deal with all aliens within our borders.

Those who have special problems in this line might find it advantageous to consult the society mentioned, whose headquarters are in the Engineering Building, 29 West 39th St., New York City.

War Service Conference of the Chamber of Commerce

The main feature of the special war conference of the National Chamber recently closed at Washington, D. C., was the mobilization of the industries of the country, and this was discussed at length. A new organization, to be known as the War Service committees, will carry on the highly commended work of the coöperative committees of the National Council recently dissolved.

It is now deemed advisable to have the industries themselves name committees to carry on the work formerly in charge of the Government-appointed Council committees; for in a technical way, an anomalous situation has been created by the existence of committees, sworn officials and employees of the Government, who at the same time represented the industries in which they, as individuals, were interested.

The task of completely organizing the country's industries is a Herculean one, since to be effective, the new War Service committees must be in position to tell the Government what can and should be done. It is obvious that some industries are more essential than others, but it is at the same time, foolhardy to think that the time will not come when the so-called less essential industries may be needed.

The committees are to be democratic formations by the industries and not by the Government, and they

are advised to proceed slowly in dealing with the idea that they might prove more useful by having offices and headquarters in Washington. The real point of contact will be the new industrial representative; and close team work is imperative if the meaning of the word service is to be carried out.

The German business machine has proved to be a wonderful war institution, yet "on the whole, American business has done pretty well;" but more extensive plans of dealing with the Government through association and committee work concerned with the difficulties of obtaining supplies of raw materials in competitive bidding contracts, will have to be formulated.

Before centralized purchasing-control plans can be established, legislation by Congress will be necessary, and the plans successfully followed in Great Britain may not be practically applied in America on account of the vast difference in the size of the two countries.

One great error has been the concentration of orders at certain localities. This has brought about a housing problem, a too-great demand for electric power, and a transportation situation. An industrial representative has been appointed to correct this error, however, and it is proposed to find out what factories or power plants are idle or working part time, and gather such information as will aid in distributing the load of production for war in all localities and among all producers.

The average American business man is doing as much to win this war as the boys in the trenches, but profiteering must be eliminated. Errors have crept into business practice, but they have been at once recognized and criticized to such an extent that American business is able to take its real place in the councils of the nation.

No industry is to be classed as nonessential, but many nonessential portions of some industries are to be cut and their strength added to the essential portions, thus aiding the Government and the public. This cutting is accomplished in some industries by reducing speed 20 per cent.; in other words, to use but 80 per cent. of the amount of coal used last year!

The time has come when industry is able to tell the Government what it can do, and the foundation of an industrial situation is now being laid for what is to come at the cessation of hostilities.

All existing national trade organizations or associations which have not already appointed War Service committees, are requested to do so immediately; and these committees shall be representative, in so far as possible, of the entire industry which they represent. They are further to act as a clearing house for available plant capacity, notifying the Government of facts ascertained, in order that needless expenditures for additional plants and equipment may as far as possible be avoided.

On naming War Service committees it is desirable that persons be selected with respect to geographical location, thereby making frequent meetings possible with a minimum of inconvenience and expense; also persons so selected should be actively engaged in the industries to be administered through their committees, and be willing patriotically to assist the Government to win the war.

The War Service committees will carefully sift all data relative to how, when and where the work in hand can best be done, the financial standing and ability of local industries, and render any service in which they can be helpful in working out Government problems.

The Government will surely benefit from all this data if it be carefully condensed before it is submitted to the Industrial Representative or other Government agencies. Form your War Service committees and aid your Government now that aid is needed.

Personals

John Calder has been made vice president and general manager of the Aëro Marine Plane and Engine Co., Keyport, N. J.

E. H. Williams, general superintendent of the McKeefry Iron Co., Leetonia, Ohio, has been commissioned a major in the Engineers' Reserve Corps, U. S. A.

Carl G. Barth, consulting management engineer, Philadelphia, has been given a special commission in the matter of extending costs investigation for the Watertown Arsenal, Watertown, Mass.

R. T. Gladstone, master mechanic of the Washington Steel and Ordnance Co., Washington, has resigned to take the position of general superintendent of the Steel Products Co., Huntington, West Virgina.

Carl S. Dow, for a number of years in charge of the advertising of the B. F. Sturtevant Co., and later with Walter B. Snow and Staff, has accepted a position as advertising manager of the Lamson Co. of Boston, Mass., manufacturers of pneumatic tubes and other conveying apparatus.

Walter Rautenstrauch, professor of mechanical engineering at Columbia University, addressed a meeting in New York of the American Society of Mechanical Engineers on the evening of Jan. 8. He dwelt in particular on the industrial service movement such as is carried on by the National City Bank, New York City under the direction of **Ferdinand C. Schwedtman.**

D. L. Derrone, formerly identified with the Canada Cement Co., Ltd., Montreal, engaged in the manufacture of munitions, and later, on gun forgings machine work for the Amalgamated Machinery Corporation, Chicago, is now works manager of Winslow Brothers Co., Chicago, specialists in architectural iron and bronze works for buildings, but now engaged in making 6-in. shells.

Business Items

The Morris Machinery Co., is the new name of the Newark Second-Hand Machinery Co., 95-115 Chestnut St., Newark, N. J. The change in name has been deemed advisable, as the company is the New Jersey representative for a number of manufacturers of new equipment including such lines as Monarch lathes, Royersford Foundry & Machine Co.'s products, hangers and transmission equipment of the Valley Iron Works, wood pulleys of the Ohio Valley Pulley Works, etc.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

The sixth annual meeting of the Chamber of Commerce of the United States of America will be held in Chicago, Apr. 10, 11 and 12, 1918. Elliot H. Goodwin, Riggs Building, Washington, D. C., is general secretary.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

The National Society for the Promotion of Industrial Education will hold its eleventh annual convention in Philadelphia Penn., Feb. 21, 22 and 23. The main topics for discussion will be Vocational Education in War Time. Administration of the Smith-Hughes Act, Twentieth Century Vocational Training and Reorganization of the National Society. The headquarters of the society are at 140 West 42nd Street. New York City.

New England Foundrymen's Association Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St. Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

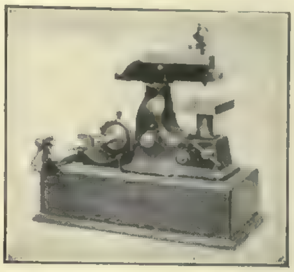
Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Gaging Machine
Davie Tool Co., Cleveland, Ohio



"American Machinist," Jan. 24, 1918

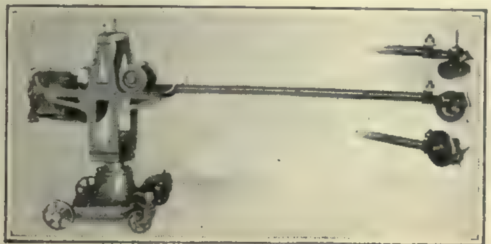
Distance center of gaging spindle to back of throat, $4\frac{1}{2}$ in.; maximum distance top of table to end of spindle, 4 in.; size of table, 5 x 6 in.; height adjustment of table, 0 to 4 in.; height adjustment of gage bracket, $\frac{1}{2}$ in.; largest diameter gaged for concentricity, 4 in.; greatest distance between centers on center-test attachment, 13 in.; largest diameter between centers, 4 in.; height, 18 in.; length, 15 in.; width, 9 in.; weight with attachments, 96 lb.

Welding Machine, Electric Spout
Thompson Electric Welding Co., Lynn, Mass.

"American Machinist," Jan. 24, 1918

For electrically welding spouts or other parts that are stamped in halves with the abutting edges projecting slightly. The halves of the work are clamped in a die and are pressed against a revolving die which completes the circuit and welds the seam. Maximum current consumption, 5 kw., or $7\frac{1}{2}$ k.v.a.; pulley dimensions, 6 x $1\frac{3}{4}$ in.; speed, 200 r.p.m.; floor space, 24 x 33 in.; height, 41 in.; table dimensions, $15\frac{1}{2}$ x 26 in.; weight, 850 lb.

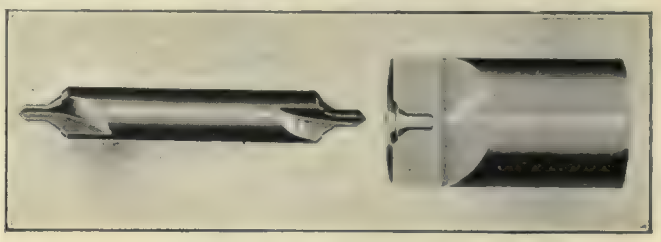
Grinding Machine, Portable Radial
Mummert-Dixon Company, Hanover, Penn.



"American Machinist," January 24, 1918

Grinding wheel, 8 in. in diameter, 1-in. face, $\frac{5}{8}$-in. hole; motor, 1 hp.; length of arm, 7 ft.; travel of trolley, 30 in.; annular working area, 30 in. wide with a mean radius of 6 to 7 ft.; vertical movement of head, from floor to as high as a man can reach; height, 4 ft. 6 in.; length, 9 ft.; weight, 700 lb.

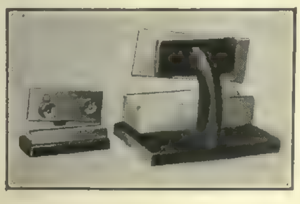
Drill, Center
Apex Drill Co., 2455 West McMicken Ave., Cincinnati, Ohio



"American Machinist," January 24, 1918

A combined center drill and countersink. The auxiliary countersunk hole allows the work to be faced up to the hole without the use of half centers or other schemes for accomplishing the same result. A further advantage claimed, is that the center is protected from injury due to accident or to pressing or driving the piece into other parts. The drill is made in the usual range of center-drill sizes.

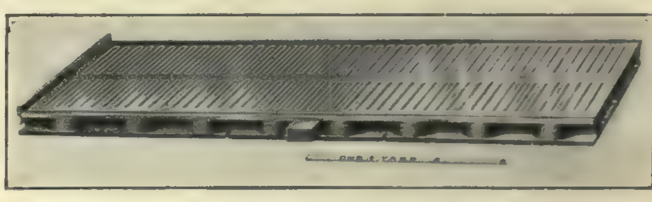
Gage, Taper
Davie Tool Co., Cleveland, Ohio



"American Machinist," January 24, 1918

This taper gage is made in various sizes and is also made with stops to indicate the proper length of the tapered work. From the small view, it will be seen that the moving member may be quickly adusted to any position within its range, by means of two knurled nuts

Chuck, Magnetic
Persons-Arter Machine Co., Worcester, Mass.

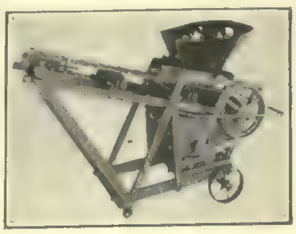


"American Machinist," January 24, 1918

Believed to be the largest magnetic chuck ever constructed, measuring 100 x 25 x 5 in. with a holding capacity approaching 250 lb. per sq.in. The chuck is made of a series of interchangeable and replaceable shells, cores and coils. It is claimed that the construction of cores and coils gives good distribution of magnetic force without sacrificing electrical efficiency

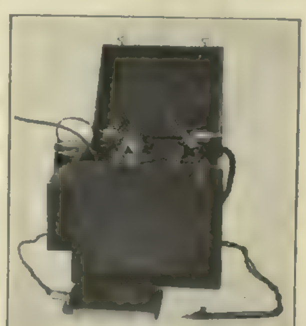
Loader, Type BX
Link-Belt Co., Nicetown, Philadelphia, Penn.

"American Machinist," Jan. 24, 1918



For the purpose of loading any kind of fine material into box cars. When in use, the material being loaded is shoveled into the hopper, from where it is carried out on the flat belt and dumped at some distance from the hopper. The machine is portable, being mounted on wheels, and may be arranged to be driven either by a gasoline engine or by an electric motor. The belt is supported on four rollers, the one at the outer end being mounted with sliding bearings equipped with adjusting screws. This feature allows any slack in the belt to be quickly taken up

Engraving Machine, Electric
Production Equipment Co., Inc., 118 East 28th St., New York City, sales agents, Rhode Island Electrical Tool Co., Providence, R. I., manufacturers



"American Machinist," Jan. 24, 1918

A machine for electrically engraving hardened-steel tools, etc., with any kind of mark or name. The tool or piece of work to be marked is placed on the plate shown, and the pencil is used in the same way as an ordinary pencil for etching in the steel whatever mark or lettering is required. A special resistance block with adjusting switches is supplied for regulating the depth of the etching and to accommodate various thicknesses of steel. Electrical connection is made from an ordinary electric-light socket, the standard equipment being suitable for alternating current. A special converter can be supplied for direct current

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Feb. 1, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	$24.00
No. 2 Southern Foundry, Chicago	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia	33.75	33.75	30.50
*No. 2, Valley	33.95	33.00	31.00
No. 2, Southern Cincinnati	35.90	35.00	26.90
Basic, Eastern Pennsylvania	33.95	30.00	30.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Feb. 1, 1918	One Month Ago	One Year Ago	Feb. 1, 1918	One Year Ago	Feb. 1, 1918	One Year Ago
Structural shapes	$4.20	$4.20	$4.10	$4.4.04	$4.10	$4.20	$3.75
Soft steel bars	4.10	4.10	4.00	4.4.04	4.00	4.10	3.85
Soft steel bar shapes	4.10	4.10	4.00	4.14	4.00	4.10	3.75
Plats, ¼ to 1 in. thick	4.45	4.45	5.15	4.39	4.75	4.45	4.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

Pittsburgh, mill	$3.50	$3.25
Warehouse, New York	4.70	3.75
Warehouse, Cleveland	3.98½	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Feb. 1, 1918	One Month Ago	One Year Ago	Feb. 1, 1918	One Year Ago	Feb. 1, 1918	One Year Ago
*No. 28 black	5.00	6.45	6.45	5.75	6.45	5.50	6.45	5.15
*No. 26 black	4.90	6.35	6.35	5.65	6.35	5.40	6.35	5.05
*Nos. 22 and 24 black	4.85	6.30	6.30	5.60	6.30	5.35	6.30	5.00
Nos. 18 and 26 black	4.80	6.25	6.25	5.55	6.25	5.30	6.25	4.95
No. 16 blue annealed	4.45	5.65	5.65	5.10	5.65	4.95	5.65	5.00
No. 14 blue annealed	4.35	5.55	5.55	5.00	5.55	4.85	5.55	4.90
No. 10 blue annealed	4.25	5.45	5.45	4.95	5.45	4.75	5.45	4.85
*No. 28 galvanized	6.25	7.70	7.70	7.50	7.70	7.00	7.70	7.25
*No. 26 galvannzed	5.95	7.40	7.40	7.20	7.40	6.70	7.40	6.95
No. 24 galvanized	5.80	7.25	7.25	7.05	7.25	6.55	7.25	6.80

*For painted corrugated sheets add 25c. per 100 lb.; for galvanized corrugated add 5c.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Feb. 1, 1918	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Feb. 1, 1918	One Year Ago
New York	$15.00	$8.00
Cleveland	15.30	7.50
Chicago	15.00	6.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00 @ 30.00
No. 8, 3/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

*Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38 00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Feb. 1, 1918	Cleveland Feb. 1, 1918	Chicago Feb. 1, 1918
Tire	4.10	5.00	4.10
Toe calk	5.70	5.50	4.35
Openhearth spring steel	7.50	8.25	8.00 @ 8.50
Spring steel (crucible analysis)	11.00	11.25	12.00
Coppered bessemer rods	9.00	....	7.00
Hoop steel	4.95	....	4.95
Cold-rolled strip steel	9.00	....	8.50
Floor plates	6.19½	....	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel: Inches	Black	Galvanized	Iron: Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Feb. 1, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	35.00
Tin, in 5-ton lots	85.00	86.00	50.00
Lead	7.00	6.50	8.75
Spelter	8.00	7.75	10.25

*Government price.

ST. LOUIS

Lead	6.85	6.37½	8.00
Spelter	7.87½	7.50	10.00

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Feb. 1, 1918	One Month Ago	One Year Ago	Feb. 1, 1918	One Year Ago	Feb. 1, 1918	One Year Ago
Copper sheets, base	31.00-33.50	35-37	42.00	32.50	44.00	36.00	43.00
Copper wire (carload lots)	32.00	36.00	36.00	28.50	44.00	34.50	37.00
Brass pipe base	36.50	38.50	47.50	36.50	52.00	41.50	46.50
Brass sheets	30.75	35.75	45.50	29.00	43.00	35.50	44.00
Solder ½ and ½ (case lots)	43.00	40.50	28.37½	47.00	27.50	41.00	28.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Feb. 1, 1918	One Year Ago
Mill	$25.25	$42.00
New York	27.25	45.50
Cleveland	34.00	42.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Feb. 1, 1918	One Year Ago	Feb. 1, 1918	One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Feb. 1, 1918	One Year Ago
New York	14.25	18.00
Cleveland	17.00	26.00
Chicago	16.00	17.25

II. The Receiver—I

The operations on the receiver are of great variety, and a high degree of accuracy is essential in all cases. There are over one hundred and fifty actual operations in all. The important locating point is established by the large hole put through the entire length of the forging, and after the completion of this operation the other cuts are positioned in positive relation to this hole. Details are given of receiver limits and tolerances, and of methods of milling, drilling, reaming and lapping.

THE most interesting member of the Lewis machine gun considered from a mechanical point of view is the receiver, and in this first detailed article on the methods of the Savage Arms Corporation, Utica, N. Y., the illustrations will be confined to the receiver itself and will indicate the operations by which it is machined.

The receiver in various stages from drop forging to finished piece is illustrated in Fig. 12. This group shows, of course, only a very few of the numerous stages through which the work progresses in course of manufacture, but it gives a general idea of some of the important machining cuts which are required.

The vanadium-steel drop forging shown in the upper left-hand corner of the group weighs 18 lb.; the finished receiver shown in the lower row at the center and left, weighs only 3½ lb. In other words: in the 150 and more, distinct operations through which the work passes, nearly 15 lb. of metal are cut away to produce the finished piece.

It will be noticed that the drop forging is formed with a thin lug seen projecting at the right. This is for a test piece for each forging and before the work starts in the shop, the test lug goes to the laboratory for the determination of important characteristics.

The receiver is shown in plan and sections in the assembly-gun drawing, Fig. 13; the various views illustrate the manner in which the other members such as barrel, radiator-locking piece, feed cover, butt tang, etc., are attached. The 62 parts all told, of the gun proper, can be put together and taken apart without special tools of any kind, so no tool kit is repuired in service.

Important Details

Reference has been made in another article to the comprehensive system of limits and tolerances which have been established by the manufacturers to produce all parts of the gun on a positively interchangeable basis, so that any part whatsoever will fit instantly in place in any gun made at any date under this system. It is a liberal education in the art of establishing tolerances for interchangeable work, to examine in detail the parts drawings of this gun and check up the allowances for the various dimensions. In this connection attention is called to the detailed drawing in Fig. 14, where it is safe to say there are two or three hundred dimensions all with plus or minus limits. The other parts of the gun are dimensioned in similar manner and there is no overlapping or interference whatsoever, between maximum or minimum parts, for complete sets of gages are used for every piece, and the gages are so constructed and maintained that work which gages properly, will fit together absolutely.

The drawing shows some of the allowances plus or minus to be very minute; on other dimensions more liberal allowances are permitted. In each instance the character of the fit desired has been thoughtfully considered and limits and tolerances established accordingly.

It is a shop truth that where limits are fixed upon too

fine a basis production will necessarily be hampered; it is equally true that an insufficient degree of refinement in such practice will make impossible truly interchangeable work. It is also the truth that the word "interchangeable" has various grades of meaning in different factories and what would be considered interchangeable workmanship on certain shop products would be anything else but that, if considered in a more highly refined line of manufacture.

The present-day requirements on firearms have established a finer shade of understanding in regard to interchangeable work than has heretofore been known in factory practice, and it is undoubtedly true that the highest standards yet set up in the manufacture of such material, are those established and maintained for the production of the Lewis gun at the Savage plant.

Returning now to the specific example, the receiver: let us consider one or two classes of fits; first, examine the tolerances in the chamber at the front end which receives the barrel. The smaller diameter beyond the thread carries the dimension 1.0005 in., plus or minus 0.0005 in. The enlarged or counter-bored portion *M* is dimensioned 1.1425 in. plus or minus 0.0005 in. The minimum figures for these holes are therefore respectively 1 in. and 1.142 in. The corresponding figures for the barrel end are 1.000-0.001 in. and 1.142-0.001 in. Now if the chamber in the receiver is made to the maximum limit and the barrel also to the maximum figures there will be for each of the two fits an allowance in the hole of 0.0005 in. above the size of the barrel end. On the other hand if the receiver hole is made to its minimum and the barrel to its maximum, the dimensions of the entering and receiving parts would theoretically read alike, but in practice as the fit on the barrel must go into its ring gage which is permitted no wear whatsoever, it must actually be at least 0.001 in., or 0.0002 in. under its theoretical maximum size and it will therefore enter properly into its seat in the receiver even though the latter may be a minimum sized hole.

Taking now another class of fit, the feed cover on the receiver: the latter has a series of lugs at *NN*, under which are square guide surfaces for holding the feed cover in position. The thickness of the receiver lugs is given as 0.137-0.001 in. and the corresponding cut milled under the feed cover is dimensioned 0.138-0.001 in. The maximum allowance in this fit is then 0.002 in. and the minimum 0.001 in.

There are various cases where an allowance of several thousandths is permissible between entering and receiving surfaces, but here also both are dimensioned with plus and minus limits, and these surfaces are checked with limit gages just the same as in the case of surfaces where finer limits are required.

Another interesting class of fits for sliding parts is represented by the bolt in the receiver where the long hole passing clear through the receiver is lapped practically from end to end to a limit gage measuring 0.905 in. on the small or go end and 0.906 in. on the large or not go end while the bolt itself is ground to 0.902 in. plus or minus 0.001 in. An analysis of the general system of limits and tolerances will be given at greater length in another article in which the data already presented will be included, in order to show something of the character of the results produced by the methods shown in the illustrations that follow.

When the drop-forged receiver comes to the shop the first machine operations as indicated by the accompanying schedule, are the grinding of the forging, the rough

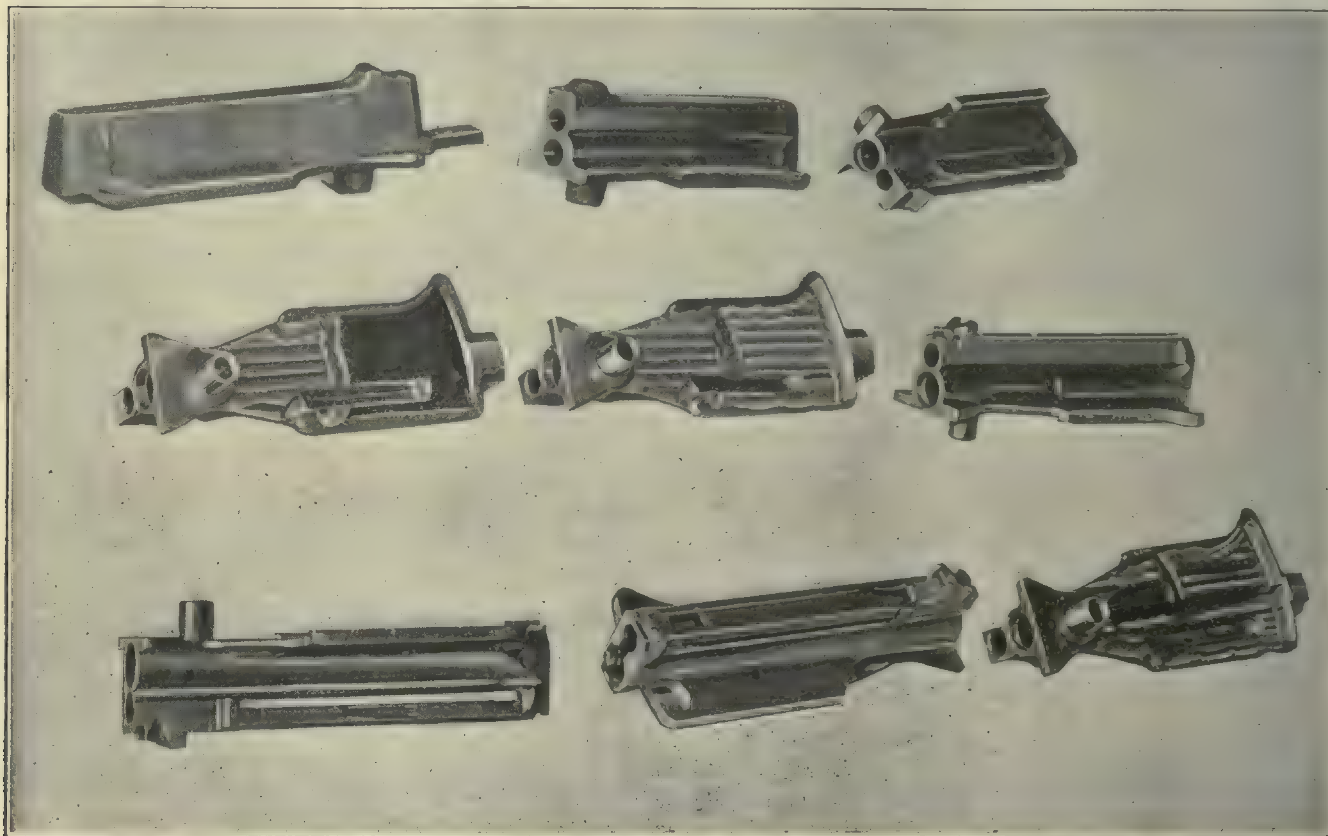


FIG. 12. THE RECEIVER FROM DROP FORGING TO COMPLETED PIECE

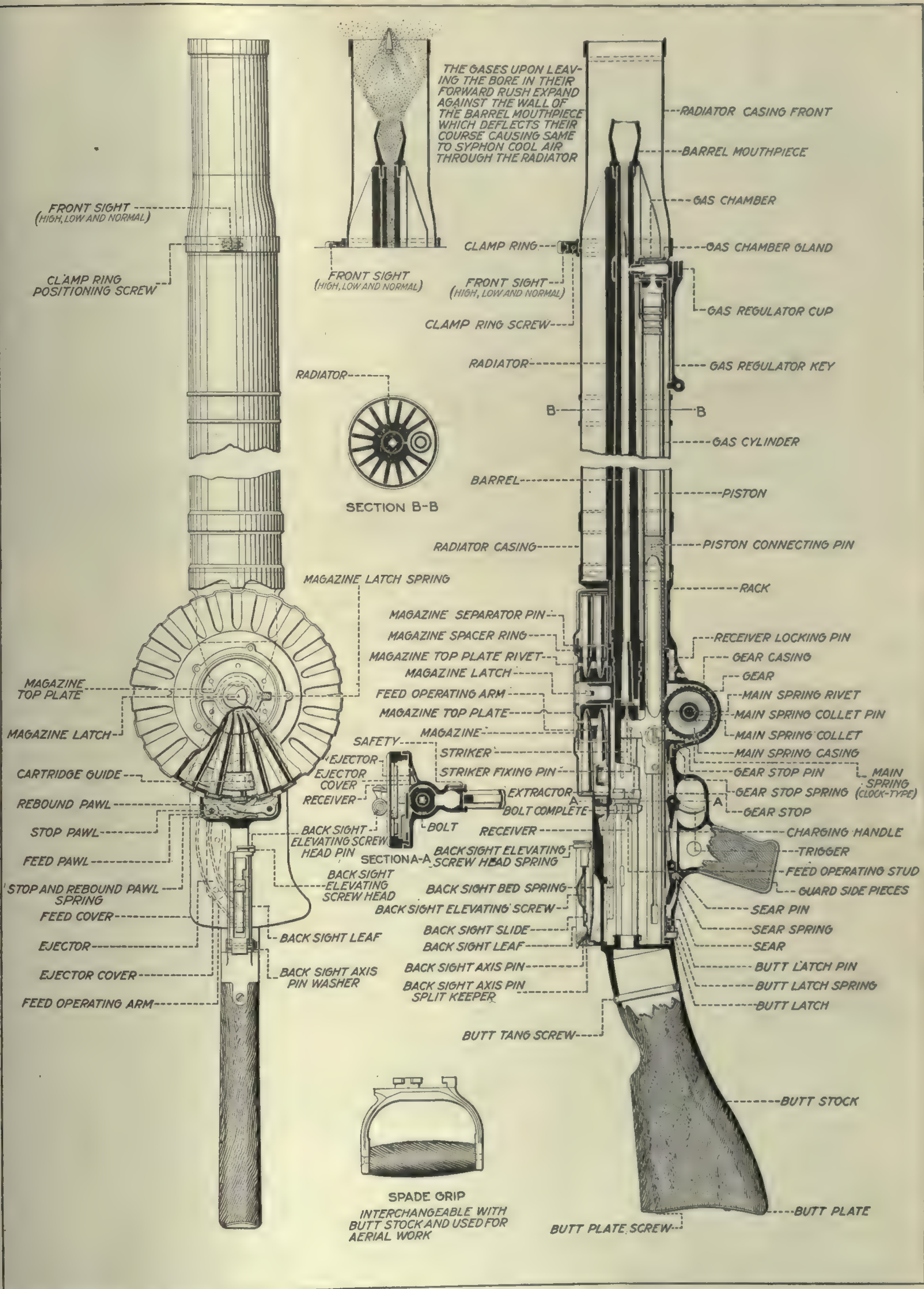


FIG. 13. THE LEWIS GUN, SHOWING RECEIVER AND OTHER PARTS

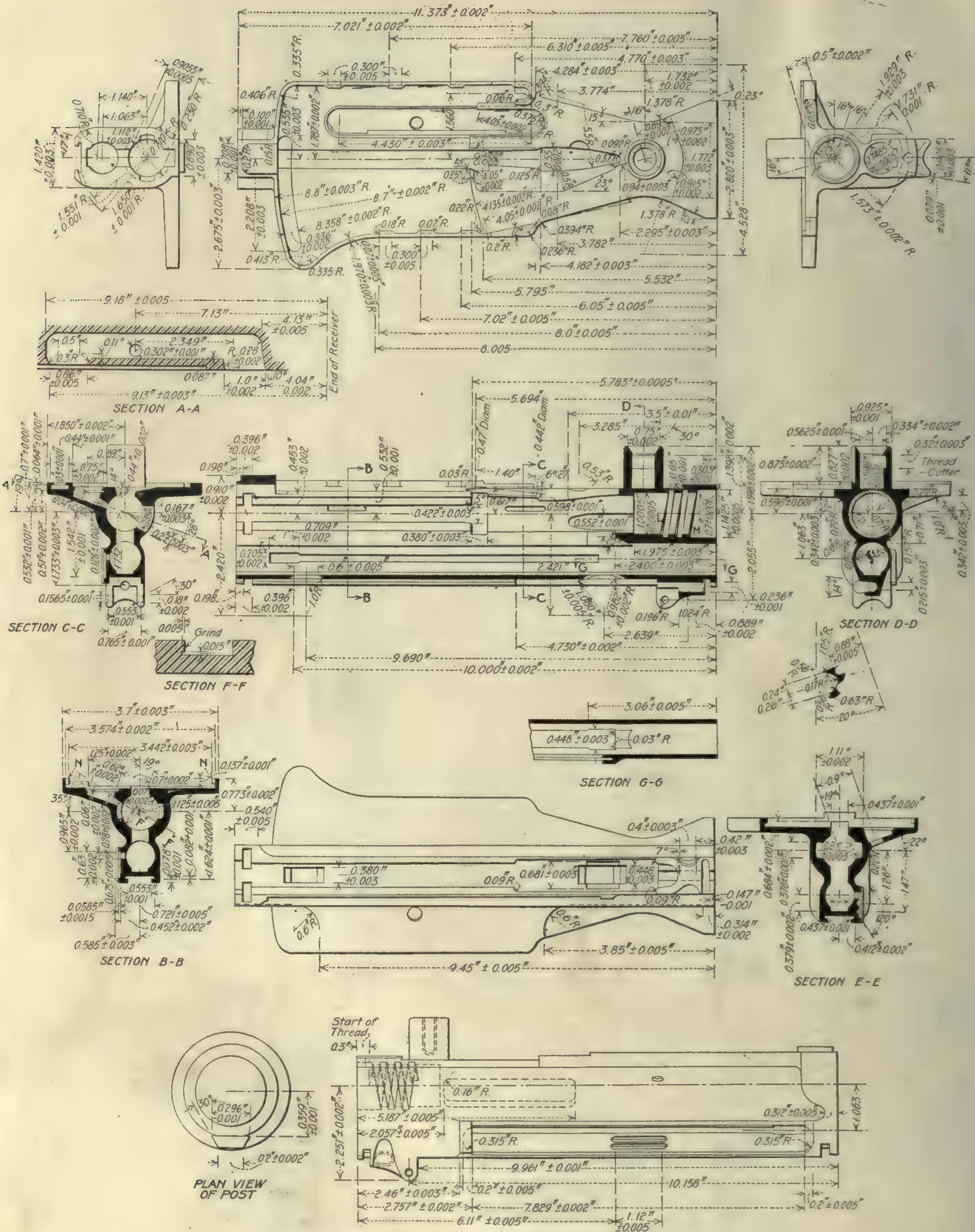


FIG. 14. RECEIVER DETAILS WITH LIMITS AND TOLERANCES

milling of the bottom, and the roughing for Operation 1, which is the straddle milling of the ends to rough dimensions, followed by the rough milling of the sides from end to end with the work held in simple fixtures as shown in Fig. 15; here, in one machine the forging is seen undergoing the milling of the right-hand side while the opposite side of another forging is milled in another machine; the two milling machines in view form part of a large battery of similar machines employed on the receiver work.

The drawing, Fig. 16, represents a double fixture designed for milling of two receivers in which two forg-

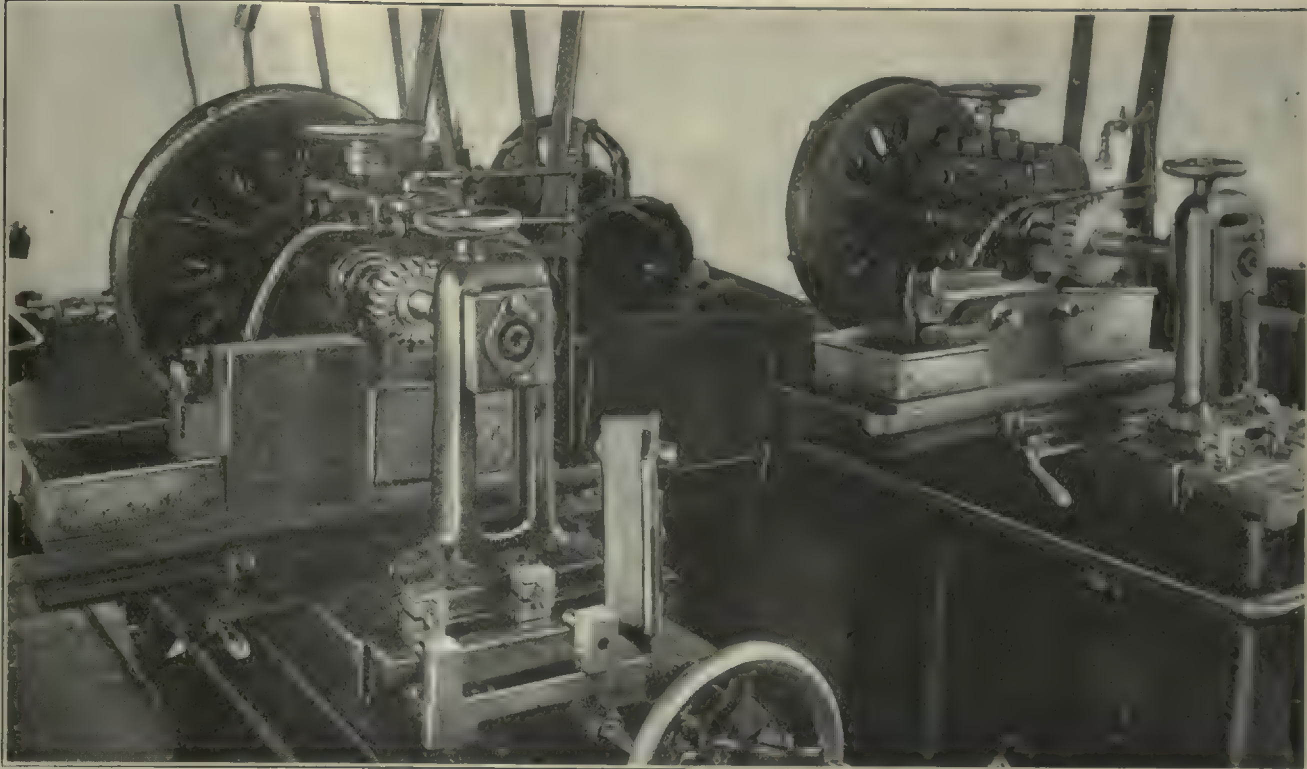


FIG. 15. MILLING THE SIDES OF THE RECEIVER

ings are held simultaneously by means of straps, and through bolts tightened by a pair of nuts at one side of fixture. The details in this drawing show the end stop pin for locating the forgings, the serrated faced shoes upon which the work rests and the rocker-ended clamps by which the forgings are secured in place against the central wall of the fixture.

Figs. 17 and 18 are details of the cutter arbors and formed cutters used in performing this same operation.

The first boring operation on the receiver consists in putting through the large or main hole, which is bored from end to end. This is the hole which in the finished receiver carries the bolt, and which is enlarged and threaded at the front end for the screwing in of the barrel. This hole constitutes the working point by which is located the smaller, parallel hole below for the piston rack which actuates the gun, and is also used for locating the receiver for all subsequent operations.

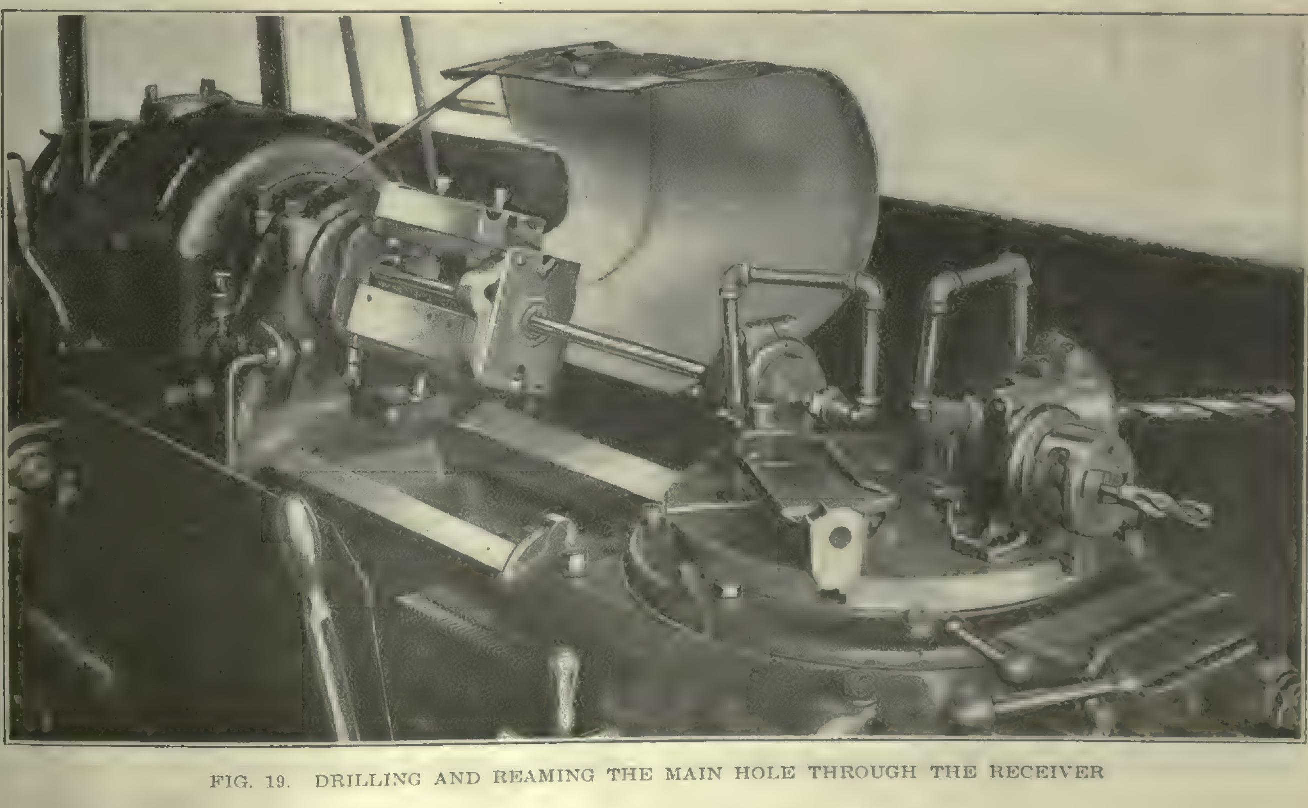


FIG. 19. DRILLING AND REAMING THE MAIN HOLE THROUGH THE RECEIVER

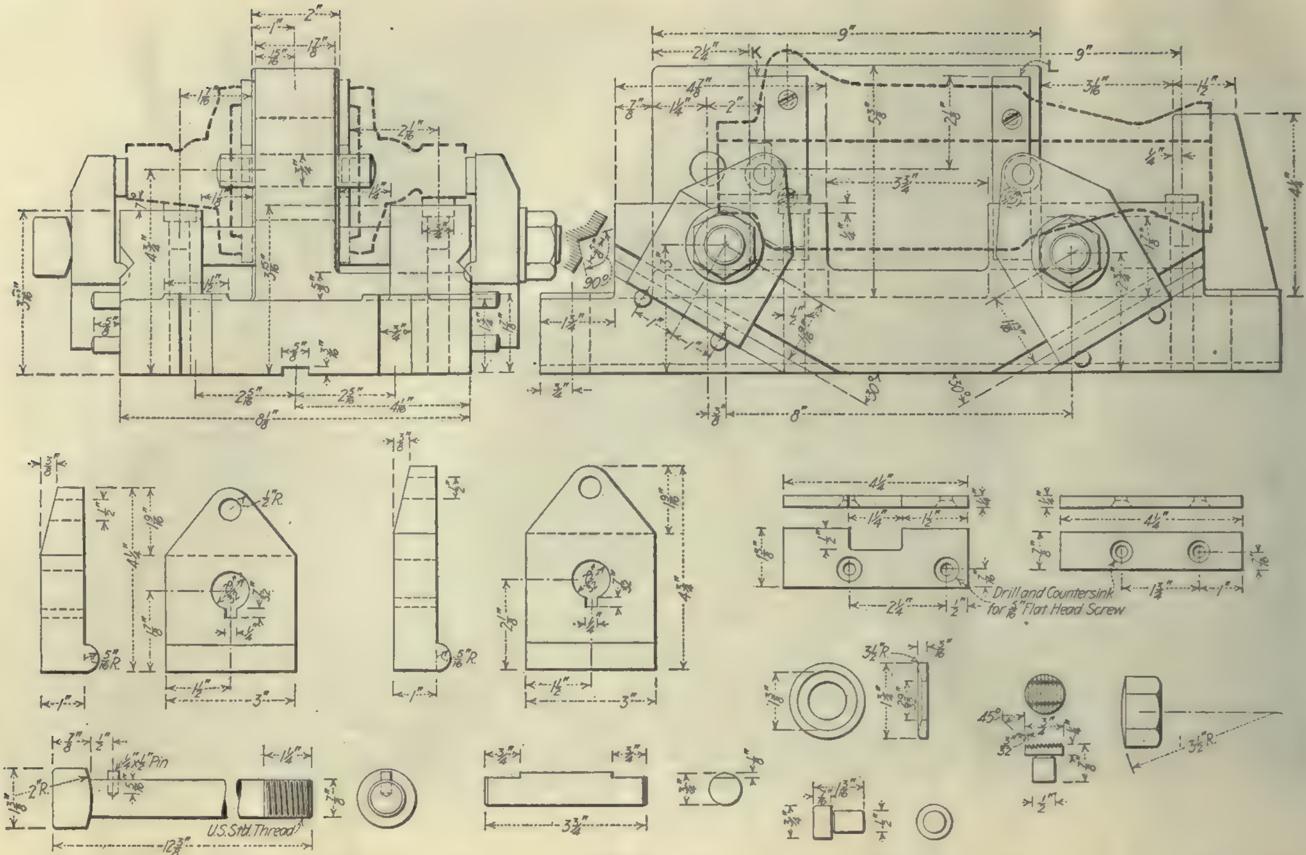


FIG. 16

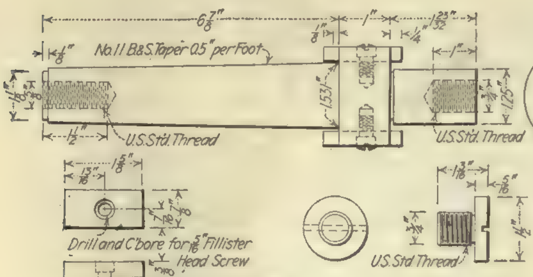


FIG. 17

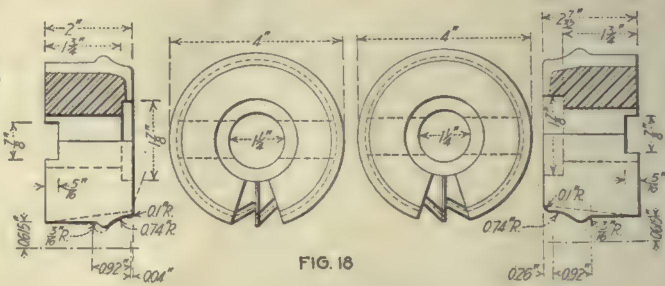


FIG. 18

FIGS. 16 TO 18. MILLING FIXTURE AND CUTTER DETAILS

The operation of drilling and reaming this large hole is performed in the turret lathe and is shown in Fig. 19.

The tools used here are a spot drill, through drill and machine reamer; this reamer does not however size the hole to finished dimensions; there are later, at least three machine- and hand-reaming operations.

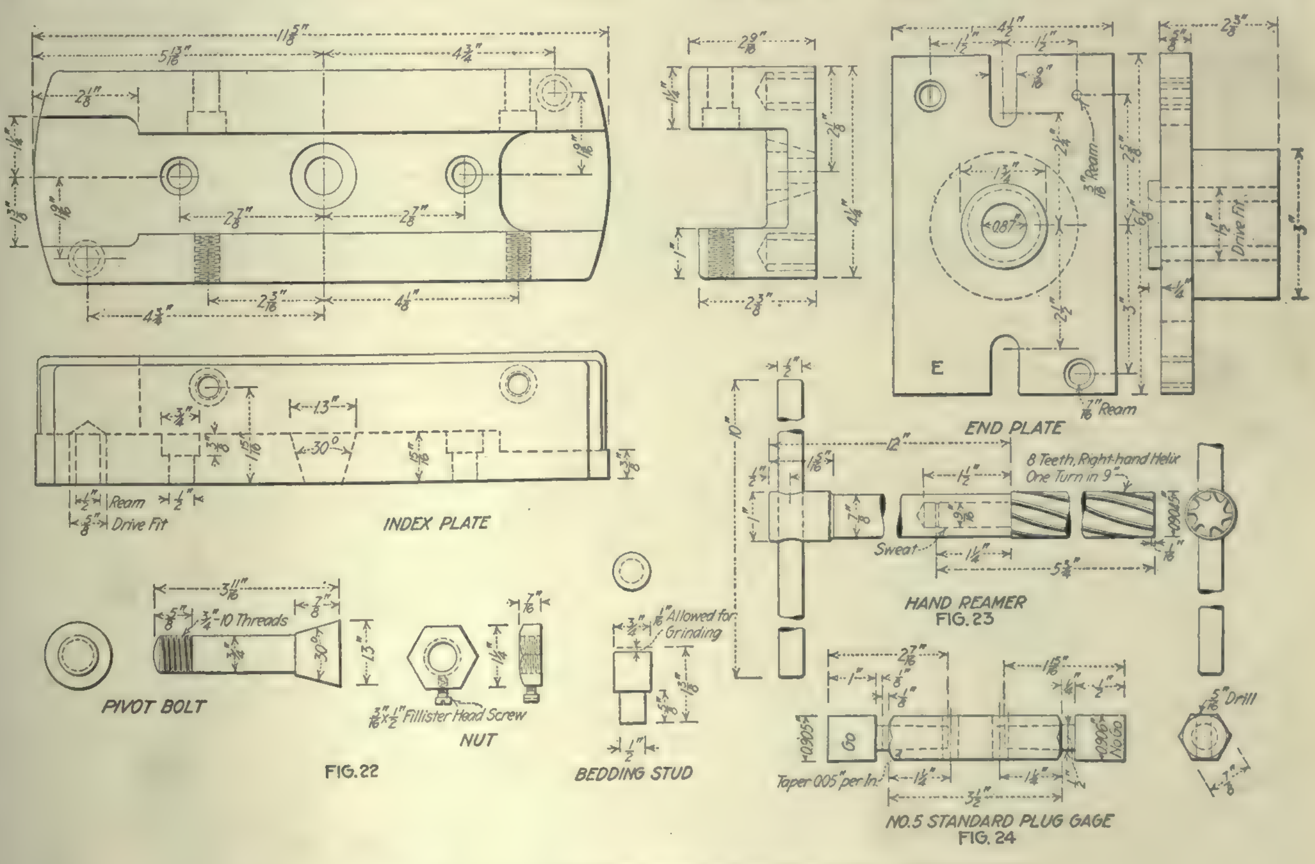
SEQUENCE OF OPERATIONS ON THE RECEIVER

Number	Operation
¼	Grind forging.
½	Rough mill bottom.
¾	Rough for operation 1.
1	Straddle mill ends.
2	Length mill left side (rough).
3	Length mill right side (rough).
4	Drill and ream large hole.
4½	Rough ream large hole in barrel reaming machine.
5	Finish ream large hole in barrel reaming machine.
6	Lap.
7	Drill and ream small hole.
7½	Rough ream small hole.
8	Finish ream small hole.
8½	Lap small hole.
9	Finish face ends to standard length.
10	Finish machine recess locking grooves and counterbore.
10½	Hand ream and counterbore.
11	Mill retractor spring case lug to shape and finish portion of bottom of receiver.
12	Length mill top of platform.
13	Rough mill over grip-slide cut.
14	Rough broach.
15	Finish broach.
16	Length mill grip-slide, finish shape of sides and rough cut stock for grip-slide grooves.
17	Finish rounded shape on bottom of receiver.
17½	Rough straddle mill underside of table at left and right sides.
18	Finish straddle mill underside of table at left and right sides.
19	Length mill circle at front end and groove on left side.
20	....
21	Length mill outside shape of bolt bore on left side.
22	Length mill outside shape of bolt bore on right side.
23	Mill left side of spring case lug.
24	Mill right side of spring case lug and safety clearance slot.
25	Length mill safety clearance slot on left side.
26	....
27	Length mill ejector clearance slot.
28	Length mill ejector opening.
29	Profile full outside shape (rough).
29½	Profile full outside shape (finish).
30	Undercut grip-slide groove.
31	Profile platform surface at front end and finish locking lug top.
32	Profile platform rear end.
33	Profile underside of platform on left side.
33½	Finish gear casing stop shoulder.
34	Profile continuation of grip-slide cut.
35	Profile feed-arm clearance.
36	Profile ejector clearance slot.
37	Drill small hole.
38	Drill and ream all holes except hinge-pin hole.
39	Drill and ream magazine boss.
40	Hub magazine boss.
41	Drill and ream hinge-pin hole.
42	Finish rear end of bolt-lug slot on top of receiver.
43	Rough out cartridge clearance slot.
44	Straddle mill front end of safety lug.
45	....
46	Square up ends of safety clearance cut on left side.
47	....
48	Length mill safety-locking notches on left side.
49	Mill gear clearance slot.
50	Mill gear clearance slot.
51	....
52	Profile front end of firing pin clearance slot.
52¼	Shave front end of firing-pin clearance slot.
52½	Mill angle at front end of firing pin lug slot.
53	Shave bolt locking lug clearance slot (wide).
54	Shave bolt locking lug clearance slot (narrow).
55	Shave bolt cam lug clearance slot.

Number	Operation
56	Length mill charging handle clearance slots.
57	Finish bolt bore cuts at rear end.
58	Finish front and rear ends of safety clearance cuts on left side.
59	....
60	Profile magazine clearance at front of feed cover locating surface, locking slot at front of magazine boss and finish feed cover locating lug.
61	Profile small radii and feed arm clearance and finish.
62	Profile and finish small radius at front end of receiver.
63	Profile feed cover locating lug at rear end.
64	Profile feed cover locking cut.
65	Profile ejector slot cover locking cut rear end.
66	Profile ejector opening.
67	Profile cartridge clearance slot to shape at front end.
68	Profile cartridge guide cut on right side of cartridge clearance.
69	....
70	....
71	Profile cartridge guide wings at rear end of cartridge clearance slot.
71½	Profile radius on right side of cartridge opening.
72	Profile heading cut.
72½	Recut heading cut.
73	Recut rounded shoulder at rear of receiver.
74	Recut extractor clearance cut on inside of bolt bore on side.
74½	Recut extractor clearance cut on side of bolt bore on front.
75	Recut ejector clearance cut on inside of bolt bore.
75½	Spline mill ejector slot on front end of bolt bore.
76	Rough mill locking clearance cut at front end, finishing bottom shape and leaving 3-64 on shoulder.
77	Mill clearance slot at front of gear case lug.
78	Mill take down pin clearance slot.
79	Rough out locking slot.
80	Mill butt tang locking slot at rear end.
81	Mill lock butt tang stop shoulders.
82	Mill operating lug clearance on left side of cartridge clearance slot.
83	Mill butt tang clearance on right side.
84	Shave charging handle clearance slots.
85	....
86	Shave rear end of charging handle clearance slots on left side.
87	....
88	Profile bevel at rear end of ejector clearance slot.
88½	Shave ejector clearance at rear end.
89	Profile magazine catch in magazine boss.
90	Profile angles at front end of upper and lower locking lug clearance slots.
91	Profile rounded shape at back to fit bottom of butt tang.
92	Mill feed arm stop lug clearance slot.
93	Profile hinge clearance slot.
93½	Profile corner of front end of ejector cover slot.
94	Undercut front end of grip-slide cup.
95	Inspect after machine operations have been done.
96	File uneven surface off rear end and burr tops for polish.
97	Rough polish bottom side and top.
98	Corner edges of receiver and polish edges.
99	Rough polish.
100	....
101	Polish angular surface at right on cartridge clearance cut, gage bolt race, break inside corner and file cartridge clearance cut.
102	Polish extractor clearance cut and safety-slide.
103	General inspection after first polishing operation.
104	Grind face end.
105	Lap large hole to size.
106	Gage receiver for bolt and rack.
107	Lap small hole and rack slot.
108	File safety-slide slot.
109	File ejector slot.
110	File receiver to fit ejector.
111	....
112	File and fit receiver to guard.
113	Broach guide rib.
114	File receiver to fit gear case.
115	File ejector opening.
116	File end of locking cut to fit feed cover.
117	Finish platform of feed arm clearance cut.
118	Machine ream cartridge guide wings.
119	File top of receiver and break corners at front end of ejector slot.
120	Fit charging handle, gage, and corner rear end.
121	File top to gage.
122	Mill barrel thread at front end.
123	Profile off end of barrel thread.
124	Roll stamp name.
124½	Roll inspection stamp.
125	Scrape out barrel end after threading.
126	....
127	File and qualify front end after threading.
128	Finish bolt lock up on receiver.
129	Finish locking slot to size.
130	Match receiver with feed cover on outside shape.
130½	File and emery receiver to match receiver.
131	File receiver to fit locking piece.
132	File receiver to fit butt tang.
133	Number receiver.
134	Finish polish.
135	....
136	Grind magazine hub to gage.
137	Put in magazine center key and file to micrometer.
137¼	Profile feed operating arm lock cut.
137½	Profile magazine locating key-slot in magazine hub.
138	....
139	Hand tool recess clearance cut.
140	Squeeze in receiver at locking shoulders 0.006 in.
141	Harden.
141¼	Lap piston bore.
141½	Regage, fit rack, bolt bores, and feed cover.
142	Sand blast.
143	Brown.
143½	Qualify after browning (finish).
144	Grind lock up shoulder.
145	Assemble.

The fixture in which the receiver is carried on the turret-lathe spindle, is shown clearly in Fig. 19, and in the drawings Figs. 20, 21 and 22. It will be noticed that the receiver forging is secured in the fixture by set-screws at the side which hold the work in a channel formed in the top of a swiveling plate *D*, Fig. 20, while two other screws through the top of the fixture act downward upon the flat face at the top of the forging.

The receiver forging measures over all 11⅝ in., and



FIGS. 22 TO 24. A NUMBER OF THE FIXTURES AND TOOLS USED

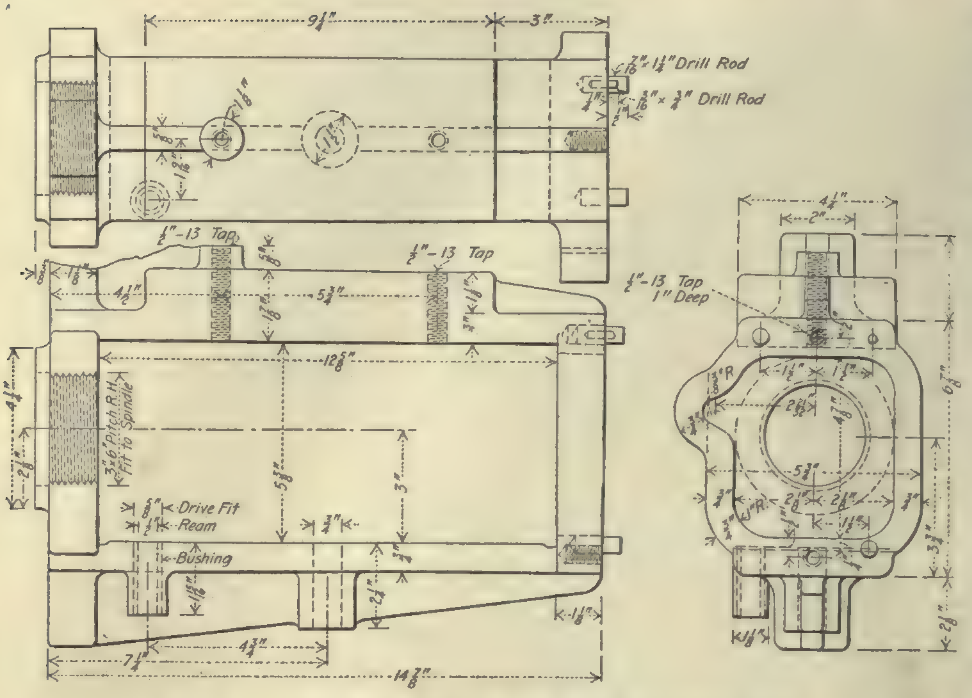


FIG. 21. COMPLETE DETAILS OF ONE FIXTURE USED

it is obviously impossible to put the hole through from one end with satisfactory results. Instead of attempting this with the probability of the drill running out of truth before it has reached the rear end, the swivel table *D* was provided in the design of the fixture, enabling the hole to be drilled halfway through, the swivel table and work turned end for end and the remaining half of the hole drilled from the front. The drawing shows the method of mounting the swivel table with a cone-headed, central stud, and the means of locking it by an index pin at the back of the fixture which enters hardened and ground bushings fitted into the bottom of the swiveling plate. The spot drill, long drill and reamer operate through the bushing carried in plate *E*, Fig. 20, in the front end of the fixture. This bushing plate is provided at diagonally opposite corners with two $\frac{7}{16}$-in. hardened bushings which fit over dowel pins in the face of the fixture more clearly shown at *E*, Fig. 22. When the bushing plate is slipped into place it is held by two screws with flatted heads which require only a quarter-turn to clear the slots in the ends of the plate and allow the latter to be removed. The fixture just described is accurately constructed and carefully counterbalanced, and the operation of drilling and reaming the hole is performed carefully to insure as accurate results as possible, particularly so far as concerns the straightness of the hole.

The actual diameter of the bore is not of prime importance at this point as several reaming and lapping operations are performed later with other equipment. The spotting drill and through drill are kept ground accurately on the lips to assure truth in starting and drilling, and feeds and speeds are adjusted to preserve the greatest degree of accuracy obtainable in the drilling and reaming process. The reversing of the work end for end by means of the swivel plate, is a test of the accuracy of the fixture; and the fact that the hole drilled half-way through the receiver from each end and then reamed clear through will test out properly for straightness and size when a long standard plug gage is slipped clear through, is a proof both of the good workmanship in the fixture and of the care taken in drilling and reaming the receiver.

After the receiver leaves this fixture it is placed in another fixture on a gun-barrel reaming machine where the hole is still further enlarged by two machine reamers. A hand reamer, Fig. 23, is then put through the work for the final reaming operation, this leaving about 0.001 in. to be removed by lapping. The limit gage to which the hole is lapped is shown in Fig. 24. The small end of this gage has a diameter 0.905 in.; the large end is 0.906 in., the tolerance therefore being 0.001 in.

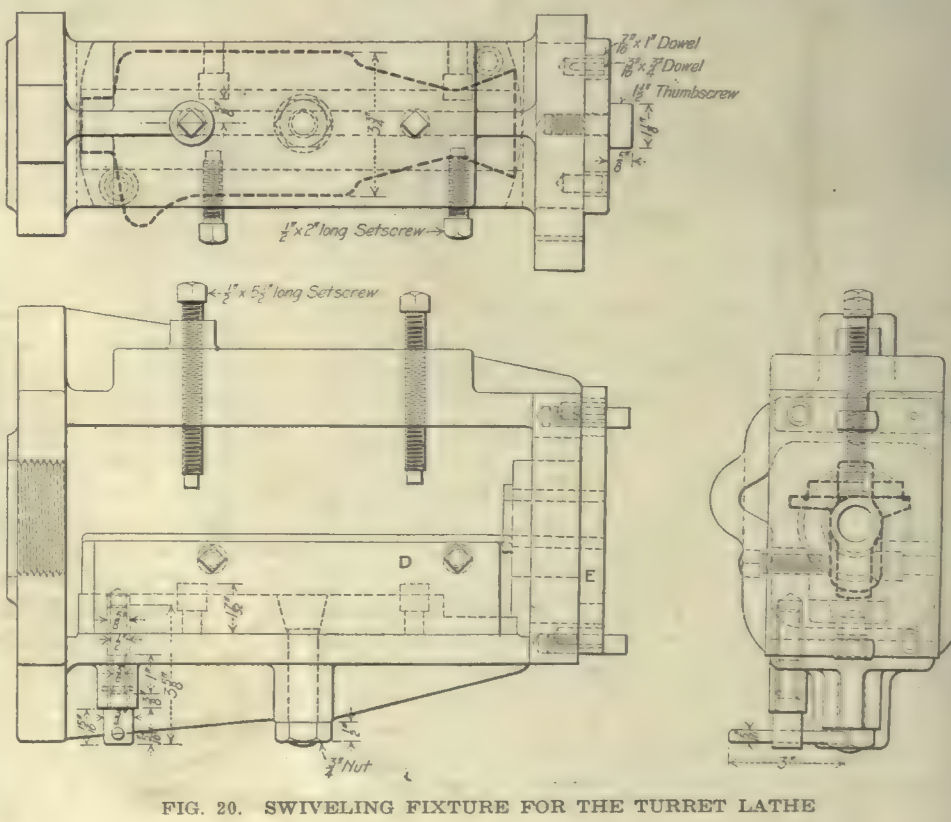


FIG. 20. SWIVELING FIXTURE FOR THE TURRET LATHE

This gage is made of three pieces. The handle or body is a 3½ in. length of hexagonal cold-rolled steel, ⅞ in. across flats, with a hole in each end made to a taper of 0.05 in. per in. In these holes fit the taper shanks of the limit gages proper, which are made of tool steel hardened, ground and lapped. A $\frac{5}{16}$-in. hole is drilled crosswise through the handle at the bottom of each taper hole to allow the gage ends to be drifted out for replacement or other purpose.

Lapping the Receiver Hole

The method of lapping the main receiver hole is illustrated in Fig. 25. The work is held in a fixture on a gun-barrel machine in similar manner to the set-up for machine reaming. As in the case of the reaming operation two receivers may be lapped at the same time. The laps used are of the "cat tail" form, the lead lap on the end of the long shank being about 5 in. long. The lead is cast on the end of the rod and is split for the insertion of a thin pine adjusting wedge. Emery and oil are used on the lead body for a lapping medium, No. 36 emery being used for roughing and No. 60 emery for the finish lapping.

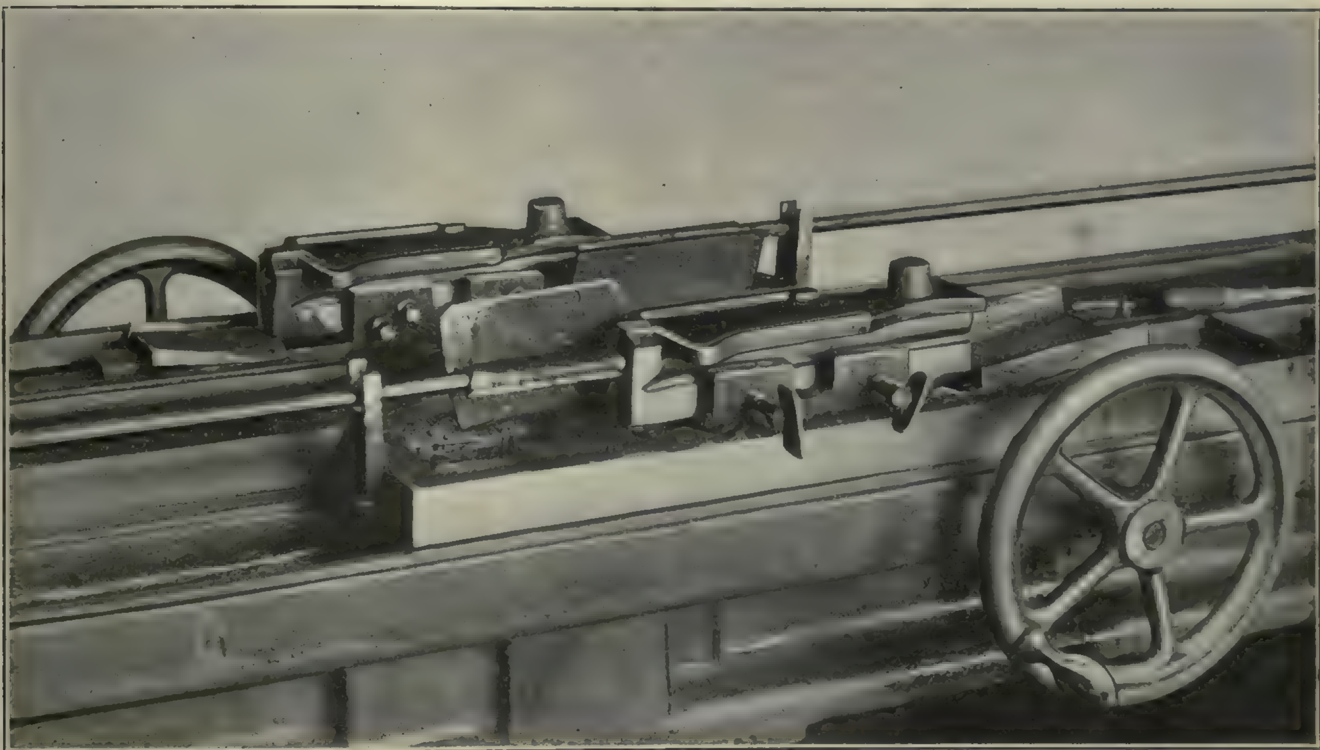


FIG. 25. LAPPING RECEIVER HOLE TO SIZE

An Early Form of the Famous Caterpillar Tractor

By W. D. Forbes

In an article on page 20 "Anent Our Fortieth Birthday," your devil—I suppose there is still a devil—made me say that the articles by an Englishman in America were to be found in the *Locomotive Engineer*, when I really said they were to be found in the issues of *Engineering* of 1870, '71, '72; and as they are well worth reading I call your attention to the devilish performance.

In thinking over the life of the *American Machinist* I call to mind something which I believe must have been very near the original idea of the now celebrated war tanks. I returned to America from working in various continental shops, to find that those in America differed in many ways from them; so I went to work at Delamater's shops at the foot of West 13th St., New York City. My work was in a huge wooden building on the south side of the street and Mr. Miller was the foreman. During my first noon hour I noticed a group of men around a platform which was perhaps 12 ft. long and half that width, and on it were mounted four wheels around which were belts—chain belts I think—and to these belts were fitted posts or pillars about a foot apart; these posts were of course radial as they passed over the wheel, and vertical between them.

The inventor whose name I cannot recall, had a broken arm; he and a couple of men pushed on the back of the platform and it moved along the floor laying its own tracks, so to speak; or perhaps more properly: laying its points of support. I think the idea of it was to make a traction engine, but I did not stay long enough to see it completed. As this was in the winter of 1874, I think, it must have been one of the very earliest of this type of motor. As I remember, a Baxter engine and boiler was to be the motive power. Perhaps if there are any left of the old Delamater association some further details of this, to me, interesting machine could be obtained. H. B. Roelker, 41 Maiden Lane, was I think chief draftsman for Delamater at that time, and he might recall the circumstance.

I saw John Ericsson looking at the machine with his draftsman, Mr. McCord, who later became professor of mechanical drawing at Stevens Institute of Technology, Hoboken, N. J.

Gag Punch for Structural Punch Press

BY J. V. HUNTER

In the punching of bars or shapes in the structural steel shop, commercial accuracy is the prime essential. The description of a highly efficient device for the accomplishment of this work will be of interest to all who are in any way connected with structural steel fabrication.

HAVE you ever noticed when you went through a manufacturing shop where they were punching holes in long bars or structural shapes, these holes to be eventually filled by rivets or bolts, that in a large percentage of the cases more than one size of holes will be made in each bar? Also, you may have noticed that as the majority of these punches were single stem, it was necessary for the man handling the work to pass them through the punch as many times as there were different sizes of holes. Naturally this rehandling adds to the cost, and should the work be heavy so that several men, and possibly a crane are required to handle it, the cost is further increased.

The punch-press attachment known as the gag punch was developed some years ago to provide a means of punching these various sizes of holes during one handling of the work, and is supplied by most of the punch-press manufacturers, but the writer has observed that the majority of those presses which have been purchased and installed in the past are not so equipped. When it has been decided that work can be expedited by the use of this device, it is often difficult to find one to fit the type of machine in use, therefore some of the more enterprising concerns have from time to time planned and built these devices in their own shops. It is with the idea that there are others who might be interested in building such a device that this description is written.

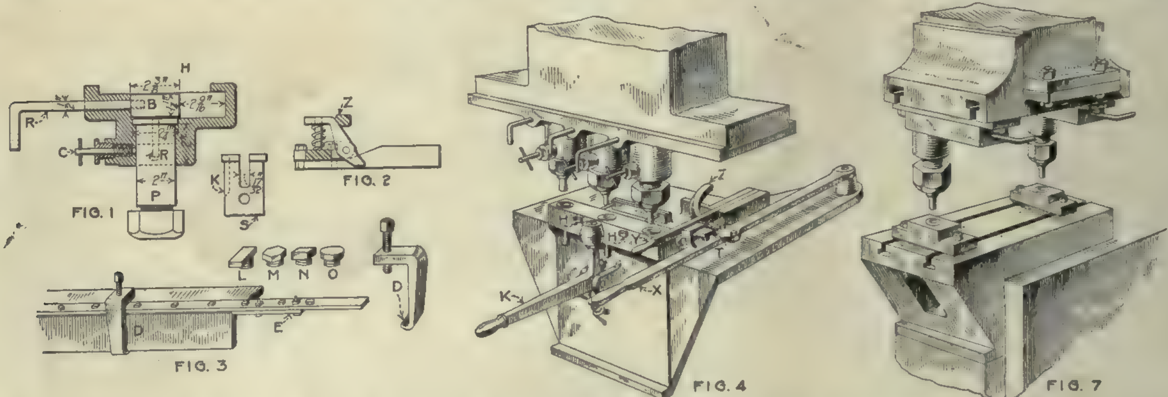
When starting to lay out the design for the punch the first problem is to know the exact amount of metal needed for the necessary degree of strength, without making it bulky and cumbersome. The sectional view in Fig. 1 may help anyone contemplating such a design; this is just about as light as it is possible to make a gag punch and have it stand up for fairly heavy service—say for a $\frac{15}{16}$-in. hole in $\frac{3}{4}$-in. steel.

To one who is unfamiliar with the principle of the gag punch it might be explained at this point that the stems are free to move up and down in their housing; except the one which is working. Above that one is a gag or block *B* that slides into place and fills all the space between the top of the punch-stem *P* and the ram head above *H*. This block *B* holds the stem firmly in position during the stroke of the punch, taking up all of the thrust during the piercing portion of the stroke. Such of the punches not desired to operate during a certain stroke, have their gags pushed away from above the stem; and with nothing above them to hold them in place during the stroke, these stems will descend with the housing until they come in contact with the piece of work and then will slide upward in the housing without piercing the metal. Manifestly the thickness of the gag must be equal to the stroke of the punch press so that the stem will not receive pressure from *H* at the lower portion of the stroke.

Perhaps the gag punch shown here is unique in one particular which is a gain in several respects and a loss in none; the advantage consists in the gags being pushed back from the worker when not in use; in all other gag punches they are pulled forward when not working. This feature was the result of an experience some years ago with a pull-forward release gag punch. In this instance it was found that the portion of the housing or box containing the gags seriously impeded the vision of the operator when lining up the punch to prick punch marks. Since that time the reverse design has been adopted and is found to be more satisfactory than the old type.

In order to accomplish this push-back type it is necessary to mill a slot in the upper end of the stem as shown at *S*, to pass over the rod *R* when the stem rises. Also the stem must be kept in a fixed position for the same reason and not permitted to turn, hence the key *K* is provided.

The spring pin *C* is another feature of this particular gag-punch head. When the stem is not wanted for use and is pushed up, this little pin immediately springs into a small recess on the side of the stem and holds it up until released by the operator. The pin can be pulled out and the gag forwarded at the same instant. Holding the nonworking stems up in this manner serves to keep the centers of the idle punches from striking



FIGS. 1, 2, 3, 4, AND 7. VARIOUS DETAILS OF THE GAG PUNCH

the work, as it has been found that the marks so caused would often mislead the operator and induce him to add a hole where none was intended.

Referring to Fig. 4 it will be seen that details have been added to the punch-press knee for this gag punch other than common; these provide a positive "feed-and-stop" arrangement for pushing the work forward to the punch when engaged on standard parts for which we could afford to furnish permanent templets to hasten production.

These templets are shown in Fig. 3, where we see one in position on an angle; this consists of a light steel bar of ¼ x 1-in. material in which holes are drilled at proper intervals and tapped for the plugs *L, M, N, O.* The plugs can be turned from any shape of bar in a screw machine, and each one will indicate a different size of hole to the punch-press operator, or perhaps a different gaging for the hole. It is preferable to make these plugs with a head that can be turned with a wrench, so they may be readily removed from one templet and put in another. No great investment in plugs will be necessary to keep the shop supplied.

For a minimum amount of interference at the punch, the clamp *D*—shown in detail at the right of this same figure—is provided to secure the templet to angles or channels. At *E* it will be noted that there is a small lug bolted to the lower side of the templet as a gage for the end of the piece of work; this lug also serves to pull the work ahead, feeding the bar up to the punch as the pull is exerted on the stops after each stroke.

This feed arrangement eliminates all necessity of lining up the work under the punch for each stroke. Fig. 4 shows a feed-lever *X* which is pulled to the right until its tripping cog *T* has passed one of the gage plugs on the templet. The stroke is then reversed, *T* engages with the gage plug, and pulls the templet and the work with it to the left until the gage plug comes into contact with the stop-lever *Y;* this is the end of the stroke and the hole is then punched. The feed-lever is then immediately pulled to the right again to engage the next plug, but in doing so it pulls with it the curved bar *Z*, which in turn slides under *Y* and is beveled in such a manner that with the beginning of its stroke it raises the stop-lever sufficiently to let the gage plug which has already been punched, pass under during the feeding stroke, and only drops the stop-lever in time to catch the plug for the next hole.

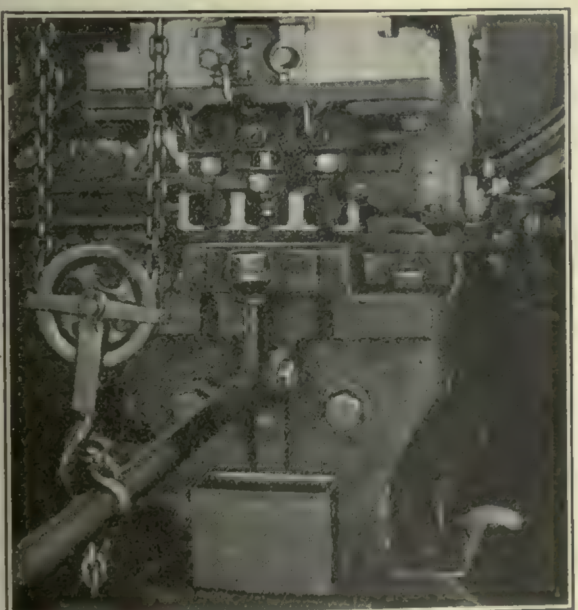


FIG 5. GAG PUNCH FREE FROM WORK

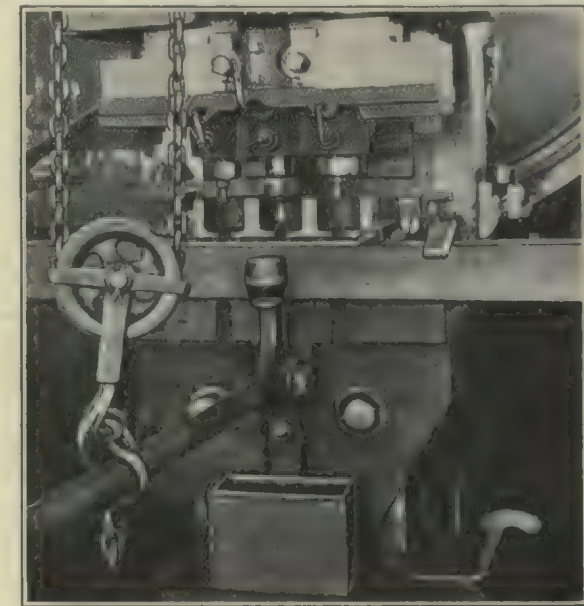


FIG. 6. ANGLE PASSING THROUGH PUNCH

A section showing the arrangement of the tripping cog *T* is shown in Fig. 2. This is a sectional view through the cast-steel feed-lever at that point, and also shows a portion of the bar *Z* extending to the right, this latter being fastened with capscrews to the under side of the feed-lever. The feed-lever was made of cast steel since that was less expensive than to attempt to forge it up in the shape designed, but there is no reason why a shop should not use a forged lever.

Punching angles where there is more or less change in the gage to be provided for, has necessitated one more device or attachment for this gag punch. This is the lever *K* in Fig. 4, a right-angle lever that carries a roller on the short end to press the work into place; the weight of this lever being carried by the spring partly shown below. Released while the work is being pushed forward over the dies, the outer end of the lever is then raised, and the roller in turn pushes the work in toward the dies. The distance that the work can be pushed in is regulated by the two lugs *H* in the face of the die-holder; these two lugs in turn being controlled by the rods that extend back through the die-holder to the bracket seen in rear. With no shim in front of this bracket these lugs are flush with the face of the holder, but by dropping shims of specified thickness between the rods and the bracket, they can be made to project a definite distance in front of the holder. When projecting in this manner they serve to hold the work a certain distance from the dies and so change the gage. As these shims can be rapidly placed and removed, the gage line can be frequently changed while handling one piece of work; these changes can clearly be indicated by different plug designs in the gage rod to indicate where they occur.

In Figs. 5 and 6 are shown two views of the gag punch in place on a press. In Fig. 5 the punch is free from work—and note that the middle punch stem plainly shows that it has been lowered into working position, while the others are in nonworking position. The feed-lever has been thrown back to the right, and it shows the stop-lever in the raised position.

In Fig. 6 a piece of angle is shown passing through the punch; the feed-lever has been pulled fully to the left and the stop-lever is lowered to the position of "stop." In both of these views one feature that deserves explanation is the light chain tackle block which may be noted hooked on the outer end of the lever; this was necessitated by the angles being badly warped so that heavy pressure on the roller was needed to make sure that the angle could not spring away from the die-blocks. The operator held the chain of the tackle in one hand and the feed-lever in the other; since the motion of a foot of the chain was sufficient to release the lever it was as quick as when held in the hand, and he was thus enabled to make both operations at the same identical time, and no time was lost on account of stock irregularity.

Gag Punch Carries Three Punches

Although the gag punch which is illustrated is designed to carry three punches, there is no reason to confine the construction to this number should the requirements of the shop call for something altogether different. Gag punches with two stems have frequently been built; and from that the number of stems may be increased indefinitely, being only limited by the length of the punch-press ram, since they must not be placed so far out that there is an over-hang to cause an off-side pressure and possibly disable the machine.

Another application of the gag-punch principle is illustrated in Fig. 7, which is an adaptation especially arranged for the larger structural shops when it is desired to punch both edges of a plate or channel at the same time; this could equally well be used in other shops wishing to make rows of two or more holes in any of their work at the same operation. As will be readily noted each of these punches is a separate gag-punch unit in itself. The punches are supported by a special slotted head that is attached to the ram of the press; the die holders are held by a knee correspondingly slotted for movable bolts.

Bolts Holding the Dies

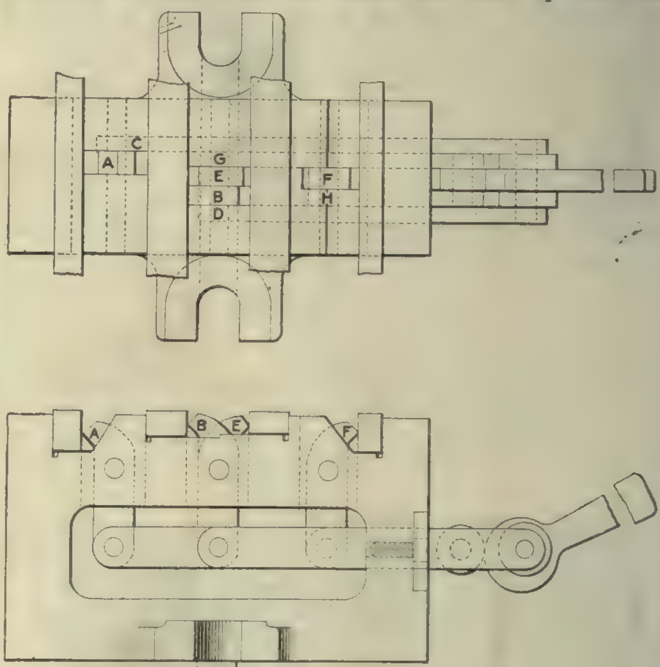
With the bolts holding the dies and punches so arranged that they can readily be moved forward and back, it is possible quickly to rearrange the machine for varying widths of work. While in this case only two punches are shown there are almost unlimited possibilities for different set-ups that will carry as many punching units at one time as the length of the punching ram head will permit. In order to have the holes very close together when desired, the gag-punch stems should be designed of a minimum width. It is easy to keep the die-holder block narrow.

Many of the older types of punches carrying this arrangement were provided with solid-stem punches, then it was a case of punching all of the holes or none, unless one stopped each time to remove one of the punches. This is an undesirable feature in many cases, because often when working a column plate, variations are found in the spacing of the holes when the top or base is reached; at such a time with the more modern gag-punch rig, the unnecessary punches are almost instantly eliminated. A similar device to this with a deeply divided knee casting, through which an I-beam may pass, is used for punching both flanges of these beams in one operation.

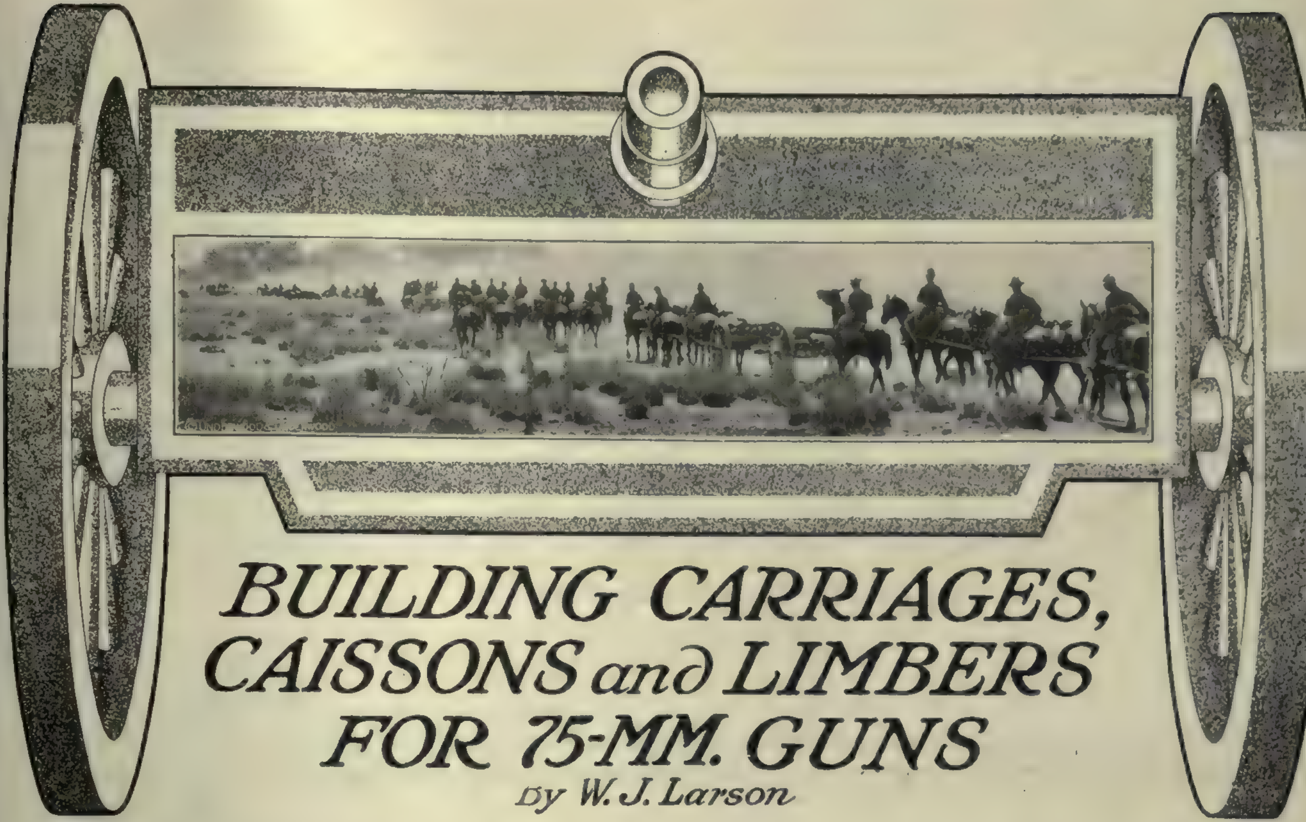
A Milling-Machine Fixture

By M. G. Hanson

Some time ago we had 100,000 pieces of tool steel to make; each was $2\frac{1}{2}$ in. long by $\frac{5}{8}$ x $\frac{3}{8}$-in. cross-section, and to be machined all over. The firm that placed the order supplied the steel in bars 25 in. long by $\frac{3}{4}$ x $\frac{1}{2}$-in. cross-section. We could spare two milling machines to do the work, and in order to keep both machines in operation, the pieces had to come from one machine finished to size, while the other cut them up into the required length of $2\frac{1}{2}$ in. We used five fixtures like those shown in the illustration, to machine the bars to $\frac{5}{8}$ x $\frac{3}{8}$ in., placing them equally along the bar. We machined the bottoms of the fitures with tongues to fit the T-slots in the milling-machine table, and then mounted them on the milling-machine table for the purpose of finishing them on the top, so they would be in exact alignment with the table and the spindle. The fixtures were then numbered before taking them off the table to finish machining. As shown in the illustration, the construction of the fixtures is very simple. The four parts which clamp the bars are made of tool steel, hardened. The two parts A and B are connected by the bars C and D to a cam. The two parts E and F are connected by the bars G and H to a thrust roller. When the cam lever is pressed down, the cam coming in contact with the thrust roller forces the bar C and D, and G and H in opposite directions. This movement is transmitted to the clamping levers, which closes the jaws on the work.



A MILLING-MACHINE FIXTURE



BUILDING CARRIAGES, CAISSONS and LIMBERS FOR 75-MM. GUNS

By W. J. Larson

V. Recoil Cylinders

It is not permissible to show drawings of recoil cylinders, nor to give a complete description of the various machining operations involved, but it is possible to show a few illustrations and some of the more interesting operations in this article.

TO THOSE not familiar with gun work the following description gives some explanation: the object of the recoil cylinders and recoil springs is to check the recoil or kick of the gun when fired, and return it to the firing position without disturbing the set of the piece; therefore, after the gunner has secured his range and has his gun set, he can fire rapidly without having to change the position of his gun or sights, until he wishes to shift his range to hit some other part of the enemy's forces or works. It is the design and proper application of these recoil mechanisms to the guns, that makes them a success or failure; hence, as a consequence each nation keeps the details of these matters as secret as possible; for if a gun is captured by the enemy the previous destruction of these parts will render it practically useless to him.

A partly finished recoil cylinder, together with wood-backed reamer, gages and slotting-tool head, is shown in Fig. 36. These cylinders are made from specially forged steel, and great care is exercised at all stages of machining in order to insure against defects in material, such as seams.

The first operations are to center the ends; turn and spot for back-resting during the drilling and hognosing, care being taken during the hognosing to leave at least 0.015 in. of stock for reaming. A rough planing operation around certain lugs is now performed to prevent the piece changing shape after some of the other machining operations have been finished.

The piece is then chucked and indicated up by the bore, and a spot turned on the outside diameter, and also a spot bored in the end to start the wood-backed reamer shown at *B*, Fig. 36.

There are many operations in gun shops that require the use of wood-backed reamers, for they cut a very true straight hole, and are not inclined to tear the work as will sometimes happen with solid reamers. To keep these reamers in shape they are kept immersed in tanks of oil which prevents the wooden packing from shrinking or warping. The wooden backing is sometimes removed and replaced with brass, as shall be mentioned later.

After this reaming operation, the piece should again be indicated to be sure that the bore runs true with the spot on the outside. If it does not run true it should again be indicated and the spot re-turned.

On account of defective material it is advisable at this stage to finish the outside diameter, between the lugs, to size, and test the piece under oil pressure, whereupon if there are any damaging defects they will show up before more time and work is spent on the remaining operations on the piece.

The bottom of the cylinder is then recessed to clear the slotting tools on the next operation. The recess boring bar for this work is shown in Fig. 37. The cutter *A* is fed out by the action of the worm *B* and the worm gear *C*. The outside of the bar *D* fits the bore of the recoil cylinder, and has an opening through the center that is eccentric with the outside. The shaft, which carries the tool *A* off center, passes through the eccentric bore of the recessing bar, and it is by rotating these parts with the worm gear *C* that the cutter is run

in or out. The workman gages the depth of cut by a line on the collar of the worm.

The next operation is to rough- and finish-slot the ribs, care being taken to space them accurately. The machine used on this work is shown in Fig. 38 with a cylinder in place and the end of the slotting tool *A* protruding from the end of the cylinder where the cut is started. The shape of these slots is somewhat similar to those in the brake crankshaft described in the preceding article of this series.

This machine was designed at the Arsenal expressly to handle this work. An ordinary lathe bed was equipped with cross-belt reversing head at *B* which is operated by a shift, and adjustable stops on the lathe, one of which is seen at *C*. The head *D* carries the slotting tool back and forth through the work and is operated by a feed screw on the lathe. The head *E* acts as a rest and guide for the toolbar. The work is indexed by the worm gear *F* and a worm on the opposite side of the fixture. In Fig. 36 the cutter head for this operation is shown at *C;* the cutter at *D;* and the various gages, in the order in which they are used, at 1, 2, 3, 4.

After the slotting operation, the seat in the rear end of the cylinder is finished for the recoil valve, by replacing the wooden packing on the wood-backed reamer with bronze, and replacing the reaming blades with bottoming blades which pick up the cut where the reaming blades left off. The reason this operation is not done before, is that the slotting cutter would leave a burr on the edge of the recess which would be difficult to remove.

The remaining operations are quite simple. The ends

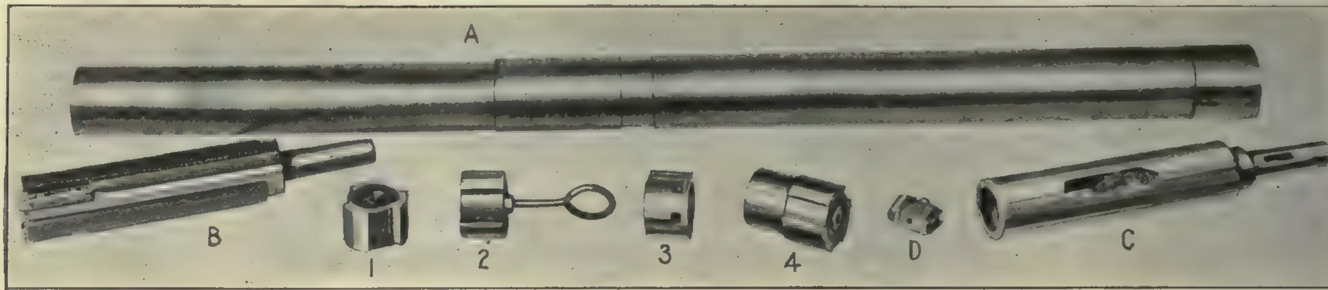


FIG. 36. CYLINDER, TOOLS AND GAGES

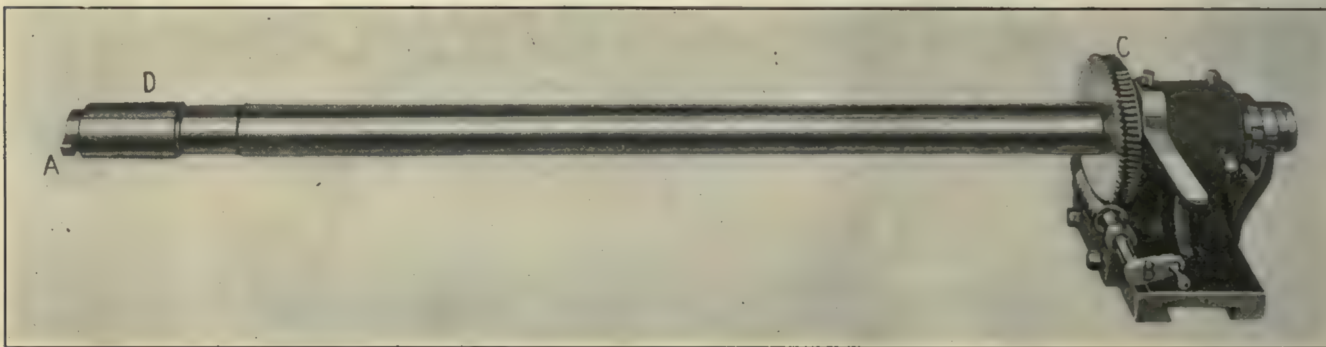


FIG. 37. CYLINDER RECESSING TOOL

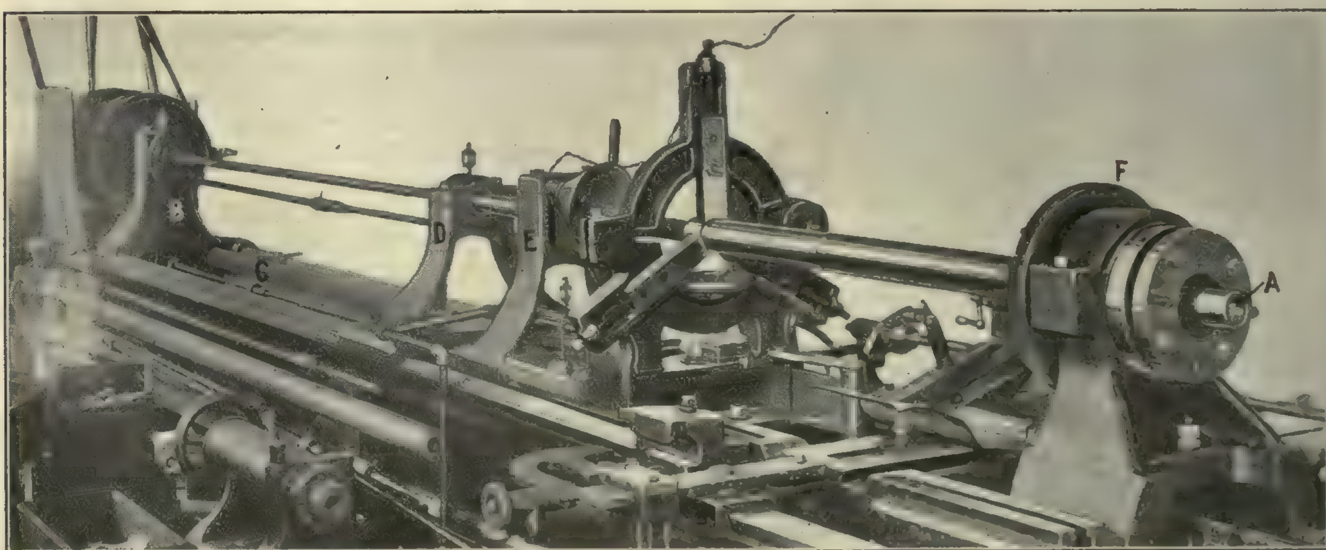


FIG. 38. MACHINE FOR SLOTTING CYLINDERS

are finish-bored and threaded. The piece is finish-turned and the ends faced on threaded centers screwed into the ends of the cylinder. The profile of the gun lug is planed to gage, the filling and draining holes drilled, counterbored and tapped, and the outside hollow-milled, a jig being used for this operation. The holes are then drilled and tapped for the locking screws, and the remaining stock milled around the lugs. The remaining radii are chipped and filed and the piece finished for inspection.

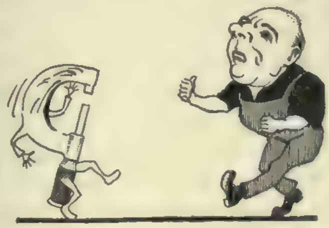
From Harry to His Uncle

"I charge thee, throw away ambition. By this sin fell the angels; how can man then, the image of his Maker, hope to win by't?"

This advice from a man in one of Shakespere's plays has always puzzled me as I have looked on ambition as the one thing that keeps us from sinking to the level of "The Man with a Hoe" in the well-known poem.

Perhaps however, Shakespere's man had in mind that mad lust for wealth, power and dominion which has been the prolific cause of sin and crime throughout the history of our little planet, and which at the present time is exhibiting to our horrified gaze the awful panorama of war, and revealing the extreme thinness of the veneer which our boasted civilization has spread over the predatory, feral instincts of the race.

As I look over the throng of comrades in this shop I long for the power of mind-reading, that I might know what ambition impels each worker. Doubtless all were drawn hither as I was, by the lure of higher wages than any of us had ever received. In many minds is also the comfortable feeling that we, though not at the battle front, are at least doing something to help those who there bear the brunt of the struggle. Some, too, are looking beyond next Saturday's pay envelope and striving to fit themselves to hold better positions when the war is over, than they are now competent to fill. But isn't it ambition, in some shape or other, that is the "vis a tergo" pushing each and everyone to exertion?



Some of its manifestations are amusing. Near me is a young fellow running a universal milling machine, and just now employed in cutting the teeth in spiral mills. Though never inside a shop till a few weeks ago, he is not only ambitious to revolutionize our time-honored methods, but sublimely confident of his ability to do so. Yesterday he reached the sage conclusion that running back the table after every cut was needlessly wasteful of precious time, and that he could add to his earnings by making the machine cut both ways. With the usual secretiveness of the would-be inventor he took no one into his confidence, but reversed the feed at the end of a cut. Though the result was the breaking of a cutter, the springing of an arbor, the spoiling of a lot of blanks and a vigorous call-down from a "Higher-up," he seemed not at all disheartened, and his neighbors are "watchfully waiting" for the next meteoric outburst of his genius.

I've been making the acquaintance of the old machinist who has charge of hiring men from the motley throngs who come from field, forest, counter, desk and Heaven knows where else, to apply for work, and have heard many interesting tales of his experiences in attempting to separate the wheat from the chaff.

We have on our floor, a new "lumper"—a man of mighty brawn. When he came he desired to "hire on" as a full-fledged all-around workman. When asked concerning his ability to handle a "mike," he rose from his seat and said, "Lead me till 'im, and if he's no moor than six-fut wan I'll handle him to the Quane's taste."

The employment man tells of another lad, evidently of agricultural antecedents, whom he asked whether he had ever run a milling machine. The seeker replied, "No, but many a load of wheat I've hauled and seen it run into one."

One husky had run a lathe in his youth, but had drifted out of the business and into cattle punching. There chanced to be a demand for screw machine hands the day he came, and he was asked if he could handle an "automatic." He said, "Wal, reely, the old Colt's 44 has allers been my chice."

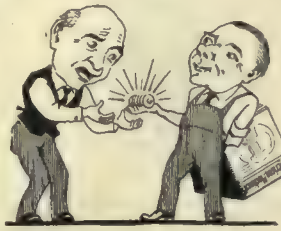
Another came on a day when there was a call for toolmakers. He made no extravagant claims of skill, but said, "I ought to know something about it, for I've sthrook for the blacksmith, fwile he foorged hoonderds."

Still another was catechized as to his familiarity with the metric scale, which the inquisitor for some occult reason, calls "meetric." The new-comer's face brightened like that of one who in a foreign land of alien speech hears the beloved accents of his mother tongue, and he confidently answered, "Yes, indeed. Why, I've run a butcher's cart for the last five years."

You didn't tell me that the superintendent here is a former shopmate and old friend of yours, and when I found attached to my pay envelope a summons to his august presence I went with fear and trembling. He has been very kind, inviting me to come to his house, a few miles from the city, for unlimited Sunday dinners, giving me the run of his library, and most tactfully cutting me dead when I'm in the company of any of the boys from the shop. I didn't suppose superintendents were ever workmen. The one in the old shop was a fine fellow, square and able, but an office man who knew no more of the trade than I do of navigating a "flyoplane." This man here used to be at the head of a concern of which we in the trade speak with bated breath as representing the apex and summit of mechanical achievement. I've told him of some of my acquaintances here in the shop, who are studying at night in the hope of making something of themselves, but I find his view of the matter strangely pessimistic. He told me of once having notice that a man drawing two or three times ordinary machinist's pay for work requiring some little education along certain lines, was to leave in three months, whereupon

he called in ten bright young fellows and promised the desirable job to whichever should prove, by examination at the end of that period, to have the most thorough knowledge of the subject. The time to acquire the necessary education was ample, and all started enthusiastically, but none appeared to take the examination, all having fallen by the wayside. Just the same, I propose to keep pegging away.

A fortnight ago my foreman asked me whether I was willing to be "lent" for a time to the repair department, which was temporarily short-handed. Perhaps some hesitation was visible in my face, for he hastened to assure me that the pay would be at least equal to what I was making on piecework. With that understanding, I gladly accepted, and have greatly enjoyed the change. The careful training of the two years of my apprenticeship has done me good service, and I feel that I have made good. One day I saw the repair foreman examining a spiral gear so thoroughly broken that not a single tooth preserved its entire length intact He was trying to determine the angle of spiral with a vernier protractor! Seeing my interest, he asked if I could make a duplicate, and handed the job over with a sigh of relief. When I handed in the finished gear and he found it O. K., it was amusing to see with what respect he regarded me. He doesn't know that I couldn't have done it if I had not chanced, one rainy Sunday, when I was reading a lot of trade papers, to see the exact process described in every detail. Perhaps I'm too young and inexperienced to be entitled to an opinion, but I'm a firm believer in books and papers on the trade. In the old shop some of the foremen looked on them as useless rubbish, and in one department some two hundred gear-cutting hobs were made, and after they were spirally fluted it was discovered that it was impossible to relieve them. They had to junk the whole lot and then pay good money to an outside expert to figure new ones. Yet all the time a clear explanation was in a trade paper of which more than a hundred copies were taken in the shop, and it's only a matter of a little simple "trig," anyway.



While I was on the repair gang, a special machine built here in the shop, came in for a little tinkering. It was virtually a lathe, plus a few "doodads" added to fit it for its particular function. It had been discovered that the head spindle pointed skyward by about 0.002 or 0.003 in. and the orders were to scrape the headstock to truth. It was given to a man who had privately revealed to me that he had never done any shop work, though he had done some engine repairing. His method of procedure struck me as novel and ingenious, whatever may be said of its accuracy and workmanlike quality. Removing both head and foot spindles, he stretched a string tightly through the holes from which they came, and was about to rectify the alignment by removing superfluous metal from the bottom of the front of the live spindle bearing with a half-round bastard file, when the foreman came along and interrupted his well-meant labors.

Another "mechanic" had a few minutes' planing to do on a small piece, and the foreman assigned him to a planing machine about 48 x 48 in., all the smaller ones being busy. He soon returned to tell the foreman that the machine wasn't big enough to take the job. This announcement was received as a badly-timed joke, but he showed his sincerity by pointing out that a tool which some previous user had left in the machine was so near the table that his little job couldn't pass under it. He was enlightened in regard to the mobility of cross-rails and tool-blocks, and the job given to someone else.

Another was handed a piece of 3-in. cold-drawn steel to be cut, and a few minutes later was seen wrestling mightily with a hand hacksaw, his explanation being that all the power saws were busy; in corroboration whereof he pointed to a row of milling machines which he had evidently looked on as circular sawmills.

How these lads will turn out, I of course don't know, but others equally "green" soon acquire the limited skill needed to operate one machine, and a few weeks' after their coming here are earning as good wages as if they were pastmasters of the whole trade.

Who knows? Perhaps many of them will not rest content with the circumscribed knowledge and skill demanded of the "specialist" but will become real machinists, and from their number may be drawn the army of skilled men which, some tell us, will be needed after the war, to fill the gaps left by death and disablement.

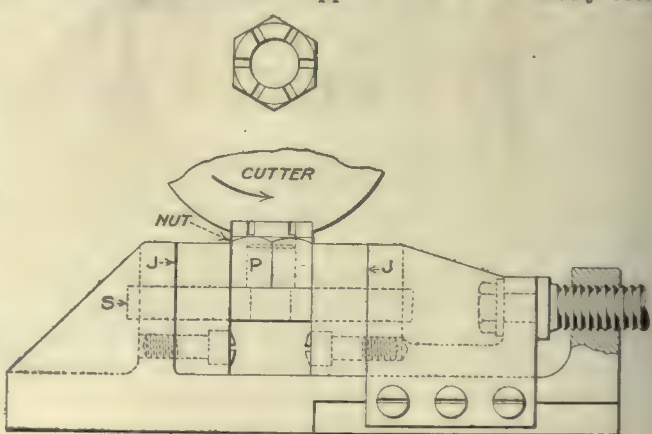
Of one thing I am certain: then, as now, the highest rewards will come to those who *know*, who possess training of brain as well as of hand. I intend to keep trying to learn, and if I fail it will not be from laziness nor lack of effort, but from deficiency of gray matter.

A Simple Rig for Castellating Nuts

By W. Burr Bennett

The accompanying sketch shows a simple and efficient rig for castellating nuts in small quantities. *J* and *J* are the jaws of an ordinary milling-machine vise in which slots are cut to receive the flat bar *S*, which is free to move endwise but confined in other directions.

In the center of the bar *S* is a pin *P*, over which the nut to be castellated is dropped. It will be readily seen



RIG FOR CASTELLATING NUTS

that with the vise fastened length-wise on the milling-machine table and the cutter set over the center of pin *P*, all cuts will pass through the center of the nut. Indexing for the necessary cuts is simply a matter of opening and closing the vise jaws and rotating the nut from flat to flat by hand.

Tool-Bit Grinding Economy

BY HUGO PUSEP

AN EVER increasing item of overhead expense in every machine shop, is the high-speed steel tool bit. It has become a necessity to the progressive shopman.

The cost of high-speed steel combined with its shortage is causing shop owners to seek a means of relief. Notwithstanding its great usefulness, the tool bit is short-lived; while despite this it is a paying investment. There is still much to be done, however, in educating the workman in the proper methods of grinding. It is not in every case the workman who is at fault for unnecessarily wasting valuable material. Many of our mechanics have never been taught how to grind a lathe or a shaping-machine tool properly. The majority of apprentices in jobbing or medium-sized machine shops, pick up the art of tool grinding from their more experienced shopmates, who in most instances have acquired their knowledge in like manner.

Much valuable data has been published relating to solid-forged, lathe shaping-machine and planing-machine tools, but the subject of the tool bit has not received its share of publicity.

The purpose of this article is not an attempt at standardization, but rather to bring out the fact that it is possible to get as much production with a sensibly ground tool bit as with one having fancy cutting and clearance angles, and further: to know that the life of the former is at least twice that of the latter.

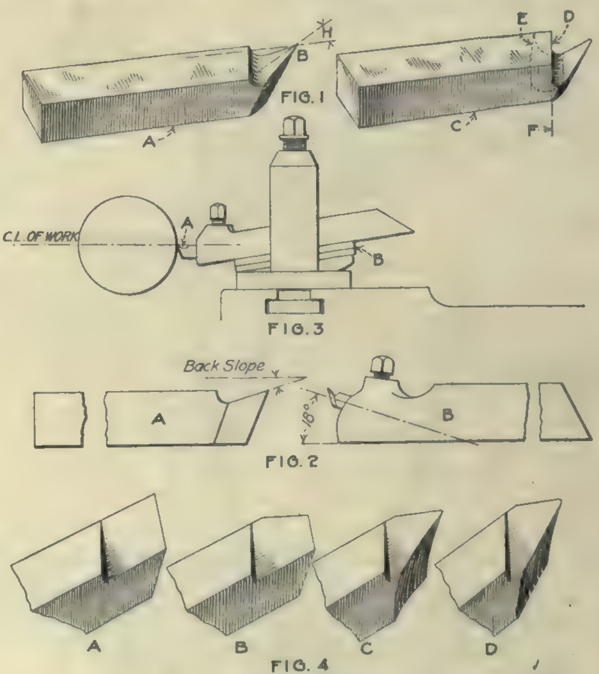
Machinists are aware that the various angles and clearances given in handbooks, are examples of ideal conditions in cutting tools for machining metals of given hardness. A knowledge of these conditions is of great help to any machinist, inasmuch as by consulting these tables of cutting angles which have been worked out by actual practice, he can quickly determine the actual shape of a cutting tool for his particular need. It is not practical, however, to grind the angles of a cutting tool to a protractor, because of the waste of time, and a slight variation does not seriously affect the tool's usefulness. There are several standard, cutting-tool, grinding machines, but these are intended primarily for the solid forged tools, and are not adapted for tool-bit grinding.

The cutting angles of tool bits are ground by eye; a machinist uses his sixth sense in determining by general appearance of the tool when the desired angle is reached. He generally accomplishes his purpose; but let one compare, for instance, a number of right-hand, roughing tools for lathe work, ground by several experienced machinists, and he will at once see the variation of angles, slopes and clearances. Each of these tools, however, will accomplish the desired results.

The chip does not always indicate the efficiency of the tool; the one that removes steel in the form of a spiral ribbon may need regrinding every ten minutes, while the tool that is breaking up the chip may be hogging into the metal in a very business-like manner, and require grinding but four or five times a day.

Sketch *A*, Fig 1 shows a right-hand, roughing-tool bit, newly ground, where the lip *B* is the full depth of the tool. After a number of grindings, the tool will appear as in sketch *C*. This has worked well up to this stage, but now the chip begins to crowd against the face *D*; requiring more and more power to pull the cut and placing a heavier strain on the point of the tool; the chips also clog around the lip. To remedy this the machinist either grinds the face *D* further back as indicated by the dotted lines *E*, or grinds off the lip to line *F* and then proceeds to develop a new cutting edge. This results in a loss of from ¼ to ⅜ in. of high-speed steel. The primal cause of this waste is the excessive back slope *H*, which is eliminated by the use of the modern toolholder. Before its advent the forged roughing tool most commonly used had the form of *A*, Fig. 2. The advent of the high-speed bit and toolholder did not change the machinist's ideas of grinding, and this is the reason for the abuse of the modern tool.

A glance at any well-known make of toolholder, will show conclusively that provision is made in its design for sufficient back slope. At *B*, Fig. 2, is a sketch of



FIGS 1 TO 4. TOOL-GRINDING METHODS

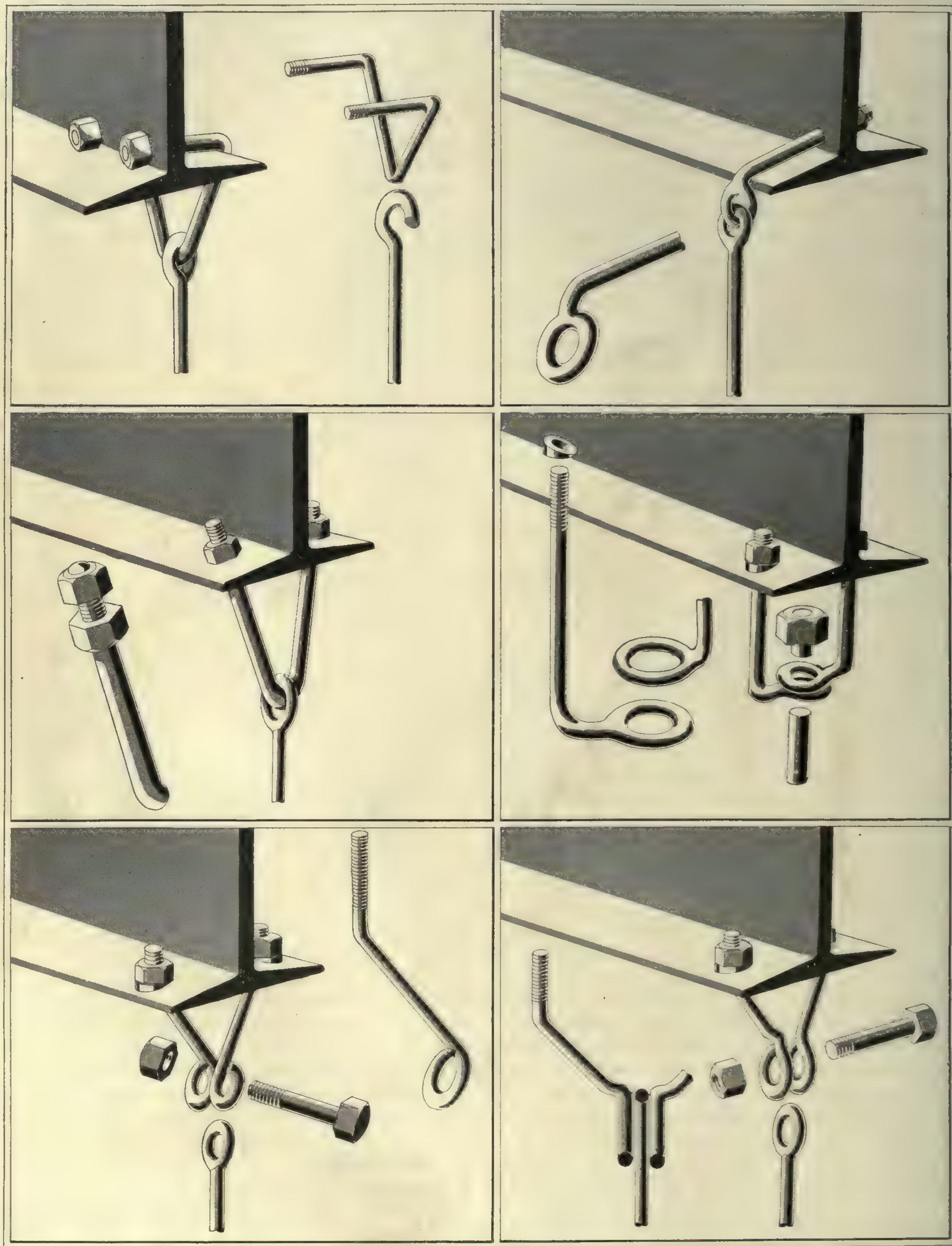
an Armstrong toolholder, familiar to every machinist. In this toolholder the square hole for the tool bit is machined at an angle of about 18 deg. with the lower face thus providing ample back slope which is obtained by forging and grinding in the old style, solid tool as shown at *A*.

A common practice of many lathe operators, is that of grinding the back slope *A*, Fig. 3, so acute on the point of the tool that it is necessary to block the toolholder as shown at *B*, in order to prevent digging in and tool breakage.

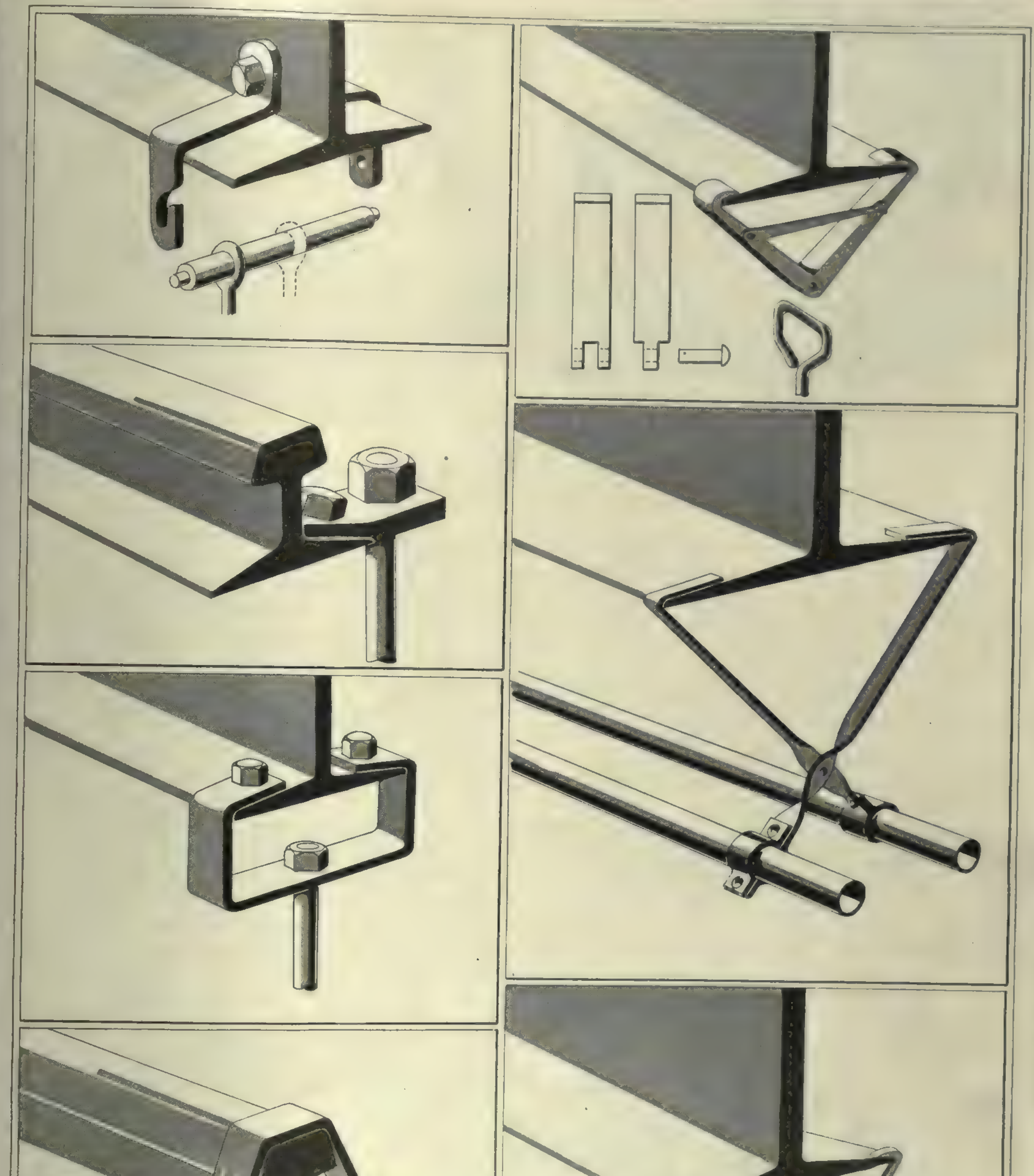
It has been said that if a machinist can grind a roughing tool correctly, he can also grind side facing and other forms of tools. The principle of the several angles can be clearly set forth by adhering to roughing tools. Sketches *A*, *B*, *C* and *D*, Fig. 4, illustrate the steps in developing a right-hand roughing tool.

From a Small-Shop Notebook

By J. A. LUCAS



METHODS OF SUSPENDING OBJECTS FROM I-BEAMS



METHODS OF SUSPENDING OBJECTS FROM I BEAMS

Making TYPEWRITER PARTS

by
M. E. Hoag

III. Bending and Forming Dies

The making of typewriter parts necessitates a very large number of blanking and forming dies. Space prevents our showing but a few of the more interesting ones used in the Woodstock factories.

THE paper fingers shown in Fig. 17 are simple in construction, yet they require a number of dies to bring them to completion. The piece is first blanked as shown at *A*, then pierced as at *B*, and the piercing completed in a third die as at *C*. The first forming die bends up the ears *F*, starts flanges at *G*, and bends the body of the piece slightly. The piece showing this operation is omitted but the punch and die used are shown in Fig. 18. The body of the piece is bent over the angle on the block *A*, and the ears forced up into the opening *B* by the punch *C* in the die. The recess in the die block *D* and the two pins *E* locate the blank. The member *F* is held by spring tension and recedes into the base of the die as the punch descends. Attention is called to a little kink used in constructing these dies which saves considerable work, i.e., the use of drilled holes *G* at the corners of the die pad and other parts where they have to be met by sharp corners of the die block. This method greatly aids in machining the parts, and in the case of the member *F*, they give round corners, which are very desirable in hardened parts as there is less danger of the piece cracking than there is with sharp corners.

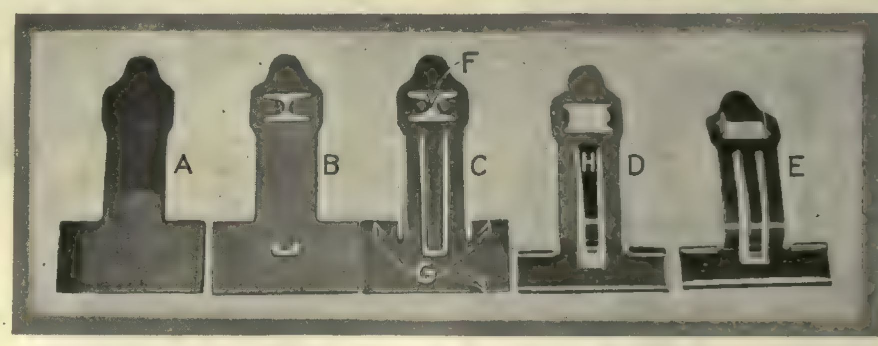
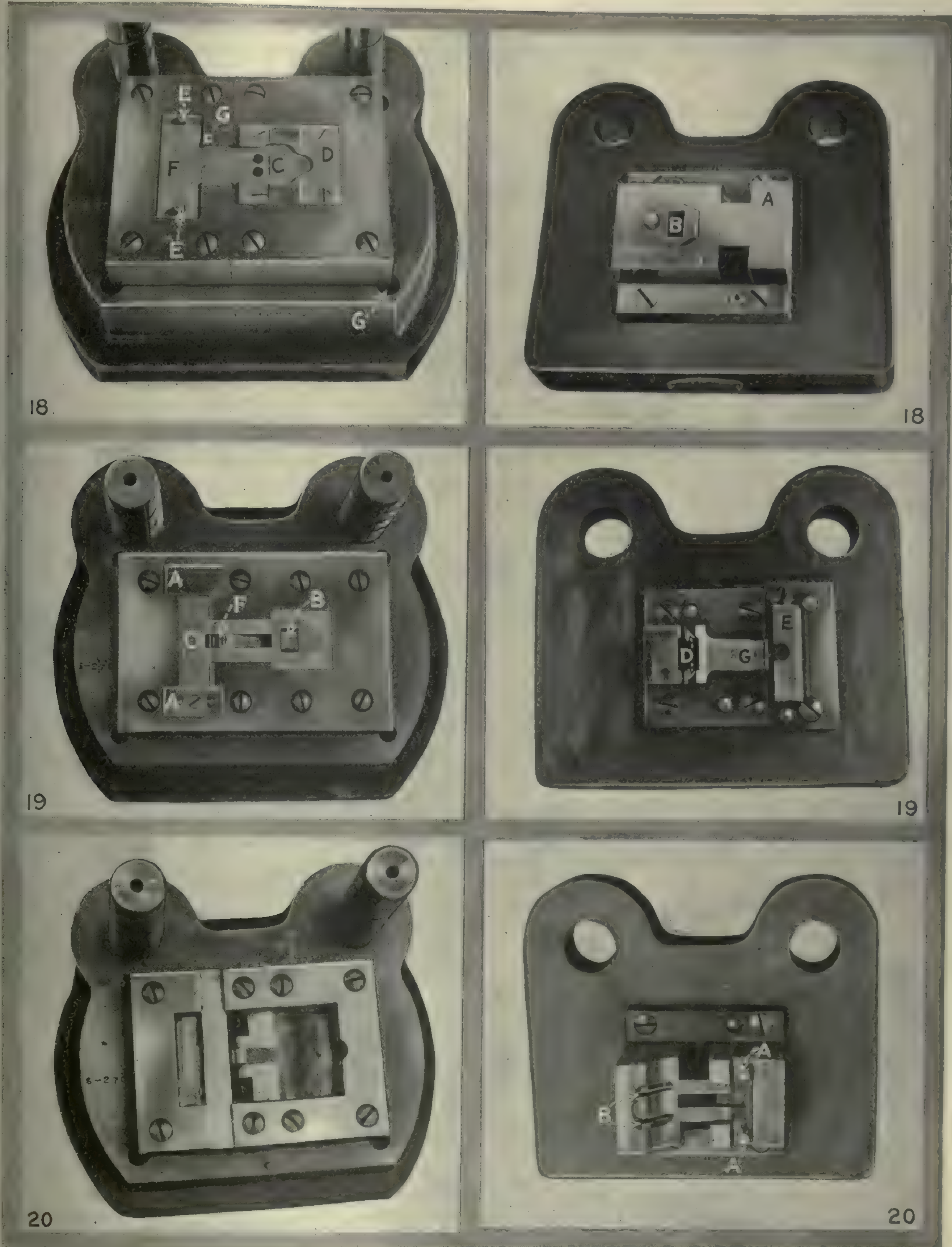


FIG. 17. PAPER FINGER IN VARIOUS STAGES

The second bending operation is handled in the dies shown in Fig. 19; these dies are much the same in general construction as those used for the first bending operation. The partly formed blank, registers between the end stops *A*. The piece *B* is a locating guide and enters the opening between the ears of the piece. As the punch descends, the formed ears enter the grooves at *D* and hold the piece firmly in position. The block *C* recedes, the block *E* forces the blank into the slot left by *C* and finishes bending over the flanges. The piece *F* of the die forms the tongue *H*, Fig. 17, against the block *G*, Fig. 19, of the punch and leaves the piece as shown at *D*, Fig. 17. The final forming of the piece *E*, Fig. 17, is completed in the dies shown in Fig. 20, which are so simple in construction that little description is required.

The two pins *A* pass between the flanges of the piece and hold it in position on the die. The openings *B* receive the ears of the piece as the end of it is pressed against the die and formed.

The piece seen in Fig. 21 is the drum-strap end and is completed in one progressive piercing and blanking die as shown at *A*, and two forming-die operations *B* and *C*. The first forming die is shown in Fig. 22 and is very simple in construction. The blank is laid on the die between the projections *A*; as the punch *B* descends, the blank is gripped between *B* and the stripper *C*, and as it is forced down into the die the serrated edges are bent up as shown at *B*, Fig. 21. The final bending is done in the wedge dies shown in Fig. 23. The already partly formed piece is laid on the die block at *A*, the hardened and ground bar *B* is laid on top of the blank and drops into the grooves in the blocks *D*. As the punch comes down the stock is pressed down and around the bar *B* by the action of the two wedges *C*, against the ends of the sliding members *E*. This completes the piece as at C, Fig. 21, and leaves the serrated end slightly elevated so that the



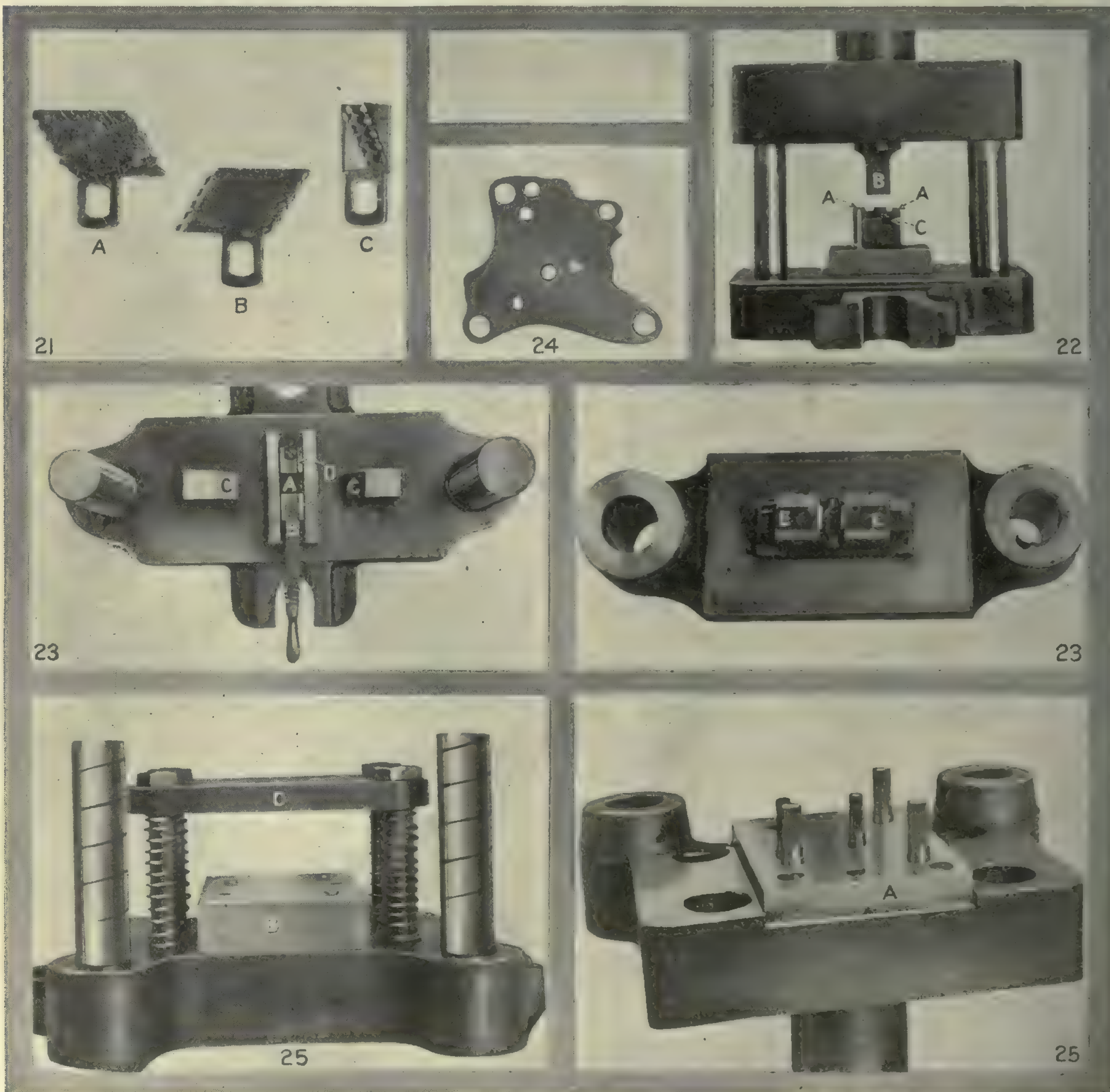
FIGS. 18 TO 20. DIES FOR PERFORMING THE FIRST, SECOND AND THIRD OPERATIONS IN FORMING THE PAPER FINGER FROM SHEET METAL

Fig. 18—Punch and die for the first operation. Notice the locating pins "E" and the receding member "F." Fig. 19—The dies for the second operation. These dies are quite similar to those used for the first operation except for the details. Fig. 20—The dies for the third, or final, forming operation. These dies are the simplest of the three sets used in forming the piece.

drum-strap may be inserted and the end closed down with a hammer.

One of the carriage end plates is shown in Fig. 24. There are five openings in this plate which receive bushings for rotating parts, such as the platen shaft, etc., and unless these bushings are keyed or pinned in place they are liable to work loose. To overcome this tendency and do away with keying or pinning, the holes are serrated with the dies shown in Fig. 25. The plate *A* carries the five serrating punches, the die block *B* has three locating pins as shown, and the stripper plate *C* strips the work from the broaches.

The bushings for these holes are punched and pressed into place and the end slightly riveted over, to prevent their backing out, which makes a very cheap but good way of handling what would otherwise be an expensive operation.



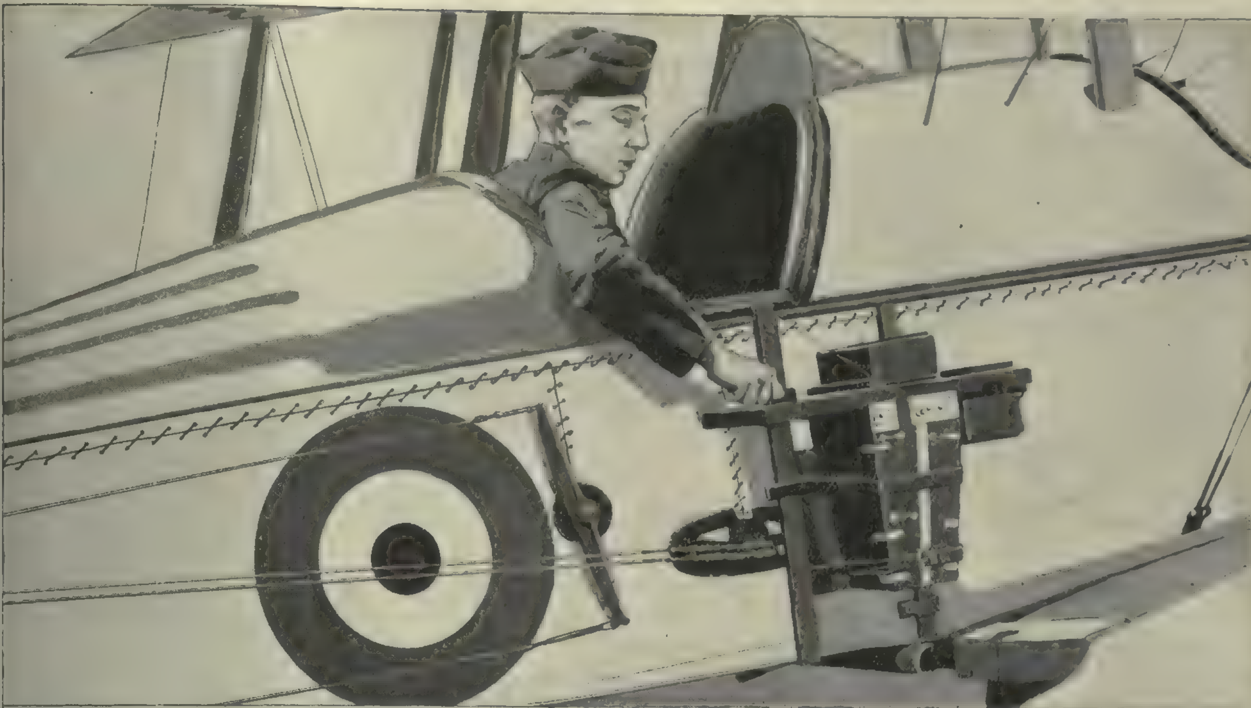
FIGS. 21 TO 25. VARIOUS DETAILS OF THE DIES

Draftsmen Wanted for the Navy

The Bureau of Ordnance, Navy Department, is in need of competent draftsmen. Men who are graduates in mechanical engineering from a technical school or college of recognized standing and have had some drafting room experience, or men who are competent designers of heavy machinery, engines or shop tools, and have had a number of years drafting room experience, are eligible for these positions.

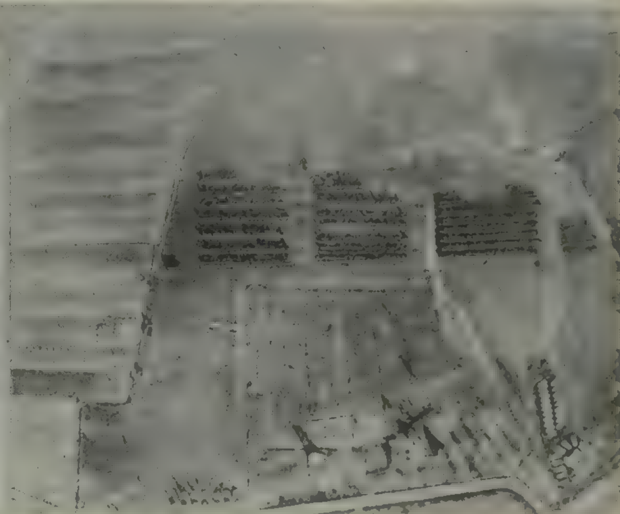
The pay ranges from $4 to $6.88 per diem, depending upon the qualifications of the draftsmen. There are at present a number of vacancies in the rating of draftsmen at the Washington Navy Yard.

Additional information may be had by addressing the Commandant and Superintendent, Naval Gun Factory, Navy Yard, Washington, D. C.



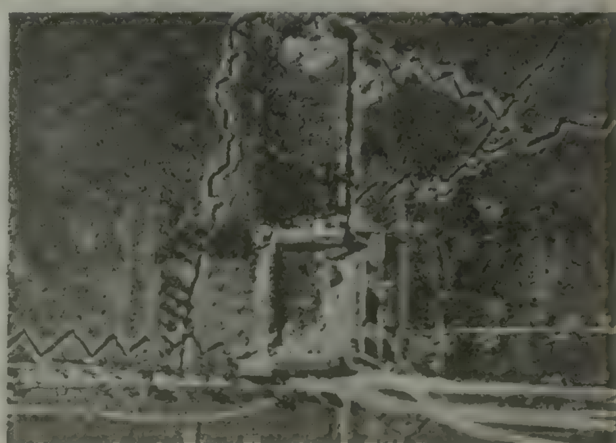
A Camera for Reconnoissance Work

An Allied Flying Field and Camp



One Battalion at Attention; Two at Ease

Remains of a Burned Zeppelin



Moquet Farm During Bombardment

SOME NEWS FROM THE FRONT

Building Motors with General-Purpose Machines—I

SPECIAL CORRESPONDENCE

The manufacture of gasoline motors in large quantities gives opportunity for the use of special machine tools, which for economical reasons cannot be used in shops that manufacture a large variety of motors in comparatively small numbers. This of itself leads to the necessity of using general-purpose machines, and brings out the true ability of the engineers and tool designers, for they must develop special jigs, fixtures, etc., to handle the work at a reasonable cost.

WHILE the Government has attempted to standardize certain types of motors there are still numbers of special motors being built, and more will be built before the war is ended. Early in the game the Wisconsin Motor Mfg. Co., of Milwaukee, Wis., offered its aid to the Government and has been building a number of special motors for various military purposes. These motors (one of which is shown in Fig. 1) have given such satisfactory service that the Government has asked for an output that will be five times as great as their entire production has been at any previous time.

Delayed delivery on special machine tools to handle this increased production, has forced the Wisconsin company to resort to emergency methods in order to make early delivery on some of these motors; the object of this article is to show how the problem has been solved by it, in the hope that it will aid other manufacturers who may be placed in a similar position.

It is the spirit of "we'll do the best we can," among American manufacturers and business men, that is going to help win the war, and those men and firms who are willing to sacrifice their personal and business interests to aid the Government, are fighting just as good a battle as the men who risk their lives at the front.

The first operations we will describe are on the crank cases and crank-case covers. Very high-grade aluminum castings are required for these parts which are furnished by local foundries. After chipping with air tools and filing and smoothing up, the castings are put through the following operations in sequence:

OPERATION-SHEET NO. 1—CRANK CASE

1 Rough-mill top.
2 Rough-mill bottom and arms.
3 Finish-mill top.
4 Drill bolt holes and arm holes.
5 Put on caps.
5A Drill and ream caps, fit dowels and number.
6 Face main bearings.
7 Rough-bore all bearings.
8 Finish-bore all bearings.
9 Take off caps.
10 Mill gear end.
11 Mill face of cam, pump and magneto bosses.
12 Mill pump and magneto bosses.
13 Mill pump and magneto pads.
14 Mill magneto pad.
15 Mill two cam-bearing lock-screw bosses.
16 Drill valve guide and cylinder-stud holes.
17 Ream valve-guide holes.
18 Drill breather hole, governor drive-shaft hole and cam-bearing lock-screw holes.
19 Drill and tap valve-guide stud holes, counterbore cylinder-stud holes, and drill and tap stud holes in pump and breather pads.
20 Drill and tap main bearings for retainer screws, and spot face bolt-holes and cylinder-stud holes.
21 Drill three oil holes in main bearings.
22 Drill oil hole in side.
23 Drill and tap stud holes in water pump.
24 Drill all holes in bottom.
25 Drill, face and ream pump-shaft hole.
26 Spot face bolt holes in support arms.
27 Drill and tap for index finger.
28 Drill bolt holes and dowel-pin holes in gear end and face gear clearance.

CYLINDER CASE COVER

1 Grind joint.
2 Drill all holes in bottom.
3 Bore and face both ends.
4 Drill and tap for two pipe holes.
5 Drill and tap drain holes.
6 Mill pump pad.
7 Drill and tap two holes for oil pipe.
8 Mill oil groove.
9 Face rear end.

The first machining operation, milling the top surface, is handled on a Garvin milling machine without fixtures, as shown in Fig. 1. Parallels at *A* support the work which is held down by straps and bolts at each end as at *B*. The large inserted tooth cutter *C* is fed across the end of the case by hand, in order to clean up the stock in the corner *D*. Power feed then carries the work under the cutter until the other end of the case is reached, when the hand feed is again used to clean up close to the gear box.

The bottom of the case is now milled on an Ingersoll milling machine as shown in Fig. 2. The block *A* is used to support the work, and carries screw studs for clamping the work down while the cutter *B* does its work.

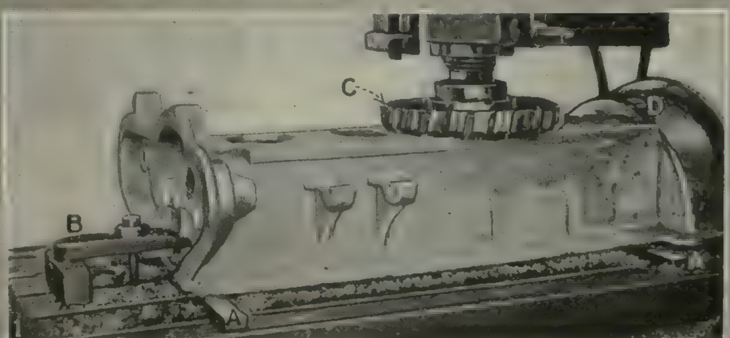


FIG. 1. MILLING TOP OF CASE

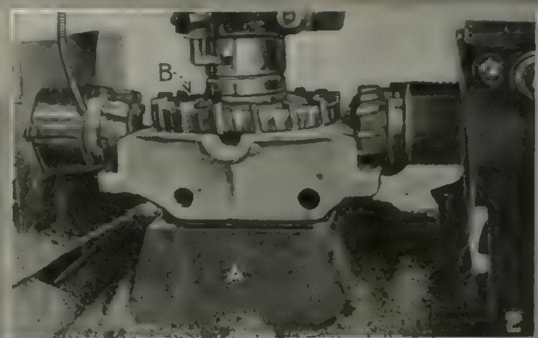
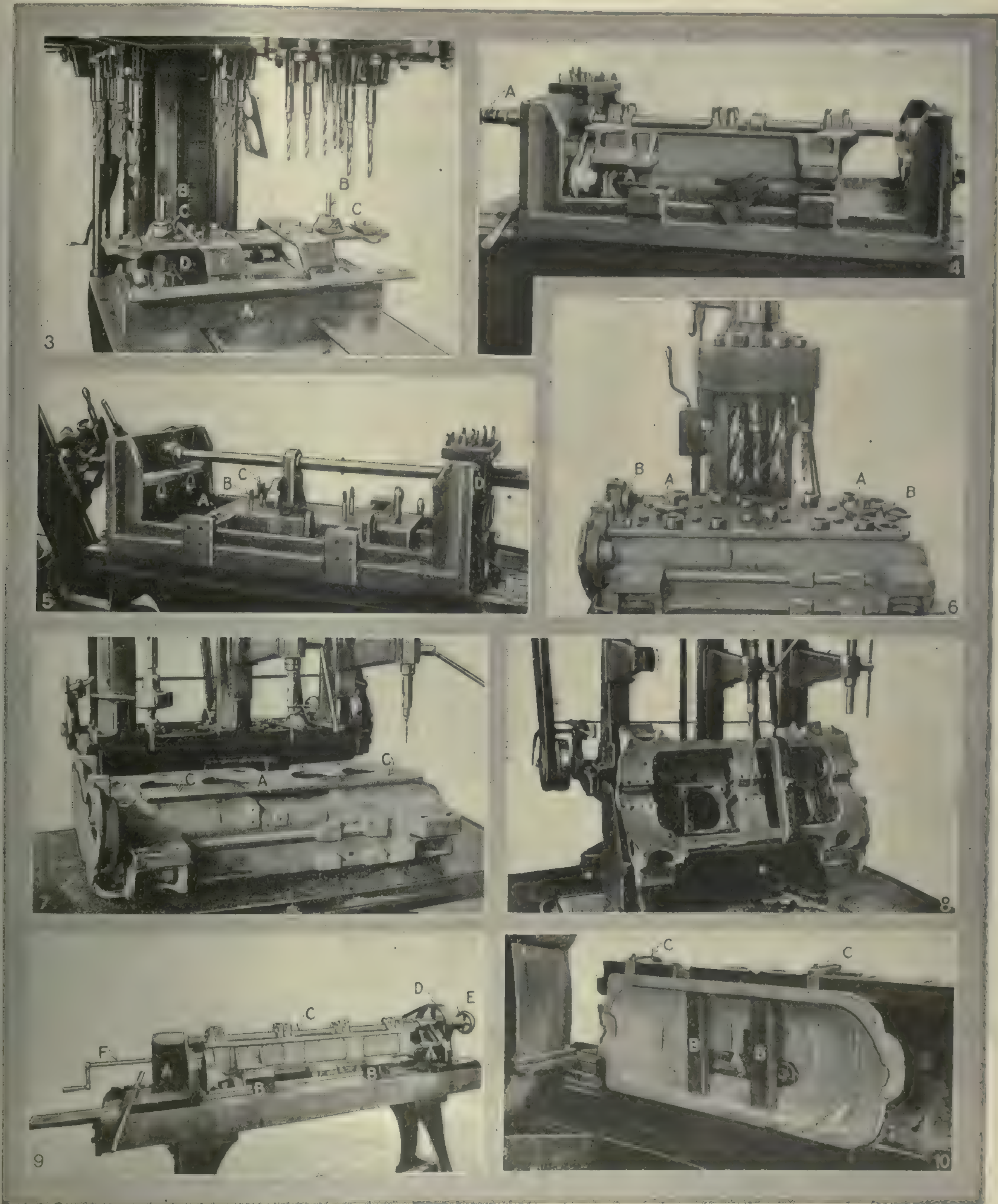


FIG. 2. MILLING BOTTOM OF CASE



FIGS. 3 TO 10. SOME OF THE JIGS, FIXTURES AND METHODS USED

Fig. 3—Jig for drilling bolt holes. Fig. 4—Boring bearings. Fig. 5—Fixture for boring bearings. Fig. 6—Drilling valve-guide and cylinder-stud holes. Fig. 7—Drilling and tapping valve-guide bolt holes. Fig. 8—Drilling oil holes in bearing seats. Fig. 9—Machine for line-boring main bearings. Fig. 10—Grinding joint surface of case cover.

On operation No. 3 a light finish cut is taken over the top of the case with the same equipment as used for the first operation.

In operation No. 4 the bolt holes and arm holes are drilled on a Natco, multiple-spindle drilling machine as shown in Fig. 3. The jig for this work is quite simple. The bedplate *A* carries two posts *B* which are ground to fit the bushings *C* in the jig. Triple-armed spiders *D* at the base of each post, enter the cylinder holes at each end of the case and locate it on the jig. The bushing plate *E* is made of steel to lighten weight, and carries 21 drill bushings.

The bearing caps are now put on and after drilling, reaming and doweling, the bearings are faced and bored on a W. F. & John Barnes horizontal drilling machine as seen in Figs. 4 and 5 in which Fig. 5 shows the boring fixture with case and main-shaft boring bar in position. The bars are driven from the machine spindle through the double floating joint. The bushing in the support guides the pilot reamer which trues up the shaft hole in the case after it has been opened up with a drill.

The studs shown in the base of the fixture together with suitable straps are used to clamp the work down to the bedplate.

After the case is placed on the fixture and the main bar is in place, the work is located with a steel gage. This gage is E-shaped and is located by studs which enter the bolt holes drilled in operation No. 4. By pushing the case over until the two arms of the gage rest against the boring bar the case is lined up and then bolted down.

Boring Bars

The boring bars are supported by slip bushings which enter fixed bushings in the heavy supports which are cast integral with the base. The cutters are of round stock and are held in place by taper pins driven through the bar. This makes their removal and replacement easy and rapid which is quite necessary as each bar operates facing, roughing and finishing cutters.

In order to get the case on the fixture, the double bushed arm must be removed. The top and bottom edges of this piece are finished parallel and enter a channel planed in the support. Dowel pins and bolts hold it rigidly in position. A long, heavy, slip bushing *D* supports the boring bars on the end next to the drive where the greatest strain and wear comes.

The milling of the gear end and bosses, called for in operations 10 to 15 is handled on a Kempsmith milling machine, simple locating devices being used to hold the work in proper position on the milling-machine table.

The eight valve-guide holes and twelve cylinder-stud holes are drilled on a Foote-Burt machine with the multiple-spindle head shown in Fig. 6. This head carries 10 drills, and as the case is the same at both ends, all 20 holes are drilled with the one head. Studs on the under side of the bushing plate locate it properly on the work. Open-side washers and nuts at *A* clamp the work and jig firmly together, while handles at *B* make the handling of the bushing plate easy for the workmen.

The valve-guide stud holes are drilled and tapped on a three-spindle drilling machine by the use of the simple bushing plate shown at *A*, Fig. 7. Studs in each end of the plate at *C* enter the valve-guide holes and locate the plate. No clamping device is required on this as the holes are small, and the weight of the plate is sufficient to hold it in place.

The three crankshaft bearings have oil holes drilled through them. As the exact location of these holes is not very particular, a very simple wooden cradle is used to support the work as shown in Fig. 8. As it is necessary for the workman to move his work around on the drilling-machine table, the lightness of this wooden cradle facilitates rapid operation.

After the crankshaft bearings are assembled they are finish-bored in the special machine shown in Fig. 9. Hardened plugs at the ends *A* enter the camshaft bearings and other openings in the case ends, and locate it. Blocks *B* are placed under the case to support it at the center. The boring bar *C* is driven by an electric motor through the belt and pulley *D*, and is fed through the work by hand, with the wheel *E*. The crank *F* carries a reamer on its inner end and is turned by hand in reaming out one of the shaft holes. The object of this fixture is to remove all tool marks from the crankshaft bearings, line them up and have but a very small amount of stock for scraping, which greatly reduces the labor on this part of the work.

The operations on the case cover or oil pan, are so simple that no description is required other than the illustration, Fig. 10, which shows the fixture used on a Diamond grinding machine for facing off the joint of the cover. The work is held in the fixture by the strap *A*. The wooden blocks *B* are driven in to the case and prevent any tendency of the sides to spring together. The finger clamps *C* engage the upper edge of the piece and prevent its springing open—which would release the wooden blocks and produce trouble.

Machining operations on the cylinders will be taken up in the next article.

The Double Duty Finger Guild

By Matthew Harris

While the title of this article does not indicate anything mechanical, the reader will find something mechanical in the article itself.

The Double Duty Finger Guild had its inception in the mind of Dr. Schyler Skaats Wheeler, president of the Crocker-Wheeler Co., Ampere, N. J. It is an experiment in industrial employment of the blind. Dr. Wheeler's ideas first bore fruit about eight months ago,

FIG. 1. THE BLIND AT WORK

and the work was started with six blind men on the first floor of a building about two blocks from the main factory. The present number of employees is 35, of whom five are women. Three of the men are colored. About one-half of those employed are totally blind, while 11 are able to distinguish light from darkness and a few have slight vision.

The work done in this guild is the insulation and taping of formed armature and stator coils. The coils are first covered with built-up mica insulation, or wound with linen tape and lastly with asbestos tape. The speed-efficiency of these blind people as compared with skilled workers having sight, is about 80 per cent., though there

is one worker who is 100 per cent. efficient. The quality of the work turned out is equally as good as that regularly done in the factory and in some instances it is better. Plans for several other kinds of work are being considered for the guild but are being held in abeyance for further developments.

The workers in this guild are paid a nominal wage of 50 cents per day while learning, but as soon as the work done equals a value of 50 cents they are put on piece work at practically the same rates as are paid to skilled workers in the factory, and many of them are making almost $2 per day while a few are doing still better.

The time taken to learn the work sufficiently well to be put on a piecework basis, varies with the aptitude of the operator, but an average time of two weeks usually suffices. Two things are of interest to note in relation to this important undertaking: first, the original workers were personally taught by Dr. Wheeler; second, the work of the guild is supervised entirely by two women. The superintendent, Miss Purse, is an expert in social-service work and the forewoman has had 10 years' experience as a worker in the winding department of the Crocker-Wheeler factory.

It is indeed an inspiring sight to see these blind men and women really self-supporting, and dependent not upon charity, but entirely upon their own exertions. The blind make wonderful workers, as their sense of

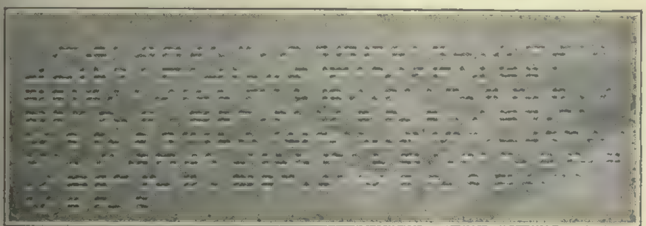


FIG. 2. SHOP NOTICE

touch is highly developed; moreover, they are very happy in their work. I quote from a statement made by one of them: "I managed to make a sort of living before I came to the guild. I was weaving baskets, but I knew that half the time people bought them because they were sorry for me. *Here I am earning what I get.*"

One thing that struck the writer was that the workroom, though used by those who could not see, was flooded with light, and was kept exceedingly clean and neat as will be seen by the accompanying illustration. That the work of the guild is attracting a great deal of attention is made evident by the fact that one of the late visitors was Mr. Fryer, who is investigating conditions of the blind in this country on behalf of the Chinese Government. I am told that among the Chinese one out of every 400 is blind. The superintendent told me they have an application for employment from a blind man in Idaho, and at the time of my visit I met a man from Boston who had brought his blind son there to work.

The workers live in their own homes or in boarding houses.

In starting this excellent work Dr. Wheeler had in mind the providing of work not only for the blind who are with us today, but for those of our heroes who are nobly fighting for the liberty of the world, many of whom will come home partially or wholly blind.

A Gage for Depth of Recesses

By Wilfred Griffin

On page 58, C. H. Dengler describes a feeler gage which he uses upon airplane parts. This gage evidently belongs to the flush-pin type, but Mr. Dengler evidently does not recognize the principal advantage of this gage—its limit feature—else he would not put in the dowel pin. The flush-pin type of gage usually consists of two elements: a rod or pin, and a block, collar or barrel, in which the pin slides freely for a limited distance. One end of the pin projects the required distance: i.e., the depth of the hole being measured, the other end being flush with the opposite face of the barrel.

This face of the barrel has half of its surface ground lower than the other half, by an amount equal to the tolerance allowed upon the work being gaged. The pin is ground to such a length, that when the hole being gaged is at its maximum depth, the projecting end of the pin will be at the bottom of the hole and the opposite end will be flush with the low surface on the barrel. The minimum depth of hole is indicated when the end of the pin is flush with the high part of this surface.

The line drawing accompanying Mr. Dengler's article shows the top face of the barrel divided, but no dimensions are shown to indicate this limit feature, nor was any mention made of it.

This is a simple and convenient limit gage, as the sense of touch readily indicates the position of the end of the pin with reference to the face of the barrel. If still more refinement is desirable, a scale or other straight-edge may be laid across the face of the barrel and the end of the pin noted.

Workless Monday

By E. A. Dixie

Today is a Garfield tradeless day, and this afternoon I found myself without a yellow pencil and with a number of blueprints that had to have the dimensions altered. I had forgotten all about the closing of the stores, and as it was bitter cold outside (as all heatless days should be), I climbed into a pair of arctics, a sweater and a heavy storm coat.

The first stationer's was closed, as was also the second; it then dawned on me that the day is tradeless day, with nothing but freights, food emporiums and pharmacies running. The first two did not look like prolific hunting grounds, so I went to the nearest pharmacy.

"Got any yellow wax pencils?"

"Yep, but we can't sell 'em today."

"Got any sulphite of soda?"

"Yep; what do you want it for?"

"To mark some figures on a blueprint."

"Can't sell anything but medicine."

"But this is a Government blueprint and it is for Government work!"

"I can't help that! you'll have to get a permit from Garfield."

"Got any bi-carbonate of soda?"

"Yep, what do you want it for?"

"This workless day has given me waterbrash"; and I got it!

P. S.—The alterations on the blueprints are fine.

Sidelights

EDITED BY D. BACON

More than 172,000 men were employed in the shipbuilding yards of the United States at the close of 1917. A call is out for 382,000 more men, and a three-shift plan is reported to have been ordered by Mr. Hurley, chairman of the United States Shipbuilding Board. The call for this great number of men must be met within three months.

The Canadian Government Furnishing Farm Tractors

In the Province of Ontario the Government has purchased 95 farm tractors. It rents these tractors to farmers at the rate of 45c. an hour and the farmers furnish the gasoline, oil and the food of the driver. The Government pays the wage of all tractor drivers. In case of bad weather, when the machine cannot be used, the farmer must continue to board the operator—who has come to be called the *tractioneer*—until work can be resumed.

Wire Rope Has to Be Classified for Export

An attempt has been made to export wire rope under a classification of galvanized wire, without an export license. Vance McCormick, chairman of the War Trade Board, has duly notified shippers that all shipments of iron- and steel-wire rope, of cable, and of strands consisting of six or more wires, whether painted, galvanized or coated in any way, must be licensed. No camouflage of this material will serve. The exporter who undertakes to send out these goods, without frankly declaring their character, is liable to a specified penalty of the law.

New Laboratories Contribute to the Government

Information comes through C. E. Drayer that George Merryweather and R. H. Danforth of the Cleveland Engineering Society have wrought and initiated a plan by which subsidiary bureaus may be added to the Bureau of Standards at Washington. The Washington Bureau has become greatly congested and hampered for space, and at the instigation of the Cleveland men, numbers of technical schools have offered their laboratories for testing, calibrating and the standardizing of gages. This offer has been made through the American Society of Mechanical Engineers in coöperation with the American Machine Tool Builders' Association. If this economical offer is accepted, these technical school laboratories will become temporarily, branches of the Bureau of Standards; thus, temporarily soldierized as is most of the world.

No Food Exports from Haiti to Enemies of United States

A telegram from the American Minister at Port au Prince states that the official organ of the Haitian Government on Dec. 26 published a presidential decree prohibiting the exportation of foodstuffs to countries at war with the United States and countries dissociated with us in the war; and the reëxportation of foodstuffs imported from the United States, except to the United States.

It is promulgated that the exportation or reëxportation of articles other than foodstuffs is also prohibited, with the exception, where the destination is such that enemies of the United States can not be benefited thereby. Articles comprising metal and coal, when imported from the United States, may not be reëxported. Only ships clearing for ports under the jurisdiction of the United States will be supplied with coal, gasoline, and oil fuel. Sailing vessels will not be cleared for Mediterranean or European ports.

A Very Great Cause of Transportation Congestion

Again and again, when goods to be exported arrives on a lighter long-side a steamer, its export license still operative, the goods cannot be loaded at once. So narrow a margin of time has been allowed by the shipper, that his privilege to export has expired before the goods can be taken on board. Heretofore the license was not abrogated if the goods arrived at the shipment-dock, before the limit of time named in the license. Now, to meet the conditions of delayed lighterage or else of transference to the ship, the date for exportation is to hold upon the arrival of the lighter *long-side the vessel*, as it has hitherto held good on the arrival of the goods at the dock.

If a shipper's export license expires on Feb. 3, for example, and arrives at the ship's side on that date and yet is not put aboard till Feb. 10, still the conditions of the exporter's license have been fulfilled in point of time.

The Greek Government Acts in the Matter of Radio Equipment

The Royal Hellenic government has ordered that all Greek passenger ships of 300 tons or more dead-weight, and that all cargo ships of 1000 tons or more deadweight, shall be equipped with wireless installations having a radius of not less than 100 miles, and their auxiliary apparatus shall be of not less than 30 miles radius. This provision has gone into effect and haste is demanded. The government reserves the right during times of war, to order the installation of this equipment on any vessel, and a vessel ordered to be so equipped, must provide the necessary electricity for the operation of the wireless outfit. The government can order the removal of such equipment at its discretion.

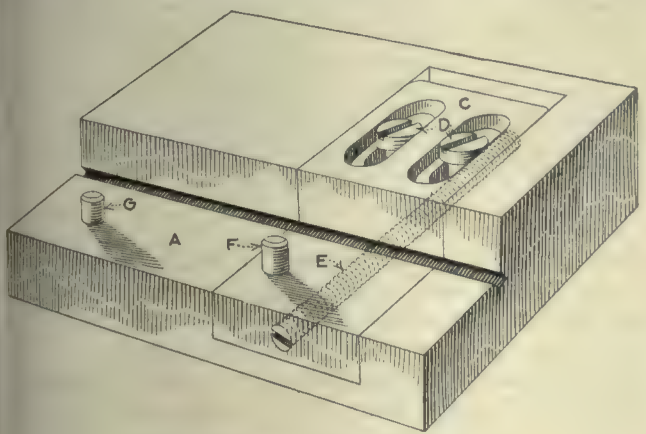
If any ship coming under the Royal order cannot meet the demand, then the government will supply what is necessary to the fulfillment of the order. The staff is to be provided by the government, paid by the ship's captain, who in turn is to be reimbursed by the government for salaries paid; but the ship must provide food and clothing at its own expense.

IDEAS FROM PRACTICAL MEN

Adjustable False Jaws for a Milling Vise

By Edward Heller

The illustration shows a very simple device for adjusting work in a milling-machine vise when it is desirable to mill two like pieces in one operation. This will, of course, make it necessary to use two sets of cutters, and to save the operation of grinding the two sets of the same diameter, this device is employed. The



DETAIL VIEWS OF FALSE JAWS

dead jaw *A* serves to hold the work in position. It is recessed as shown to receive the adjustable part *C*, which is held in place by the fillister-headed screws *D*. The long headless screw *E* is for moving the jaw and work up and down, while the pins *F* and *G* are for locating the work.

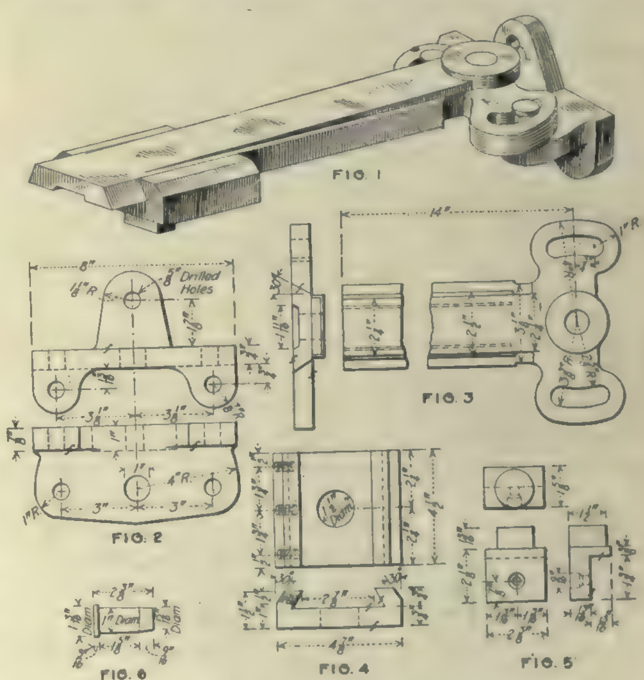
In operation two pieces are inserted in the vise, and brought into position under the cutters. They are then taken out, gaged, and the difference noted. The screw *E* is then turned until the part *C* reaches the desired height. The screws *D* are then tightened, and the holder is ready for the milling operation.

Short Taper Attachment for Engine Lathes

By Martin H. Ball

The accompanying drawings show an engine-lathe taper attachment that was designed to supply a need in truing and boring tapers from 4 to 8 in. long. Some of the parts to be machined were tapered as steep as 3 in. per ft., but the device was designed to accommodate a range up to 6 in. per ft. The portions requiring tapers were all at the ends of the pieces, thus making it convenient to attach the device to the tailstock of the lathe. The tailsock being secured near the carriage when handling chucked work as well as when the work is swung on centers. The device is shown assembled in Fig. 1, and the details of the parts in Figs. 2, 3, 4, 5 and 6.

The bracket is shown in Fig. 2; it is firmly attached to the inside end of the tailstock with three capscrews below the spindle and at a height that will bring the other parts in alignment with the cross-slide of the carriage. The slide, Fig. 3, is connected to the bracket with the pin shown in Fig. 6 which is made a very close-working fit in the slide, and a taper-driving fit in the bracket as shown; and it is clamped in any



FIGS. 1 TO 6. THE DEVICE SHOWN ASSEMBLED AND THE PARTS REQUIRED

desired position by two capscrews passing through the slots in the slide and screwing into the bracket.

The guide, Fig. 4, is adjusted to the slide by means of three gib-adjusting screws in the tapped holes. This adjustment needs to be as close as possible while allowing the guide to move fairly easily. The guide is connected to the cross-slide of the lathe by means of the pivot shown in Fig. 5; the upper, round portion fitting the hole in the guide without lost motion. The pivot piece shown is a duplicate to the cross-feed nut

insofar as its fitting parts to the lathe cross-slide are concerned, and will in all cases, take the place of the cross-feed nut. This nut must be detached from the cross-slide to use the taper attachment.

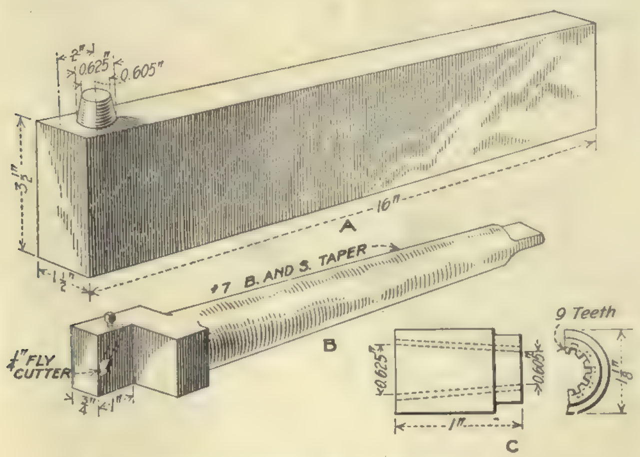
In use, the tailstock is clamped at a point on the lathe bed that will allow the carriage to feed the required distance, and keep a full-length bearing on the guide. The tool is adjusted to its cut by means of the compound rest screw and the carriage is brought back far enough to take up any lost motion, as is commonly done when using any taper attachment.

The work that this device was designed to do was not severe, but since its installation, fairly rugged jobs have been done with it, and it has made a very satisfactory showing.

Machining a Conical Boss on the Milling Machine

By F. H. Jennings, Jr.

A block *A* of alloy tool steel, finished to 16 in. long, 1½ in. wide, and 3½ in. high, had to be machined with a taper post on top—the post being 1 in. high, 0.625 in. diameter at the base and 0.605 in. at the top—central



THE WORK AND THE TOOLS

with 1½ in. thickness, and 2 in. from one end, with a tolerance of ±0.0005 in.

We had no lathe large enough to swing the block, so decided to use a milling machine.

The fly cutter shown at *B* was designed. It carried a ¼-in. square tool. This gave us as many trial cuts as we wanted and allowed us to set our table exactly before the last cut. Placing the tool bit at an angle of 45 deg. gave us a fine adjustment. To finish the post with the 0.020-in. taper, we made the tool *C* which is simply a hollow mill with the required angle.

How Would You Form This Tube?

By G. R. Smith

I would like to know the most practical and economical method of forming the steel piece shown herewith. This piece is to be made from 0.030-in. cold-rolled steel, or from seamless steel tubing.

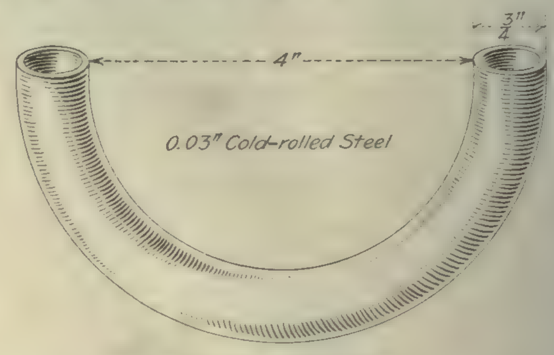
The tube is ¾-in. diameter and formed into a semicircle 4-in. inside diameter.

I am familiar with the method of forming such shapes from sheet stock, over a spiral spring; also of filling tubing with fine sand before forming, to hold it in shape; it is therefore unnecessary to describe such methods.

This piece must be formed cold, in not more than three operations and one or two annealings, on a 4-in. stroke, Bliss No. 21 punching machine.

The pieces are to be made by the thousands in ten thousand lots, and are being made now, but by an unsatisfactory method.

If this piece is to be made from tubing, it should, after cutting to length, be formed in one operation, and



THE TUBE REQUIRED

if made from sheet steel it should be formed in two operations after the blank is cut.

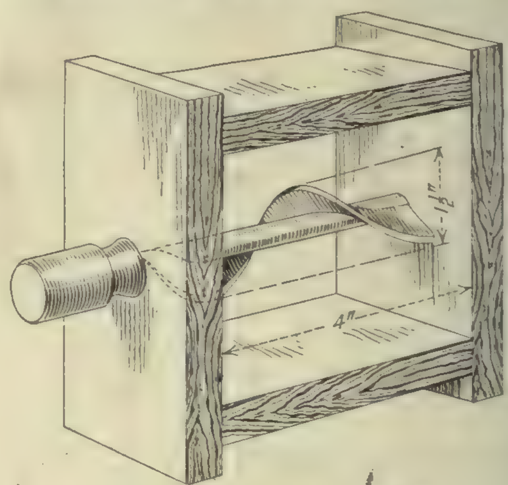
Also, will some one describe a punch and die for cutting this tubing to length, without upsetting the diameter at the ends?

Core-Molded Spiral

By J. L. Gard

The sketch shows pattern used in making a cast-iron spiral. This spiral, 1½ in. in diameter by 4 in. long, and having one complete turn in 4 in., was cast in a core.

The pattern continued through one side of the core box. Projections in the box-opening, fitted the grooves



PATTERN FOR SPIRAL CASTING

of the pattern and gave the proper twist required in drawing; they also acted as a stripping plate.

After drying, the cores were stood upon one end in a row, and opencast, no cope being required; the castings were made long enough to allow one end to be sawed and still leave sufficient spiral; this is a simple way to handle a difficult piece of small work.

Mail Delivery in a Large Factory

By C. L. Edholm

The delivery of mail to the various departments of an extensive industrial plant is something of a problem. Usually it is handled by messengers and often by a system of pneumatic tubes, but it remained for the executives of an East Pittsburgh electric manufacturing concern to hit upon a perfect solution of the problem.

This plant covers a large area, and mail is collected and delivered on two floors; to avoid confusion and delay a traveling post office was devised which makes six trips every working day. For this purpose an electrical industrial truck was selected, and on both sides a number of compartments were constructed similar to pigeon-holes in a small post office. At one end of the vehicle a sorting table was installed, and a space was left under the shelves to receive large packages.

TRAVELING FACTORY POST OFFICE

The portable post office requires about an hour to make its round of deliveries and collections. Sorting of mail matter proceeds while the car is on its route through the plant, for the clerk has no responsibility concerning the operation of the little truck; that is intrusted to a young man who has no other duties.

It is estimated that a saving in time and labor of no less than 50 per cent. has resulted from the installation of this novel system which displaces the pneumatic tubes and the staff of messengers that were needed.

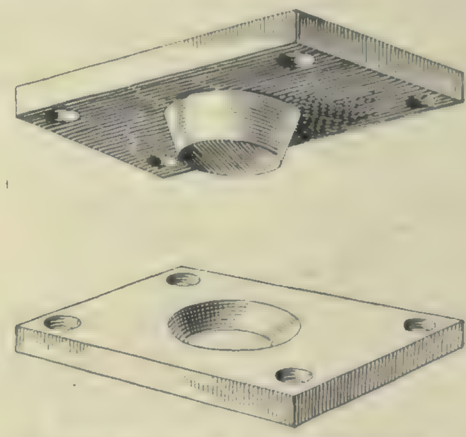
Core-Box Dowel Pins

By Frace

On page 1049, Vol. 47, A. E. Holaday discusses the advantages of the straight dowel pin over the taper pin for core boxes. The taper pin is a rarity in modern foundry practice and one must travel far to find a shop wherein it is standardized.

The straight dowel pin is the correct pin to use on small- and medium-size core boxes, but is should be stated that both pin and socket shall be of metal. The grit in the core sand will have the same abrading effect on the straight wooden pin and socket as on the tapered one, and inaccurate cores will surely result from the constant use of boxes equipped with either. Brass dowel pins and socket plates may be obtained in a variety of sizes. They are long-lived and insure accuracy in cores. The joints of the boxes are protected from wear by the generous screw plates of both dowel and socket, which is an important feature in standard boxes subjected to frequent use.

On large and unwieldy core boxes the taper pin is an advantage for the reason that it does not require the extreme steadiness or juggling to locate. The straight pin must be accurately centered before closing the box, else wear will take place on both pin and socket. An efficient home-made, cast-iron pin for heavy boxes is shown in the sketch. This pin is inexpensive and has proved satisfactory. The upper half of the box may be placed as near as possible to location and then shifted at will until the pins are in position.



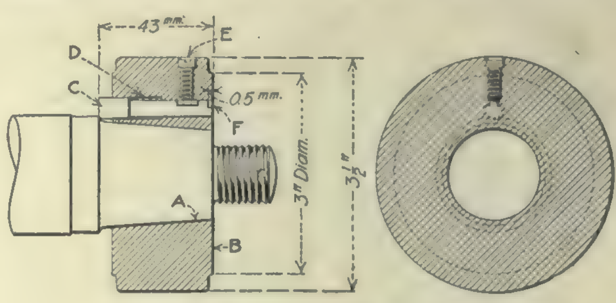
CAST-IRON DOWEL PIN AND SOCKET

The dowel and socket can be used for heavy split patterns as well, and molders have praised it highly.

Flush-Pin Taper Gage

By Albert A. Dowd

When a ring gage is used for gaging a taper shaft like the one shown in the illustration, there being a shoulder immediately adjacent to the large part of the taper, it is a rather difficult proposition to obtain an accurate reading on the gage. In this instance the tapered shaft is used to carry the large bevel-drive pinion on the tail shaft of an automobile; it is therefor essential that the bevel gear should be located longitudinally on the shaft in the correct position. The fact that the shaft has a shoulder so close to the points where the double gear fits on the taper, makes the gaging proposition much more difficult.



FLUSH-PIN TAPER GAGE

In order to overcome the difficulty a flush-pin type of gage was used, and the gaging done from the shoulder instead of from the taper. The knurled collar *B* was made to fit the taper, keeping a distance of $\frac{1}{4}$ in. from the shoulder. The flush pin *C* is so mounted in the collar that the end strikes the shoulder of the work and a reading is obtained at the opposite end of the gage by the projection of the pin beyond the face of the gage. It will be noted that the pin is shouldered at *F* to the amount of the tolerance permitted on the work. In this particular case the amount of the tolerance was 0.5 mm. A small coil spring *D*, in the body of the gage insures contact of the gage pin *C* against the shoulder. A retaining screw *E* prevents the gage pin from leaving the collar. This gage is accurate and dependable.

Lapping Snap Gages

Special Correspondence

In many cases there is considerable unnecessary time spent in lapping the measuring surfaces of flat and snap gages. Lapping can be almost dispensed with in many cases if sufficient care is taken in the grinding of these surfaces, since by using a sufficiently soft wheel, from an H to a K, and of fairly fine grade such as best suits the particular work being done, an excellent surface can be secured which requires very little lapping.

By careful grinding the proper size can be secured to within a very few "tenths" (0.0001 in.), so that any lapping is really more in the nature of polishing and can be done quite rapidly.

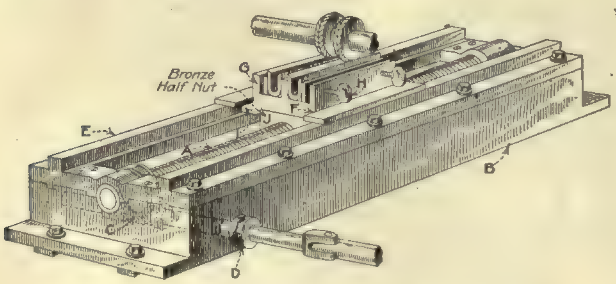
Careful attention to this will save considerable time and greatly increase the output of gages from a given equipment.

A Milling-Machine Fixture

By Norman V. Christensen

The accompanying illustration shows a milling-machine fixture that can be used to advantage when a large quantity of articles, in this instance saw tabs, are to be milled.

A feed screw *A*, is journaled in a box *B*, which is shaped to fit the platen of the milling machine to which



A MILLING-MACHINE FIXTURE

it is suitably secured. The screw *A* is driven by a worm *C* connected with the knuckle feed shaft of the milling machine by the flange coupling *D*. The feed screw *A*, runs in a bath of oil.

The box *B* is provided with the ways *E*, and about midway of their length are located the guides *F*, slightly beveled at their front ends. The saw-tab holder *G*, is formed with longitudinal slots to receive the saw tabs, which are clamped in position by setscrews *H*. At the base of the holder are outwardly projecting flanges *I*, which rest and travel on the ways *E*, and are engaged by the holder guides *F*, when the holder is moved under the milling-machine cutters.

For moving the holder, a half nut *J*—preferably of bronze—is located on the underside of the holder *G*, and engages the feed screw *A*. The feed screw *A*, will accommodate three holders: one in which the tabs are finished, one under the milling cutters, and the third progressing toward the latter. Thus an operator is enabled to engage on other work near at hand while the milling operation is under way, it being necessary only occasionally to remove the finished saw tabs and replace them with work to be done, placing the holder in front of the cutters.

Improved Lathe Centers

By E. N. Moor, Jr.

Here is an idea we use in the shop for our lathe centers. The body is made of low-carbon steel, carbonized on the surface, hardened and ground to fit the taper in the lathe spindles. The point is a piece of high-speed steel hardened and ground cylindrically and pressed into the nose of the body as illustrated by Fig. 1. After inserting the point, the 60-deg. angle is ground in the usual manner in the lathe using a motor-grinding attachment. The high-speed steel will stand the most severe use without "ringing" or burning on the point,

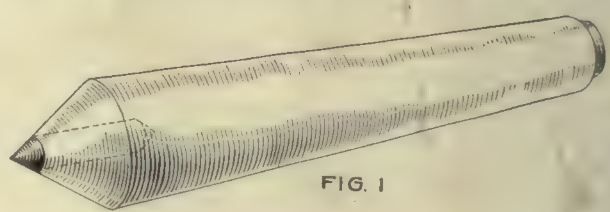


FIG. 1

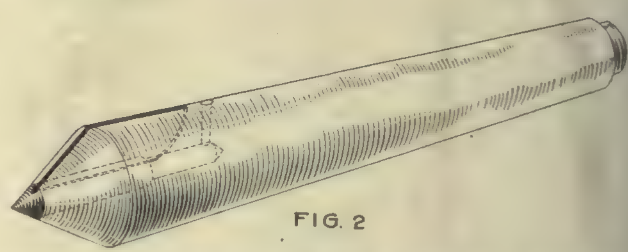


FIG. 2

FIGS. 1 AND 2. IMPROVED LATHE CENTER WITH AND WITHOUT OIL RESERVOIR

and will need very few regrindings as compared to the plain carbon-steel center.

By going to a little more trouble and annealing the high-speed point, then grooving it lengthwise with a thin saw for about one third of its diameter, then drilling back into the center body with a drill somewhat smaller in diameter than the one required for the high-speed plug, a reservoir for oil is formed which may be filled through a $\frac{1}{8}$-in. hole at right angles to the axis directly behind the plug, Fig. 2. The taper on the body should be fitted so this hole will stand outside the tail-spindle nose when in use. This type of center has been found to lubricate perfectly although it is hardly necessary in the ordinary run of work to go to this trouble.

New Priorities Regulations

THE object of these priorities is to secure the selective mobilization of the products of the mines and the factories for direct and indirect war needs in such a way as will most effectively aid in winning the war. Before making an application for priority, the petitioner should ask himself to what extent, if any, will the granting of this priority certificate aid, directly or indirectly in winning the war, and how urgent is the need.

These rules and regulations governing priority will supersede all directions, rules, and regulations heretofore promulgated by the Priorities Committee. All priority certificates heretofore issued and now outstanding shall remain in full force and effect according to their original terms.

During the war in which the United States is now engaged all individuals, firms, associations, and corporations engaged in the production of copper, iron and steel, and in the manufacture of products thereof; of chemicals, cotton duck, and woolen cloth, and of such other essentials raw materials and manufactured products as the Committee may deem necessary from time to time, are requested to observe the following regulations respecting priority, viz:

1. All orders and work are divided into four general classes: Class AA, Class A, Class B, and Class C, with subdivisions of Class AA, Class A, and Class B indicated by suffix number, thus: Class AA-1, Class AA-2, etc.; Class A-1, Class A-2, etc.; and Class B-1, Class B-2, etc.

2. Class AA comprises only emergency war work of an exceptional and urgent nature.

3. Class A comprises all other war work; that is to say, orders and work necessary to carry on the war, such as arms, ammunitions, destroyers, submarines, battleships, transports, merchant ships and other watercraft, airplanes, and locomotives, etc.; and the materials or commodities required in the production or manufacture of same.

4. Class B comprises orders and work which, while not primarily designed for the prosecution of the war, yet are of public interest and essential to the national welfare, or otherwise of exceptional importance.

5. Class C comprises all orders and work not embraced in Class AA, Class A, or Class B, and no certificates will be issued therefor. All orders for work or materials not covered by priority certificates will fall within Class C, save such orders as fall within the provisions of paragraph 6 hereof.

6. All orders placed prior to Sept. 21, 1917, by or on behalf of the War Department or the Navy Department of the United States, or of the United States Shipping Board Emergency Fleet Corporation, were, by Circular No. 1 of that date, classed as A-1, and they will retain that rank on the schedules according to the dates placed, without the issuance of priority certificates unless otherwise specifically ordered by the officer placing the order or by the Priorities Committee. All orders for arms, ammunition and other military supplies and equipment placed prior to Sept. 21, 1917, by or on behalf of the Allies, were, by Circular No. 1 of that date, classed as A-2, and they will retain that rank on the schedules without the issuance of priority certificates according to the dates placed, unless otherwise specifically ordered by the Priorities Committee.

7. All orders placed after Sept. 21, 1917, should be classed as Class C unless covered by certificates or other written directions of the Priorities Committee.

8. Orders and work in Class AA shall take precedence of orders and work in all other classes. Orders and work in Class A shall take precedence of orders and work in both Classes B and C. Orders and work in Class B shall take precedence of orders and work in Class C, irrespective of the dates the orders were placed. Orders and work in Class AA-1 shall take precedence of orders and work in Class AA-2 and all lower classes, etc. Orders and work in Class A-1 shall take precedence of orders and work in Class A-2 and all lower classes, etc. Orders and work in Class B-1 shall take precedence of orders and work in Class B-2 and all lower classes, etc.

Where work is in progress on several classified orders the rules of precedence set forth in paragraphs 9 and 10 hereof will be observed.

9. The classification of an order simply means that it shall be given such precedence over orders of a lower classification as may be necessary and only such as may be necessary to insure delivery on the date specified in the order. It does not mean that work should cease on orders of a lower classification, or that the order should be completed and delivery made in advance of orders taking a lower classification if this is not necessary to effect delivery within the time specified. The one to whom a priority certificate is directed should make his own production plans, so as to get the maximum of efficiency out of his operations, making all deliveries at the times contracted for, if possible, and where this is not possible, giving precedence to the orders taking the highest classification.

10. As between orders in the same subdivision of a class (as A-1), save where otherwise specifically requested by the committee, the date of delivery contracted for will control unless this will operate to delay the delivery required by an earlier order of the same class, in which event the earlier order will have precedence in delivery. For example: Two orders, Order X and Order Y, are both covered by A-1 certificates. Order X is dated Oct. 1, 1917, and calls for delivery Feb. 1, 1918. Order Y is dated Nov. 1, 1917, but calls for delivery Jan. 1, 1918. As between these two orders preference will ordinarily be given to Order Y, because it calls for an earlier delivery date. If, however, such delivery will delay completion of Order X, then preference should be given Order X, because it is the earlier order. If possible, both orders will be completed on the delivery dates called for. The dates of the certificates are not controlling.

11. In case of doubt as to which certificate or certificates should have precedence, the certificates should be laid before the committee by correspondence or in conference, so that the committee may give specific instructions.

12. The committee classifies only specific orders for materials, commodities, or work. Applications for priority certificates must be made on the form of application prescribed by the Priorities Committee.

13. As a general rule, where an application is necessary, it should be made by the one placing the order on which the application is based.

14. If the order has been placed by some purchasing officer of the United States Army, Navy Shipping Board Emergency Fleet Corporation, or any other branch or department of the Government, or for delivery to the Government itself or to some one for account of the Government, the application should be made by and in the name of the department or official for whose account the order has been placed.

15. If the order has been placed by a representative of one of the allied Governments for delivery to his Government itself or to some person for account of his Government, the application must be made to the committee through and with the written approval of the War Mission which is representing that particular Government in this country.

16. One who has a contract with the Government or with the Allies, and who needs priority assistance to obtain the materials, commodities, or work to fill such contract may make application direct to the committee. In some instances the committee will have already issued a priority certificate against such contractor directing him to give priority to the filling of his Government contract or contracts. In other instances such certificates will not have been issued. In either event, however, one who is working on Government contracts may make application direct if he needs priority

assistance. While it is not necessary for such applications to be made through or with the approval of the Government official, it is desirable that this course should be pursued where it will not involve substantial delay. Where this course is not pursued, such applicant's connection with the Government work and the correctness of his representations will be verified and checked by the committee.

17. Those who may be one or more times removed from a direct contractor with the Government or with the Allies, but who are furnishing materials, supplies, or commodities to be used in connection with the fulfillment of such direct contract, may make application direct to the committee for such assistance as they may need to obtain such materials, commodities, or supplies. Such applications need not be approved by either the principal contractor or by the agency of the Government or the Allies placing the original order, but the representations of the applicant will be verified by the committee.

18. One who has placed an order for any material, commodities, or supplies which fall within Class B, as defined in paragraph 4 hereof, and who requires priority assistance to procure reasonably prompt delivery thereof, may make application direct to the committee. In such cases the paragraphs in the application seeking to elicit information with respect to the applicant's connection with the Government or Allied contracts may be disregarded.

19. In placing orders care should be exercised in determining the date that delivery will actually be required. The contractor should not ask to have delivery made before he will be prepared to use the articles. A rigid adherence to this rule will greatly facilitate timely deliveries of urgent orders and prevent needless interference. The application must state the date of delivery specified in the order.

20. When the committee shall approve an application and give it a rating it will issue a priority certificate in the form set forth in these regulations. The one to whom the certificate shall be directed will, in fulfilling the contract or order mentioned in the certificate, give to it such precedence or priority as it may be entitled to under the classification specified in the certificate and rules set.

21. A certificate issued by the committee shall supersede any and all previous instructions, by whomsoever issued, with respect to priority in production and delivery of the contract or order covered, except commandeering orders.

22. Certificates or other documents signed by order of the Priorities Committee (printed) and countersigned in person by any person whose name appears thereon as one of the persons authorized to countersign, shall be deemed to have been authorized by said committee, the Priorities Commissioner, and the War Industries Board of the Council of National Defense.

23. That unusual emergencies may be promptly met and cases of great urgency provided for, the Priorities Committee may, by an order in the form of a letter, a special certificate or otherwise, signed personally by the Prorities Commissioner or by the Chairman of the Priorities Committee, direct that a particular contract or order shall have priority over other contracts or orders covered by existing certificates, or may in the same manner reclassify or regrade existing contracts covered by previous certificates.

24. Unless requested to the contrary, the Priorities Committee will forward direct to the applicant the original and one copy of the certificate, if issued, that the applicant may send the original to the one to whom it is directed, retaining the copy for his files. If the applicant desires, and so expressly states, the certificates, if issued, will be forwarded to the one to whom directed. Should the committee decline to approve the application, prompt notification of such action will be sent direct to the applicant. All applications for priority by any department of the Army or Navy or United States Shipping Board Emergency Fleet Corporation will be first cleared through the Clearance Committee of the War Industries Board, and such applications will be presented to the Priorities Committee through the said Clearance Committee. Certificates issued on these applications (or advices of declination, should the application be declined) will be forwarded to the applicant through the Clearance Committee.

25. The committee does not undertake to administer priority on all products and commodities, but only on iron, steel, copper, chemicals, cotton duck and woolen cloth, and the products thereof, and such other essential raw materials and manufactured products as the committee may deem necessary from time to time. It does not administer priority on coal, coke, foods, feeds, export and import licenses, transportation, prices and purchases.

26. The committee does not distribute coal or coke or issue priority orders governing the delivery of these commodities. The President has named H. A. Garfield as Fuel Administrator, and has entrusted to him supervision over the production, supply, and distribution of fuel during the war. Requests for assistance in purchasing these fuels or in expediting deliveries thereof should be addressed to United State Fuel Administrator, Washington, D. C.

The committee, however, will consider applications of fuel producers for priority assistance to procure materials, tools, equipment, or supplies required for the production of fuel.

27. The committee does not distribute foods or feed, over the production, supply, and distribution of which Herbert C. Hoover, Food Administrator, has supervision. Requests for assistance in purchasing foods and feed or in expediting deliveries thereof should be addressed to the United States Food Administrator, Washington, D. C.

The committee, however, will consider applications from producers of foods and feed for priority assistance to procure materials, tools, equipment, or supplies required for their production.

28. All applications for export or import licenses should be addressed to the War Trade Board, Washington, D. C.

29. The committee does not expedite transportation.

30. The committee does not fix or assist in fixing prices. Neither does it make or assist in making purchases.

31. No industry, plant, material, or commodity will be classified as such. Only specific orders for materials, commodities, or work are classified according to their importance in war preparation or in work necessary to the public interest and essential to the National welfare, or otherwise of exceptional importance.

32. When it appears that a large per cent. of the capacity of any plant is covered by certificates of the same subdivision of a class, the Priorities Committee will, when it appears desirable so to do, arrange, through conference between it, the authorized representatives of such plant, and those placing the orders covered by such certificates, for the reclassification thereof or the rearrangement and regarding of the schedules within each subdivision of a class, so as to insure the most urgent order having precedence without unnecessarily interfering with the efficient management and operation of such plant.

33. No application should be made for priority in any case which does not fall within Class AA, Class A, or Class B, as defined in paragraphs 2, 3 and 4 hereof.

34. Applications should not, save in very exceptional instances, be made for priority assistance unless an order is actually placed for the materials, commodities, or work. If the proposed Government contractor or subcontractor is unable to place an order for or to obtain materials necessary for Government work (other than foods, feed, and fuels), he should communicate with the Government purchasing officer concerned, who will take the necessary steps to aid the contractor in obtaining the material.

35. Save in very exceptional cases priority assistance is only required where the demand exceeds the supply. Therefore, where there is no shortage in the available supply of a particular raw material or manufactured article no application for priority should be made or will be considered, save where the case is very unusual, justifying an exception to this rule.

36. Although there may be a general shortage in a given product, the particular producer or manufacturer with whom the order is placed may be prepared to make delivery on scheduled time. Inquiry should first be made of him to ascertain if there will be a delay. If it appears at any time that there will be a serious delay in the delivery of some article or commodity which is essential, application for priority assistance should be made in the manner herein prescribed. In all cases, however, the application should state when delivery is needed and when delivery is promised.

A Traveling Anti-Waste Exhibit

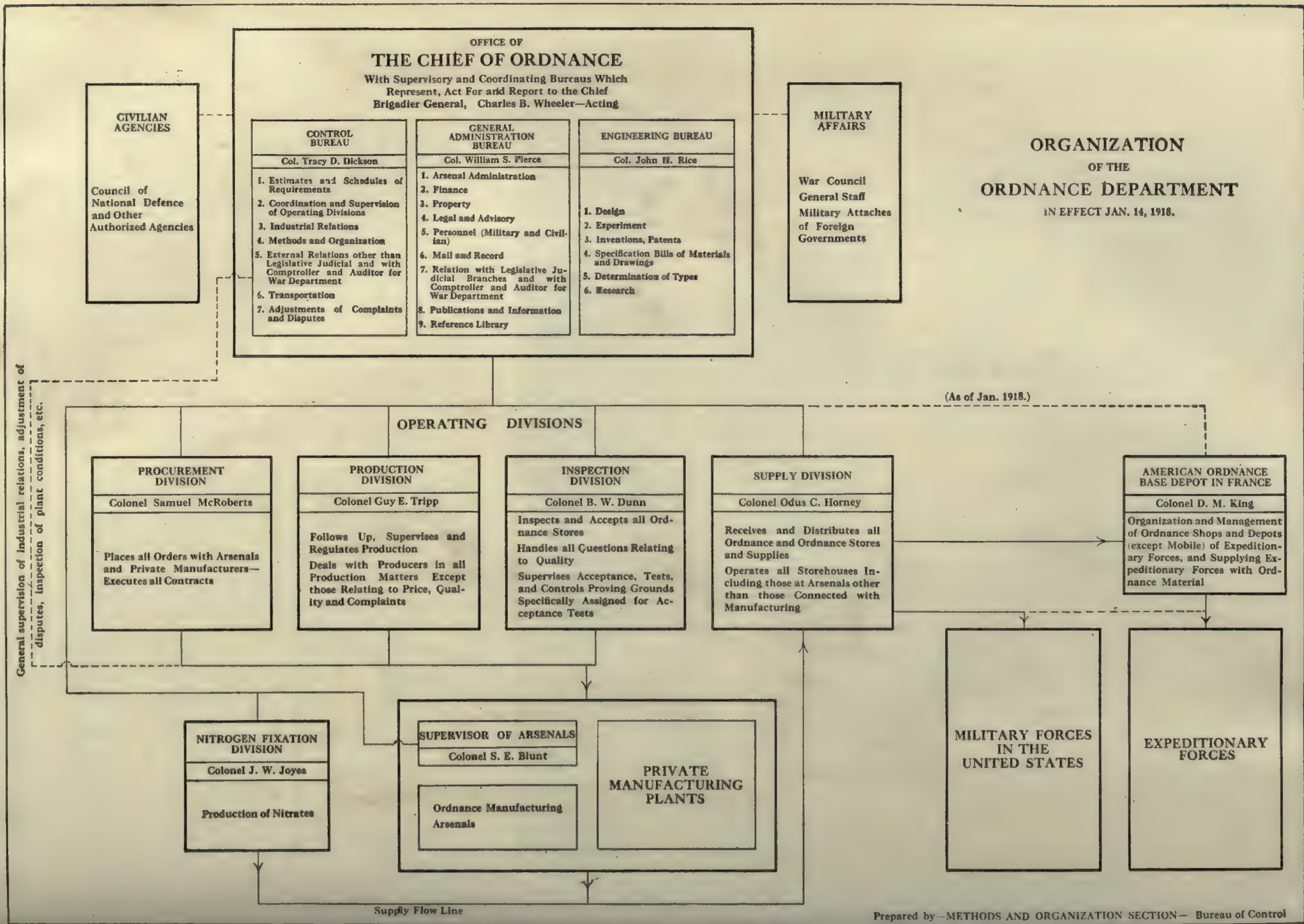
In a large manufacturing plant where thouands are employed, it is surprising to learn of the food products and material wasted each day

To give the employees of the Westinghouse Electric & Mfg. Co. some idea of the waste, the management devised the novel scheme of fitting up a storage battery truck, as a traveling exhibit. Upon it was a collection of food wasted including bread, butter, meats, cakes, crackers, pickles, cheese, fruits, etc., as well as a quantity of manufacturing material such as copper, zinc, lead, mica, rubber, felt, gum, and similar material which could be used to advantage.

It was estimated that the waste per day of foodstuffs in the plant amounts to between $35.00 and $50.00, cost of which, of course, comes out of the employee's pocket; the waste of material, amounting to hundreds of dollars per day, is a loss to the company; all of which is due largely to the thoughtlessness and carelessness of the employees.

Above the material is constructed a sign in large letters, reading, "Wasted," and underneath, the words "Food brought from your homes," and on the other side "Material belonging to the Company."

This truck was driven up and down the shop aisles where the employees could look upon it and form in their minds some idea of the waste in a large manufacturing plant; such an object lesson is valuable at this time when everyone should take all precautions necessary to affect as little waste as possible.


ORGANIZATION
OF THE
ORDNANCE DEPARTMENT
IN EFFECT JAN. 14, 1918.
OFFICE OF
THE CHIEF OF ORDNANCE
With Supervisory and Coordinating Bureaus Which Represent, Act For and Report to the Chief
Brigadier General, Charles B. Wheeler—Acting
CONTROL BUREAU
Col. Tracy D. Dickson
1. Estimates and Schedules of Requirements
2. Coordination and Supervision of Operating Divisions
3. Industrial Relations
4. Methods and Organization
5. External Relations other than Legislative Judicial and with Comptroller and Auditor for War Department
6. Transportation
7. Adjustments of Complaints and Disputes
GENERAL ADMINISTRATION BUREAU
Col. William S. Pierce
1. Arsenal Administration
2. Finance
3. Property
4. Legal and Advisory
5. Personnel (Military and Civilian)
6. Mail and Record
7. Relation with Legislative Judicial Branches and with Comptroller and Auditor for War Department
8. Publications and Information
9. Reference Library
ENGINEERING BUREAU
Col. John H. Rice
1. Design
2. Experiment
3. Inventions, Patents
4. Specification Bills of Materials and Drawings
5. Determination of Types
6. Research
CIVILIAN AGENCIES
Council of National Defence and Other Authorized Agencies
MILITARY AFFAIRS
War Council
General Staff
Military Attaches of Foreign Governments
General supervision of industrial relations, adjustment of disputes, inspection of plant conditions, etc.
(As of Jan. 1918.)
OPERATING DIVISIONS
PROCUREMENT DIVISION
Colonel Samuel McRoberts
Places all Orders with Arsenals and Private Manufacturers—Executes all Contracts
PRODUCTION DIVISION
Colonel Guy E. Tripp
Follows Up, Supervises and Regulates Production
Deals with Producers in all Production Matters Except those Relating to Price, Quality and Complaints
INSPECTION DIVISION
Colonel B. W. Dunn
Inspects and Accepts all Ordnance Stores
Handles all Questions Relating to Quality
Supervises Acceptance, Tests, and Controls Proving Grounds Specifically Assigned for Acceptance Tests
SUPPLY DIVISION
Colonel Odus C. Horney
Receives and Distributes all Ordnance and Ordnance Stores and Supplies
Operates all Storehouses Including those at Arsenals other than those Connected with Manufacturing
AMERICAN ORDNANCE BASE DEPOT IN FRANCE
Colonel D. M. King
Organization and Management of Ordnance Shops and Depots (except Mobile) of Expeditionary Forces, and Supplying Expeditionary Forces with Ordnance Material
MILITARY FORCES IN THE UNITED STATES
EXPEDITIONARY FORCES
NITROGEN FIXATION DIVISION
Colonel J. W. Joyes
Production of Nitrates
SUPERVISOR OF ARSENALS
Colonel S. E. Blunt
Ordnance Manufacturing Arsenals
PRIVATE MANUFACTURING PLANTS
Supply Flow Line
Prepared by—METHODS AND ORGANIZATION SECTION— Bureau of Control

Editorials

What of the Labor Situation

THE war is bringing many changes in industry and industrial relations. The machine building industry being no exception. All who have studied the trend of events both here and abroad must realize that all business managers are facing and must face new problems—perhaps more than we know at the present time.

Realizing this, and knowing the changes in thought which are occurring in all countries, including our own, it is the part of wisdom to consider these changes from all angles, and to have a hand in guiding them into rational channels. The reactionary attitude will only add fuel to the flame.

The following editorial from the *Engineering News-Record* shows the trend of thought in high engineering circles:

What of the labor situation? Let us face the facts.

Labor is stronger today than ever before. It has tremendous power. It can for short periods stop industry. Within reason it can force almost anything it will. If it goes to extremes the rural communities and large groups in the cities will rise to check and thwart its demands. Nevertheless, if misguided, it can work serious hardship. What then is its purpose? How will it use its power? Is it bent on a rule or ruin policy? Or, seeing the good in the existing order and conscious of the sure control that lies in the mass of the people, is it desirous of compromise?

Emphatically the latter is true—speaking as to the majority of the acknowledged labor leaders. Their desires cannot be realized unless capital comes half way. If capital resists, if it is represented—or rather misrepresented—by those who take an autocratic stand, it will force millions into the radical wing of the labor party, it will add fuel to fires already burning.

These are not the days for sugar coating the pill. The coward will cringe from facing the facts. He will roundly condemn those whose object is to save him—and with him the essential elements in the present social order. Charles M. Schwab said ten days ago that the worker was to dominate the world. A more temperate statement is that of former Supreme Court Justice Hughes, a student of industrial relations, accustomed to consider and weigh facts. Before the New York Bar Association last month, he said:

"Individual privilege in the future will have to show cause before a public to which old traditions are no longer controlling—a public trained in sacrifice—which will enforce its own estimate of the common right." And again he said, "The present exercise of authority over the lives of men will hereafter find its counterpart in a more liberal exercise of power over the conduct, opportunities and possessions of men."

Mr. Schwab and Justice Hughes had the courage to recognize the changing order. Narrow minds, however, will rail and rant, urge that capital prepare to fight for its position and declare that no man shall dictate how they shall run their plants. Such minds are not changed by dissertations on the reasonableness of the new order, which decrees that the public good shall take precedence over private gain; that the public cares for the individual and demands that he shall have a voice in determining the conditions under which he works.

It is a matter of indifference, in any event, what the individual thinks as to the soundness of the coming order. We are in a new era, in fact. Witness the fires raging socially in Russia and now kindling in Austria and even in Germany. Note the power which labor has in England.

We are in and of the world. The power drifting to the workers here is part of the world tide. Wither will it lead us?

Even as there are standpat autocrats as well as men of enlightenment among employers, so there are radicals and conservatives among labor. The autocrats on the one hand and the radicals on the other are the extremists. If they are left to lead us out of the difficulties, we shall have an arming for conflict and a great catastrophe. It is for those who see the light to compose the differences—the moderates among the employers, the conservatives among the workers.

These wings of the opposing parties can reach a working agreement. They must come together in order that the extremists may be disarmed—aye, that they, and the country with them, shall be saved from their own madness. The final result will work for the greater good of all. "Harsh changes are necessary," said Mr. Schawb, "but they will be more than repaid not only materially but in happiness and contentment."

Practically, what is coming out of the present economic crisis? Detailed predictions are dangerous. This much is certain: (1) Labor will demand and get a larger share of the profits of industry, and (2) it will demand a voice in each industry in determining the conditions under which it shall work.

It that a cure-all? Will all labor difficulties be then composed?

Not so. There is not an absolute unity of interest; there cannot be a permanent peace. All we can hope for is compromise under conditions that obtain today. When conditions change, there will be a new compromise, succeeded by another and another and still another. But the present compromise will be the greatest for many a day, for it will definitely establish labor's voice in the control of industry.

And what of the industries that pay a bare four or five per cent. on a fair or low valuation of investment? Bankruptcy or a reduction of overhead through increased production. These are the only alternatives.

And what of efficiency, now at a low mark in industrial plants? Education is the answer—education, through participation in management, regarding the factors which affect profits; education which will engender a sense of responsibility for the success of the industry, a realization that there can be no labor prosperity without industrial prosperity—a realization that will be turned into effective action by confidence that labor will get "its share" of the profits it helps to create. A long process, yes, but a necessary one.

And efficiency is a shoe that both parties can wear. Management inefficiency more than matches, count for count, labor inefficiency.

Radical talk this? Yes, if you will have it so, but read again the words of Charles Schwab and of Justice Hughes.

Shall we fear to face the facts? Shall we, by ignoring conditions that the merest numbskull can appreciate, drift into anarchy? *Lassez faire* and "last-ditch resistance" both lead to that end.

Soon there will meet in Washington a Labor Policy Board. It will hold the balances for our industrial peace. There must be give-and-take—compromise. Both sides must surrender much that they value highly. Far-seeing employers are ready to make sacrifice. So, too, are the forward-looking labor leaders. The interests of the country demand that both sides look carefully to it that they be not misrepresented.

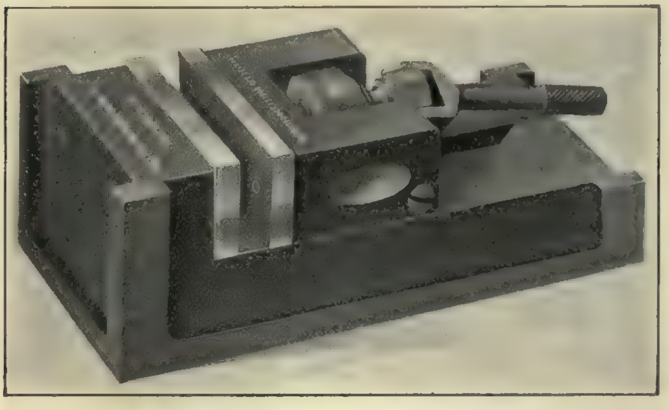
And above all, let both be prepared for large concessions. In that direction lies peace and the country's good.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Nestor Quick-Acting Machine Vise

This vise is intended for use in a drilling or milling machine or may be used on the faceplate of a lathe. It has flanges around the sides and ends which are machined square, so that the vise may be used on either side or end with equal facility.

The quick-acting sliding jaw moves easily from maximum to minimum capacity and is of such construction that it can never cock up when clamping the work.



NESTOR QUICK-ACTING MACHINE VISE

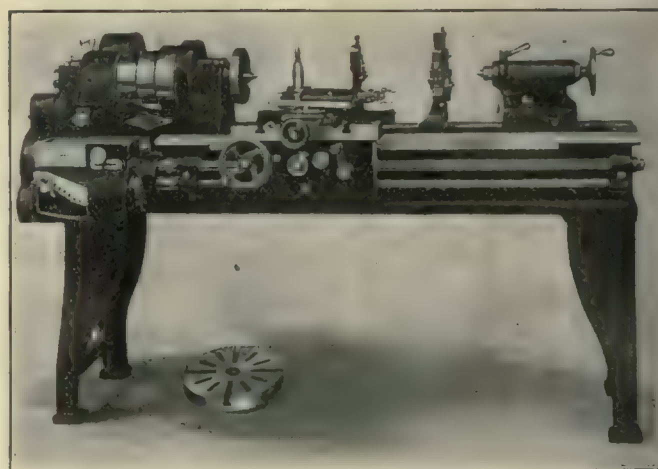
Made in three sizes, as follows: No. 0, 5$\frac{3}{4}$ in. long, 3 in. wide, 2 in. high; jaws 2$\frac{1}{2}$ in. wide, 1 in. high; maximum opening, 2$\frac{1}{2}$ in.; weight, 4$\frac{1}{2}$ lb.; No. 1, 9$\frac{1}{2}$ in. long, 4$\frac{3}{4}$ in. wide, 3 in. high; jaws 4 in. wide, 1$\frac{1}{2}$ in. high; maximum opening, 4 in.; weight, 18 lb. No. 2, 14 in. long, 7 in. wide, 4$\frac{1}{2}$ in. high; jaws 6 in. wide, 2 in. high; maximum opening, 6 in.; weight, 57 lb.

The vise jaws are hardened and ground, thus insuring accuracy; and they can be easily replaced with form jaws for duplicate manufacturing work.

The unusual capacity of this vise in proportion to its size is a great advantage in handling many difficult jobs. It is made by the Nestor Manufacturing Co., 40 West 13th St., New York City.

"Filsmith" 14- and 16-Inch Back-Geared Lathes

The Philip Smith Mfg. Co., Sidney, Ohio, has recently added to its line of lathes the machine illustrated, which is built in 14 and 16-in. sizes, with or without gap bed. The machines are equipped with three-step cones, double back gears and quick-change boxes. The spindle bearings are of phosphor-bronze, the spindle having 12 speeds. All gears are pack hardened and the holes ground true with the pitch line. The entire transmission runs on ball bearings. The tailstock is so shaped that the compound rest can be set at right angles when this is desirable. The compound rest is provided with taper gibs and is graduated for angular work, but a plain rest will be furnished if desired. The apron is cast in one piece and power crossfeed is provided. The quick-change gear box, as regularly furnished, gives feeds for cutting threads from 4 to 46, but additional gears for other threads can be supplied if desired. The lead screw is disengaged by means of a slip gear so that it is not necessary to have it running except when cutting threads. All gears are thoroughly guarded. Standard equipment consists of compound rest, follow rest, steadyrest, double friction countershaft and wrenches. Special equipment such as draw-in chucks, chuck plates, taper attachment, automatic stop, chasing dial, chasing stop and extra bed lengths are furnished at additional cost if desired.



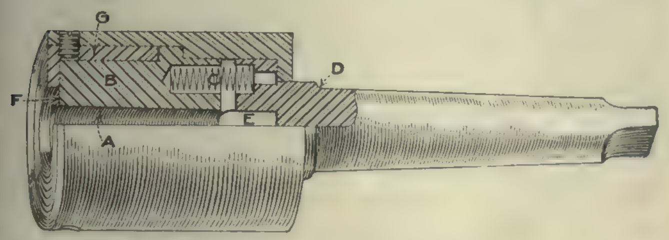
"FILSMITH" DOUBLE BACK-GEARED, 14-IN. LATHE

Swing over bed, 14$\frac{1}{2}$ in.; swing over carriage, 9 in.; distance between centers, 6 ft. bed, 35 in.; travel of tailstock, 5$\frac{1}{4}$ in.; diameter of tailstock spindle, 1$\frac{3}{4}$ in.; centers, Morse No. 3; front spindle bearing, 2$\frac{3}{8}$ x 4 in.; rear spindle bearing, 1$\frac{13}{16}$ x 3 in.; hole through spindle, 1$\frac{5}{16}$ in.; diameter of spindle nose, 2$\frac{1}{16}$ in.; threads cut, 4 to 46; feeds, three times threads; cone diameters, 5$\frac{1}{2}$, 6$\frac{3}{4}$ and 8 in.; width of belt, 2$\frac{1}{2}$ in.; back-gear ratios, 3 to 1 and 8 to 1; Number of spindle speeds, 12, 27 to 600 r.p.m.; bearing of carriage on ways, 18 in.; width of bridge, 7$\frac{1}{4}$ in.; size of tools, 1$\frac{1}{4}$ x $\frac{5}{8}$ in.; weight with 6 ft. bed, 1350 lb.; extra weight per additional ft. of bed, 90 lb.

On the 14- and 16-in. gap lathes swings of 22 and 24 in. are possible with a width of face of 6$\frac{1}{2}$ in.

Progressive Drill Chuck

The illustration shows a drill chuck that has recently been placed on the market by the Progressive Machine and Metal Products Co., Inc., 210-212 Canal St., New York City. The feature of the device is that the drill is driven by the tang, the construction being such that if the drill catches or sticks, the drive is disengaged by a slight reverse motion of the feed mechanism. When the feed is reversed in a case of this kind, the tang is disengaged from the driving shank and the drill turns in the taper socket. The action of the device is as follows: the drill is placed in the taper hole *A* in the part *B;* two springs *C* hold the driving shank *D* away from *B* so that the slot *E* in the driving shank



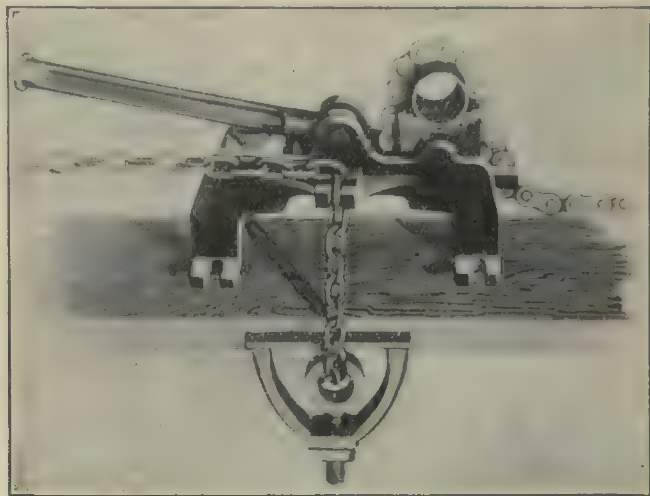
PROGRESSIVE DRILL CHUCK

does not engage the tang of the drill. When the drill strikes the work and a slight pressure is applied, the springs *C* are compressed and the driving shank *D* moves down against *B*, the slot *E* engaging the tang of the drill and providing a positive drive. When the feed pressure is released the springs *C* force parts *B* and *D* apart, disengaging the positive drive, and if the drill sticks in the work it will turn in the taper socket *A*, and not be broken. The drive shank *D* is cylindrical, extending down nearly to the surface *F* while the part *B* is flat and fits into a slot milled in *D*. All the parts are held in place by the part *G* which is secured in the outside shell by two screws.

Gerolo Pipe Vise

The "Chaingrip" pipe vise illustrated, is one of the recent products of the Gerolo Mfg. Co., Old Colony Bldg., Chicago, Ill. The device is made in two sizes; No. 1, accommodating $\frac{1}{8}$- to $2\frac{1}{2}$-in. pipe, and No. 2, accommodating $\frac{1}{4}$- to $4\frac{1}{2}$-in. pipe. The respective weights are 17 and 22 lb. The device is portable and so made that it may be fastened to any kind of a horizontal or vertical support whether round, square or flat without the use of bolts. It locks any size of pipe within its limit by a slight movement of the lever, no previous adjustment being necessary. In case it is desired to use the device in a permanent position it can be secured by means of bolt slots provided in the four feet. The chain for securing the vise in position, is of wrought iron and is riveted to one side of the base from whence it passes around the supporting column through the eye of the eyebolt in the clamping support to the other side of the base where any convenient link is caught in a socket. Tightening of the eyebolt nut tightens the supporting chain and holds the vise in position.

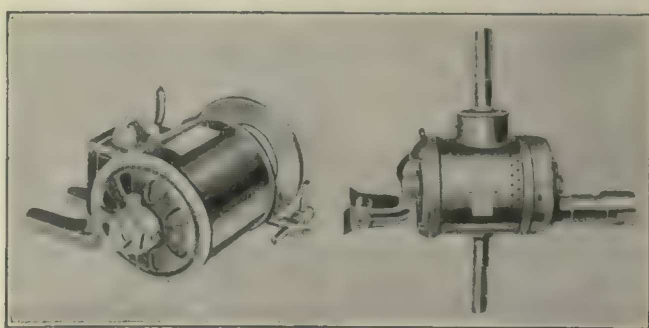
The vise locks a pipe between a double set of steel jaws on one side, and a close-linked steel chain. The locking motion is accomplished by the movement of the handle toward the vise. This handle fulcrums on a steel pin, which projects through two bosses, one on either side of the frame. Directly beneath this fulcrum point the handle takes the shape of a cam, which in turn operates against a movable horizontal bar. To one end of this bar is riveted the steel gripping chain. The other end, or fulcrum point, of the bar is supported by a threaded bolt, the enlarged, knurled head of which rests upon a boss on the base of the vise. Rotation of the head of the bolt raises or lowers the fulcrum point of the bar, and forms an adjustment for the pressure


PORTABLE PIPE VISE

exerted on the gripping chain. The base and clamp support are malleable-iron castings, while open-hearth steel is used for the jaws, grip chain socket and grip chain.

Gilfillan Electric Tools

The illustration show two devices that have recently been placed on the market by the Gilfillan Brothers Smelting and Refining Co., Los Angeles, Cal. At the left is shown a motor-driven toolpost grinder, the motor being of $\frac{1}{4}$-hp. with a speed of 3400 r.p.m. The machine


ELECTRIC TOOLPOST GRINDER AND DRILL

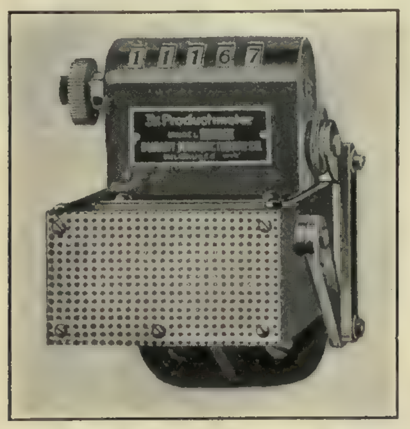
is provided with an angle plate designed to be clamped around the toolpost, any necessary vertical adjustment being secured by means of a device incorporated in the machine. The wheel used has a diameter of 6 in. and a width of face of $\frac{3}{8}$ in. The machine is also furnished with an extension mandrel for internal grinding, a tooth rest for cutter grinding and an electric attachment plug and cord.

At the right is shown an electric drill equipped with gears to give two speeds. These are changed by means

of a knob at the bottom of the gear case. All gears are of chrome-nickel steel and run in grease. Ball bearings are used throughout, the speeds being 400 and 700 r.p.m. The machine is equipped with a ½-in. standard chuck and electric switch. The motors used on both the drill and the toolpost grinder are the product of the Westinghouse Electric and Mfg. Co.

Durant "Productimeter"

The electric "Productimeter" shown in the illustration is a late product of the Durant Mfg. Co., Milwaukee, Wis., being adapted for counting operations requiring not over five figures. The device will operate with a very slight movement or at a distance from the actual point of contact. It is mounted upon a brass bracket which holds a pair of magnetic coils and an

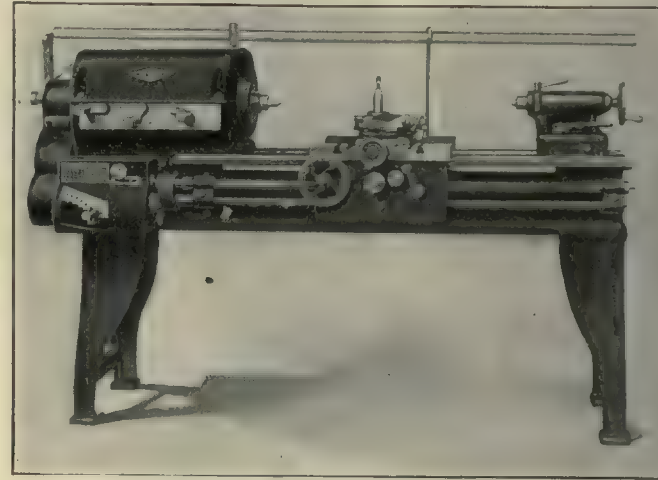


DURANT ELECTRIC "PRODUCTIMETER"

armature, the operating lever being connected to the swinging armature in a positive manner with a free and sensitive movement. The coils are ventilated and are interchangeable. They are furnished for 6- or 110-120 volts d.c., or for 110-120 volts a.c., at 25 or 60 cycles. Binding posts are placed at the rear. Contacts are not regularly furnished, but can be supplied if desired. The weight of the machine is 2½ pounds.

"Filsmith" 14- and 16-In. Geared-Head Lathes

A 14-in. lathe that has recently made its appearance on the market is shown in the illustration. It is the product of the Philip Smith Mfg. Co., Sidney, Ohio, and is equipped with a 12-speed, ball-bearing, all-geared head. The headstock casting is one piece, the caps for the spindle bearings being held in place with body fit screws. All gears are of heat-treated steel, and have involute stub teeth. The main transmission shaft has four keys milled from the solid, and all shafts carrying sliding gears have at least two keys. The spindle is of 50-point carbon steel and runs in phosphor-bronze bearings, while a ball bearing carries the end thrust. Sight-feed oilers are used. The head is driven by a friction pulley, the support of which is bolted against the headstock, thus relieving the shaft of belt stress. If desired, motor drive can be furnished, the motor being mounted directly on top of the head. The tailstock is so shaped that the compound rest can be set at right angles when turning small work. The compound rest is provided with taper gibs and is graduated for angular work. The apron is cast in one piece and power crossfeed is provided. A quick-change gear box provides feeds for cutting threads from 4 to 46, additional gears for other threads being furnished if desired. Standard equip-



"FILSMITH" 14-IN. GEARED-HEAD LATHE

Swing over bed, 14⅜ in.; swing over carriage, 8 in.; distance between centers with 6 ft. bed, 34 in.; tailstock travel, 5¼ in.; diameter of tailstock spindle, 1¾ in.; centers, No. 3 Morse taper; front bearing, 2¼ x 4 in.; rear bearing, 1 15/16 x 3 in.; diameter of spindle nose, 3 in.; hole through spindle, 1 5/16 in.; threads cut, 4 to 46; feeds, three times threads; bearing of carriage on ways, 18 in.; width of bridge, 7¼ in.; number of spindle speeds, twelve: 18 to 497 r.p.m.; size of tools, 1¼ x ⅝ in.; weight with 6-ft. bed, 1600 lb.; extra weight per additional ft. of bed, 90 lb.

ment includes compound rest, follow rest, steadyrest, large and small faceplates and wrenches. The lathe is also built in the 16-in. size and with a gap bed in either 14- or 16-in. sizes.

Measuring Morse Tapers

By Wm. S. Rowell

An article under the above head appeared on page 167 of the *American Machinist* in which Mr. P. S. Smith tells us how to measure tapers with a dial indicator.

The method would be a fairly good one if reliance were to be placed upon the instrument used, but while dial indicators are extremely sensitive to minute changes of position, they are not usually considered to be particularly accurate as a measuring machine.

Mr. Smith's method measures the taper from the center line, or one-half the angle; and furthermore, as it measures the taper over but 2 in. of its length there is the chance of error due to the multiplication by 12 to reach the final result.

It might be well when testing the lathe for parallelism to observe that the tailstock occupies the same position on the shears, and that the spindle is run out to the same point as when testing the taper, else any error that may be in the lathe will be among the factors to be considered in computing the result.

Note

Through an oversight in connection with the article on Automatic Control and Measurement of High Temperatures, by R. P. Brown, page 157, the name of the Brown Instrument Co., Philadelphia, Penn., was omitted. Mr. Brown is connected with this company, and any inquiries regarding the article should be directed to it.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Feb. 9, 1918—Dr. H. A. Garfield, the Fuel Administrator, William G. McAdoo, director general of railways, and a number of the State Fuel Administrators who met in Washington for conference, decided to continue in effect the orders preventing industry on Mondays, notwithstanding the fact that previous authoritative information to the Washington correspondents had been that the order would be rescinded.

In making public the statement, Dr. Garfield called attention to the fact that a "change in weather conditions" which is hoped for of a favorable character, must take into consideration the question of the possibility of floods when the thaws follow the present period and condition of snow and ice. Flood conditions, he said, must be figured in weather conditions, and the apprehension now exists in Washington that flood conditions may tie up the transportation of coal as badly as snow and ice have tied it up.

Weather and Transportation Conditions

The fuel situation was considered in connection with the existing weather and transportation conditions, inquiry being directed particularly to the results of the continuance of the Monday closing order. Without exception, the Fuel Administrators present bore witness to the uniform and patriotic observance of the closing order on the part of all classes of the community.

The effect of the closing order is not easily measured statistically, the more so because of extraordinary weather conditions, but the State Fuel Administrators reported that substantial savings had been effected. The most exact estimates were submitted by the Secretary of the National Committee on Gas and Electric Service. These figures were furnished by the electric light, power and gas companies of 29 of the largest cities of the country. The average by weight of the saving during the five days from Jan. 17 to Jan. 22, inclusive, was 21.2 per cent., while the saving for Monday, Jan. 28, was 25.5 per cent. of the amounts usually consumed.

The testimony of the State Fuel Administrators was substantially unanimous that, in view of the continued severity of weather conditions and the acute shortage of coal, particularly for domestic uses, throughout the entire northeastern section of the country, it would be unsafe as yet to suspend either the Monday closing order or the embargo.

The United States Fuel Administrator, in the light of this testimony and of the information submitted to him by the State Fuel Administrators, has decided to continue the Monday closing order until such time as the change in weather and resulting improved transportation conditions warrant its suspension. So long as present weather conditions continue, however, the possibility of human suffering is too imminent to permit any relaxation in the present efforts to conserve and increase the existing supply of coal.

Where One Inspector Fell Down

Just as an indication of some of the new problems which confront the Ordnance and other departments, is one case in which an injustice was unintentionally done a large manufacturer of special machine tools. This maker has evolved a new and interesting method of building large machines for special turning and boring operations. These methods are so different from the usual ones, that the machines do not appear in the shop until they are about ready to be assembled, after which they begin to come out almost like the proverbial sausage out of the sausage machine.

This manufacturer had a very considerable contract from the Government for special machines, with a guaranteed delivery at an early date; but when the inspector came to the shop and found it empty, he immediately concluded that they had fallen down on the job and reported accordingly. According to all his previous experience the shop should have been full of machines in various stages of construction. He was from Missouri and there was nothing to show him.

But, though peeved at the countermand, which would not have been accepted from a private customer, the builder kept on with the contract. He had sunk too much money in it to back out, and he completed the machines inside the contract time before anyone else had a machine ready.

In the meantime new contracts had been let to several other concerns who made all kinds of promises, but who at last accounts had not completed a single machine. The joke of it is that one of the concerns which took the new contract, tried to hire the man who was reported to have fallen down, to run the shop while the machines were being built.

The only trouble was that the inspector could not understand the new method of manufacture and consequently he could not believe that it was possible to make the machines in any such time. He was perfectly honest in the matter and was trying his best to secure prompt delivery for the Government. He could not see how the new method could possibly work and did not want to take any chances. But his incredulity has so delayed the

game that the machines will not be ready for a much longer time than might otherwise have been the case. The only thing that spoils the inspectors alibi is that the same man had been building machines by this method for two years and had not fallen down on a single order. A little inquiry would have shown this and saved the day.

There are some people who think it is patriotic to do any kind of Government work, no matter what kind of a profit they demand. One such patriot went to the commanding officer of one of our arsenals recently and offered the services of his plant. Then he took home some blueprints and samples of work he could handle and patriotically bid three and a half times what it cost in the arsenal after allowing one hundred per cent. overhead.

The bid was not accepted and the commanding officer promptly hired the best men from this patriotic manufacturer's shop. He was simply another of the kind who spell patriotic with a "y." Fortunately they are not as plentiful as formerly, but they are still somewhat too numerous.

Personals

W. H McClelland has been appointed sales manager of the Cleveland office of the Strong Carlisle & Hammond Co.

J. L. Whitehead has been appointed sales manager of the Detroit branch of the Strong Carlisle & Hammond Co.

Frank A. Robbins, Jr., has been appointed general manager of the Steelton, Penn., plant of the Bethlehem Steel Co.

C. S. Thompson, Chicago, has been appointed manager of foreign sales of the Four-Wheel Drive Automobile Co., Clintonville, Wis.

W. H. Knowles, who was formerly chief engineer of the Saxon Motor Car Co., has been appointed superintendent of Hale & Kilburn Co., Philadelphia.

Walter Nochumson, formerly with the Clark Equipment Co. (Celfor Tools) has joined the Dale-Brewster Machinery Co., Chicago, as manager of the supply department.

T. C. Allen has resigned as assistant comptroller of the Remington Arms Co. and the Eddystone Munitions Co., to become comptroller of the Tacony Ordnance Corporation, Philadelphia.

Frederick W. Nettleton, for the past eight years superintendent of the Waterbury Clock Co., Waterbury, Conn., has resigned to accept a position with the Bristol Brass Co., Bristol, Conn.

Auguste J. Rossi of the Titanium Alloy Mfg. Co., Niagara Falls, N. Y., was presented with the Perkins medal on Friday evening, Jan. 18, at a meeting of prominent chemists at the Chemists' Club, New York.

Raymond G. Hutchinson, division engineer of the American Brass Co., Waterbury, Conn., has been appointed superintendent of the Buffalo plant of the company, formerly the Buffalo Copper and Brass Rolling Mill.

E. Cooper Wills has been made superintendent of the Nagle Steel Co.'s plant at Rahway, N. J., operating one 30- and one 40-ton basic open-hearth furnace on steel for plates for the United States Government.

J. H. Bickley, mechanical engineer with the Reading Iron Co., Reading, Penn., for 17 years, has resigned to accept the position of superintendent of inside engineering, for the Merchant Shipbuilding Corporation, Bristol, Penn.

Frank J. Foley, formerly manager of the mining department of the Westinghouse Electric & Mfg. Co., became connected on Jan. 1, with the Edison Storage Battery Co., Orange, N. J., as manager of the mining and traction department, with headquarters at the main office in Orange.

Frank Bartholomew, who has been erecting engineer for the Shaw Electric Crane Co. for the past twenty years and who resigned his position with that company in December, 1917, has become associated with **N. B. Payne**, specialist in electric cranes, Havemeyer Building, 25 Church St., New York City.

F. C. Hossie has purchased all of **J. R. Stone's** holdings in the General Mfg. Co., Detroit, Mich., and sold all of his holdings in the J. R. Stone Tool and Supply Co., with whom he has been identified for a number of years. Mr. Hossie will devote all of his time to the interests of the General Mfg. Co.

H. T. Strout, formerly sales manager of the Massachusetts Saw Works and **J. W. McQuillan**, formerly general superintendent and later president of the same concern, have formed a partnership and will engage in the manufacture of hacksaw blades. The partnership will be known as the Spartan Saw Works, and will be located at 41 Taylor St., Springfield, Mass.

J. C. Bannister has been made a vice president of the Walworth Mfg. Co., Boston, Mass., manufacturers of iron fittings, valves, Stillson wrenches, etc., with headquarters at their Kewanee, Ill., plant.

Charles A. Swan, formerly superintendent of the Becker Steel Co. of America, has joined the sales organization of the Hess Steel Corporation, Baltimore. He will represent the Hess Co. in Cleveland and Detroit territory.

H. D. Gates is now sales manager of the Pangborn Corporation, Hagerstown, Md., and **F. J. Hull** is assistant engineer. Mr. Gates and Mr. Hull have been in the employ of the Mott Sand-Blast Co. for the past few years. **Charles T. Bird**, of the production and engineering departments, has been transferred to the sales department and assigned to the home territory, with headquarters at Hagerstown, Md.

Waldo H. Marshall, formerly president of the American Locomotive Co., and now associated with J. P. Morgan & Co., has been appointed assistant chief of the Division of Production of the Ordnance Department. Mr. Marshall was born in 1864 and began his business life as a railroad man. He became assistant superintendent of motive power for the Chicago & Northwestern in 1897; was appointed superintendent of motive power for the Lake Shore & Michigan Southern in 1899; was made general superintendent of that road in 1902, and general manager in 1903, his jurisdiction extending also over the Lake Erie & Western and the Indiana, Illinois and Iowa, and in 1906 was elected president of the American Locomotive Company.

Obituary

F. A. Diver, for many years a director of the Diver-Harris Co. of Harrison, N. J., died on Jan. 21. Mr. Diver was 82 years old.

Business Items

The Spartan Saw Works, 41 Taylor St., Springfield, Mass., has recently been formed, and will engage in the manufacture of hacksaw blades.

High Speed Tools Corporation, manufacturers of cast high speed steel tools and alloyed steels, has moved its offices to 43 Exchange Place, New York City. This corporation has enlarged its factory capacity considerably, and are prepared to make quick deliveries.

The Victor Tool Co., Waynesboro, Penn., at a meeting of the board of directors Jan. 22, the following officers were elected for the ensuing year: R. G. Geist, president; Frank Barnett, vice president; R. G. Mumma, secretary and assistant treasurer, and J. W. Warehime, treasurer.

The General Mfg. Co. of Detroit, Mich., announces a change in officers due to a transfer of stock holdings. The new officers are F. C. Hossie, president; M. G. Hossie, vice president; H. Wild, secretary and treasurer. The business will be conducted along the same lines as in the past.

The Ott Grinder Co., Indianapolis, Ind., which was burned out in the Industrial Building fire, has leased the three story concrete modern factory building at 10th and Roanoke Sts., formerly occupied by the Stutz Motor Car Co. They have been assisted by other manufacturers so that almost immediate delivery of equipment has been secured and they expect to be running again on a manufacturing basis within a few weeks.

The General Mfg. Co., Detroit, manufacturer of tools, jigs and fixtures, announces a change in officers due to a transfer of stock holdings. The new officers are: F. C. Hossie, president; M. G. Hossie, vice president, and H. Wild, secretary and treasurer.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

The sixth annual meeting of the Chamber of Commerce of the United States of America will be held in Chicago, Apr. 10, 11 and 12, 1918. Elliot H. Goodwin, Riggs Building, Washington, D. C., is general secretary.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

The National Society for the Promotion of Industrial Education will hold its eleventh annual convention in Philadelphia, Penn., Feb. 21, 22 and 23. The main topics for discussion will be Vocational Education in War Time. Administration of the Smith-Hughes Act, Twentieth Century Vocational Training and Reorganization of the National Society. The headquarters of the society are at 140 West 42nd Street, New York City.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North. Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

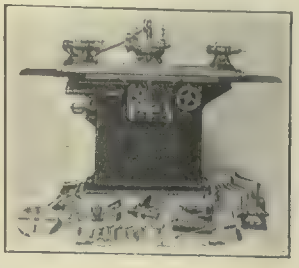
Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

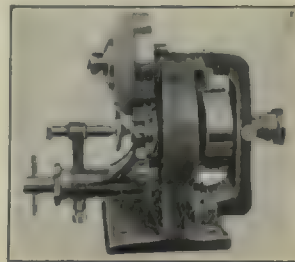
Grinding Machine, Universal Cylindrical
Webster & Perks Tool Co., Springfield, Ohio

"American Machinist," Jan. 31, 1918



Normal capacity, 10 x 30 in.; swing over table water trough, 14 in.; diameter of footstock spindle, 1⅝ in.; work-carrying centers, No. 3 Morse taper; diameter of grinding-wheel spindle, 1⅝ in. under center wheel; length of wheel spindle bearings, 3 in.; amount of reduction by automatic cross feed, 0.00025 in.; greatest amount of reduction by automatic cross feed, 0.005 in.; cross-feed hand wheel graduated to indicate reduction of 0.00025 in.; work speeds, four, 58 to 320 r.p.m.; table speeds, eight, 7 to 70 in. per min.; horsepower required, 4

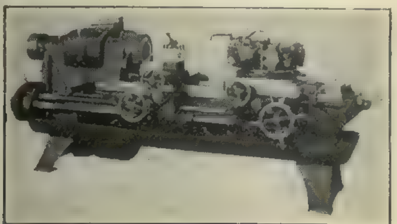
Grinding Machine, Valve and Reseating Tool
Currier-Koeth Manufacturing Co., Coudersport, Penn.



"American Machinist," February 7, 1918

Designed especially for grinding poppet valves for gasoline engines and for grinding cutters used for resurfacing the valve seats. The machine and wheel spindles are parallel and are interconnected by gears, the grinding wheel being faced off at the proper angle. The valves are held on centers while the cutters are held on mandrels mounted on centers. A device is furnished for automatically dressing the wheel at the proper angle

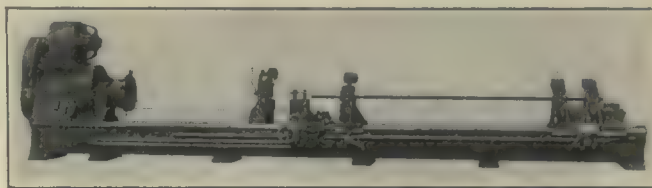
Lathe, Universal Turret No. 3
Acme Machine Tool Co., Cincinnati, Ohio



"American Machinist," January 31, 1918

Maximum capacity of automatic chuck, 3½-in. rounds, 2 5/16-in. squares, 3-in. hexagons; hole through spindle, 3⅜ in.; swing over bed, 24 in.; swing over auxiliary carriage, 17 in.; spindle speeds, nine, 14 to 280 r.p.m.; diameter of turret, 18 in.; cross travel of turret, 8 in.; longitudinal travel of turret, 44 in.; center of spindle to top of turret, 4 in.; floor space, 3 ft. 6 in. by 11 ft. 4 in.; weight of plain machine, 6750 lb.

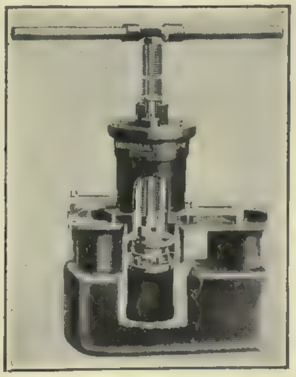
Boring Machine, 38-In. Gun
LeBlond Machine Tool Co., Cincinnati, Ohio



"American Machinist," February 7, 1918

Designed to bore solid forgings, tubes and jackets for guns up to and including 6 in. in diameter. Made in various lengths of bed with an all-geared headstock providing two changes of speed. Motor drive is used throughout. Lubricant is circulated by means of a triplex, single-acting, direct-connected pump. The main-drive motor is of 25 hp. and provides spindle speeds ranging from 5 to 60 r.p.m.

Cylinder Reboring Tool
Universal Tool Co., Detroit, Mich.

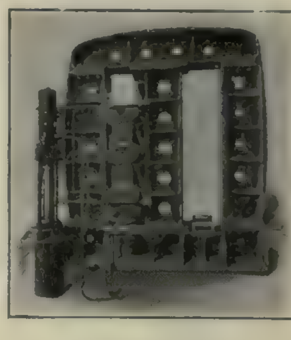


"American Machinist," February 7, 1918

Made in a number of sizes for reboring the cylinders of gasoline engines. The cutter head carries six cutters. A bevel expansion ring fits the cylinder being rebored while an oversize securing ring follows in the new cut to insure accuracy. The feed is by means of a screw cut with square threads. The device may be operated either by hand or by power

Press, Plate Bending
Southwark Foundry and Machine Co., Philadelphia, Penn.

"American Machinist," February 7, 1918



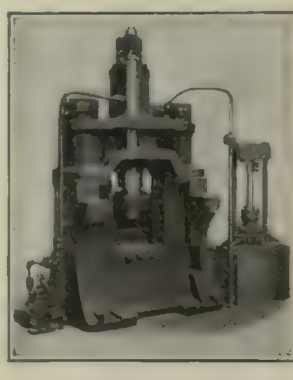
With this machine, plate can be bent to the extreme end, and may also be bent to form a complete cylinder, as the upper tension member may be arranged with a hinge bolt so that it may be swung up allowing the finished work to be lifted off the machine. The ram operates through an inclined plane and roller mechanism, which construction, is it claimed, makes the machine more economical of water than if a direct-operating ram were used

Grinding Machine, Tool and Cutter No. 2½
Woods Engineering Co., Alliance, Ohio

"American Machinist," February 7, 1918

Longitudinal travel, 22 in.; cross travel, 7½ in.; vertical travel, 10 in.; distance between centers, 28 in.; swing on centers, 9 in.; number of speed changes for table, 12; vise jaws, 1½ x 5¼ in., open, 2⅜ in.; weight, 1275 lb. Heads may be swiveled to 180 deg., and may be set and clamped to any angle by means of graduations and a clamping device. Top table swivels on a center pivot and is graduated to indicate taper in 1/16 in. per ft. Top of table is provided with two T-slots

Shear, Billet
Southwark Foundry and Machine Co., Philadelphia, Penn.



"American Machinist," February 7, 1918

A 500-ton billet shear. Has a knife 24 in. long and will shear two 6-in. billets simultaneously. A 5500-lb. pressure is used on the 16-in. ram, this pressure being obtained through a steam-operated intensifier. The stroke is 10 in. The pull-back is at a pressure of 650 lb., the water in the working cylinder being returned to the intensifier. The slide is equipped with bronze liners which bear on steel liers on the frame; weight, including intensifier, 140,000 lb.

Patent Applied For

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Feb. 8, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$24.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia................	33.75	33.75	30.50
*No. 2, Valley....................	33.95	33.00	31.00
No. 2, Southern Cincinnati...........	35.90	35.00	26.90
Basic, Eastern Pennsylvania..........	33.75	30.00	30.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Feb. 8, 1918	One Month Ago	One Year Ago	Feb. 8, 1918	One Year Ago	Feb. 8, 1918	One Year Ago
Structural shapes ...	$4.20	$4.20	$4.10	$4-4.04	$4.10	$4.20	$3.75
Soft steel bars......	4.10	4.10	4.00	4-4.04	4.00	4.10	3.85
Soft steel bar shapes.	4.10	4.10	4.00	4.14	4.00	4.10	3.75
Plates, ¼ to 1 in. thick	4.45	4.45	5.15	4.39	4.75	4.20	4.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

Pittsburgh, mill	$3.50	$3.25
Warehouse, New York..................	4.70	3.75
Warehouse, Cleveland	3.98½	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Feb. 8, 1918	New York One Month Ago	New York One Year Ago	Cleveland Feb. 8, 1918	Cleveland One Year Ago	Chicago Feb. 8, 1918	Chicago One Year Ago
*No. 28 black......	5.00	6.45	5.00	5.75	6.45	5.50	6.45	5.15
*No. 26 black......	490	6.35	4.90	5.65	6.35	5.40	6.35	5.05
*Nos. 22 and 24 black	4.85	6.30	4.85	5.60	6.30	5.35	6.30	5.00
Nos. 18 and 26 black	4.80	6.25	4.80	5.55	6.25	5.30	6.25	4.95
No. 16 blue annealed.	4.45	5.65	4.45	5.10	5.65	4.95	5.65	5.00
No. 14 blue annealed.	4.35	5.55	4.35	5.00	5.55	4.85	5.55	4.90
No. 10 blue annealed.	4.25	5.45	4.25	4.95	5.45	4.75	5.45	4.85
*No. 28 galvanized..	6.25	7 70	6.25	7.50	7.70	7.00	7.70	7.25
*No. 26 galvanized..	5.95	7.40	5.95	7.20	7.40	6.70	7.40	6.95
No. 24 galvanized...	5.80	7.25	5.80	7.05	7.25	6.55	7.25	6.80

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c. all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Feb. 1, 1918	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Feb. 8, 1918	One Year Ago
New York	$15.00	$8.00
Cleveland	15.30	7.50
Chicago	15.00	6.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16..	
No. 18	
No. 20	

*Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

***Special Welding Wire**

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Feb. 8, 1918	Cleveland Feb. 8, 1918	Chicago Feb. 8, 1918
Tire	4.10	5.00	4.04
Toe calk	5.70	5.50	4.35
Openhearth spring steel...	7.50	8.25	8.00@8.50
Spring steel (crucible analysis)	11.00	11.25	11.50
Coppered bessemer rods....	9.00	....	7.00
Hoop steel	4.95	....	4.95
Cold-rolled strip steel.....	9.00	....	8.50
Floor plates	6.19½	....	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4.......	29%	17%
4½ to 6......	44%	32½%	4½ to 6.......	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Feb. 1, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	35.00
Tin, in 5-ton lots..................	85.00	86.00	50.00
Lead	7.00	6.50	8.75
Spelter	8.00	7.75	10.25

*Government price.

ST. LOUIS

Lead	6.85	6.37½	8.00
Spelter	7.87½	7.50	10.00

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Feb. 8, 1918	New York One Month Ago	New York One Year Ago	Cleveland Feb. 8, 1918	Cleveland One Year Ago	Chicago Feb. 8, 1918	Chicago One Year Ago
Copper sheets, base.	31.00-33.50	35.50	42.00	32.50	44.00	36.00	43.00
Copper wire (carload lots	32.00	32.00	36.00	28.50	44.00	34.50	37.00
Brass pipe base.....	36.50	36.00	47.50	36.50	52.00	41.50	46.50
Brass sheets	30.75	30.75	45.50	29.00	43.00	35.50	44.00
Solder ½ and ½ (case lots)......	43.00	48.00	28.37½	47.00	27.50	41.00	28.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Feb. 1, 1918	One Year Ago
Mill	$25.25	$42.00
New York	27.25	45.50
Cleveland	34.00	42.00
Chicago	37.00	42.50

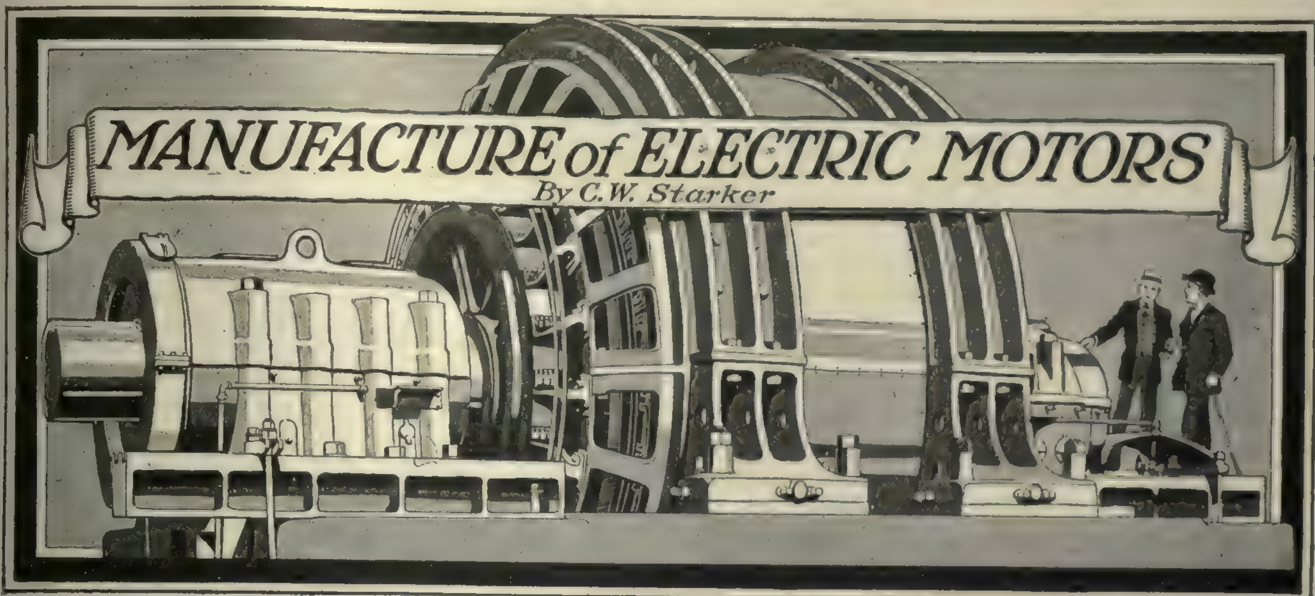
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.. 19.00

	In Casks Feb. 8, 1918	In Casks One Year Ago	Broken Lots Feb. 8, 1918	Broken Lots One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Feb. 8, 1918	One Year Ago
New York	14.25	18.00
Cleveland	17.00	26.00
Chicago	16.00	17.35



MANUFACTURE of ELECTRIC MOTORS

By C. W. Starker

X.—Squirrel-Cage Rotor Windings and Blowers

The squirrel-cage induction motor with its short-circuit winding is the simplest type of motor. In this winding there are no rotor coils to be made, no wedges of fiber or metal, but simply a number of bars, inserted in partially closed slots and all connected together at each end by a short-circuiting ring. However, in practice this apparently simple construction has proven a rather difficult problem from a manufacturing standpoint.

THERE has been a number of interesting constructions of rotor windings in this country and abroad; and while we do not propose to review them here, yet it is of interest, and gives a better understanding of the subject, to note briefly the successive steps of development by one manufacturer who has been a pioneer in alternating-current motor design, and whose experience may therefore be considered typical. We quote the following from the early history of the polyphase motor of about 1897:[1]

"The secondary winding consists of rectangular copper bars connected to end rings of copper or of some nonmagnetic alloy of higher resistance. In motors where high-starting torque was required, the alloy used was from twenty to forty times the resistance of copper. Iron was tried for the resistance material, and while it gave a good shape to the speed-torque curve, it materially lessened the maximum torque and was therefore not adopted. It is interesting to note that one of the principal problems in the development of the first squirrel-cage type of motor was a mechanical one, due to the difficulty of maintaining a secure connection between secondary bars and end rings. Copper rivets could not be used with copper bars and rings because they were not of sufficient strength and would stretch and loosen, because of the pull of the ends of the bars by centrifugal action. Iron rivets or bolts, alone could not be used because they stretched and loosened by conditions caused by unequal expansion of the materials of the end rings being heated under the starting conditions. Soldered connections could not be maintained on account of overheating under starting conditions.

"One of the first motors built for crane service had the bars bolted to the end rings. In an endurance test made on it, where it was loaded repeatedly till it dropped to zero speed, it was found that over half of the bolts had loosened and some had actually developed cracks. The situation appeared very serious until one of the engineers on test suggested using lock-washers of the spring type, not to lock the nuts but to give a cushioning or spring effect between nuts and ring. The suggestion was tried and proved entirely successful. The function of the spring washer had to be understood by the workmen in the factory and repair shop, otherwise its purpose was defeated by tightening the bolts until the washer was flattened out and no margin left for expansion. It was difficult at first to get the manufacturing department to appreciate this point."

In Fig. 101 we show a rotor of this bolted-on construction which has been used by almost every manufacturer, and has maintained itself for a long time. The bars were insulated by a paper covering, and the bar ends were tinned to improve the contact. Of course the casting and machining of the resistance rings was expensive, as was also the counterboring and drilling of every bar. Where the bars were too thin to permit counterboring, they had to be tapped; sometimes two bolts per bar were used at each end. In 1909 a modified construction was brought out, Fig. 102, in which bolts and spring washers are still used, but the rings are made from sheet copper or sheet brass as being more economical and of lower flywheel effect. Fingers at the periphery of this resistance disk were bent up and bolted to the bars. This form of ring provides a large cooling surface, particularly when two rings in parallel are used. In view of the severe service conditions for which this type of motor is intended, the rings are secured to the cast-iron spider by means of insulated

[1]The evolution of the polyphase induction motor, by R. S. Feicht, "Electric Journal," July, 1914.

bolts. However, this bolted-on construction, in spite of its successful use for many years, has largely been superseded by other constructions.

Spot welding of bars and end rings on the electric-welding machine, Fig. 103, does away with drilling and tapping, there are no spring washers, which under the influence of excessive heat, lose their temper and no longer fulfill their purpose. The bar is welded to the ring over the full width of the latter, which the writer considers a far better construction than the joining of bars and rings by welding on a third piece at the outer end of bars and ring; under the influence of vibration the ring with this construction is likely to break away from the welded-on connecting piece.

Method of Welding

With this electric-welding method an excellent joint can be made either for brass or copper. In the process a strip of fusible material about 0.020 in. thick is laid between the two parts to be welded, borax is used as a flux, and heat pressure is applied through upper and lower carbons similar to the usual method followed in spot welding. The term welding, strictly speaking, applies only where two metals fuse themselves together without an intermediate, fusible material. However, it is well-known that copper parts due to their tendency to oxidize are joined together much more securely if deoxidizing intermediaries such as brass, silver solder, etc., are used. The melting point of these materials, around 800 deg. C., is, of course, far in excess of service requirements; hence the process is more correctly an electric-brazing or hard-soldering process, even though in some constructions the impression may be created of an actual flowing of copper by the use of copper alloy as a spelter, particularly if compounded in low-melting proportions.

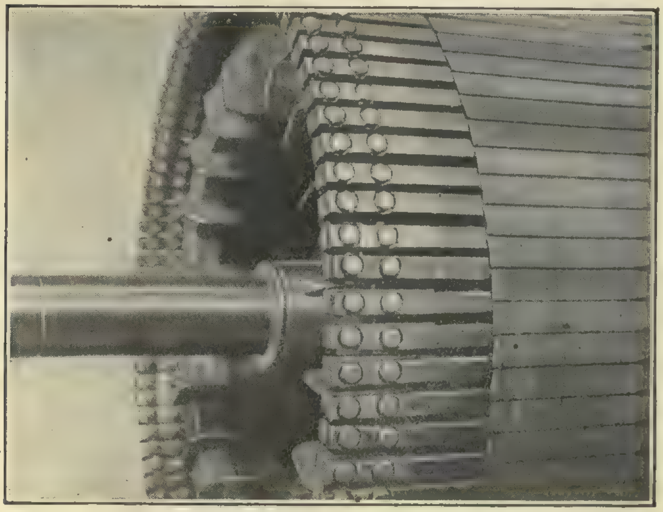


FIG. 101. EARLY TYPE OF SQUIRREL-CAGE ROTOR, BARS AND END RING BOLTED TOGETHER

For the smaller sizes of rotors a simple construction shown in Fig. 104 has been used, and to a certain extent is used today. The resistance rings consist of segments punched from sheet copper or brass and have holes at their outer ends to match the rotor bars. These segments are then pressed tightly over the bar ends and built up in staggered form until a ring of the required cross-section is completed. This work is done on an arbor press, Fig. 105, and the ends of the completed rotor are then upset and dipped into a solder pot, Fig. 106. The solder is not relied upon to make the contact between rings and bars, this is obtained by the press-fit, but the solder is intended to protect the joint from dirt and from oxidization due to atmospheric influences. These rotors have been successful for the smaller sizes of motors. On the larger sizes, where overheating of the ring and throwing of solder, with consequent damage to the primary winding is likely to occur, the use of low melting-point solder even in this form is undesirable.

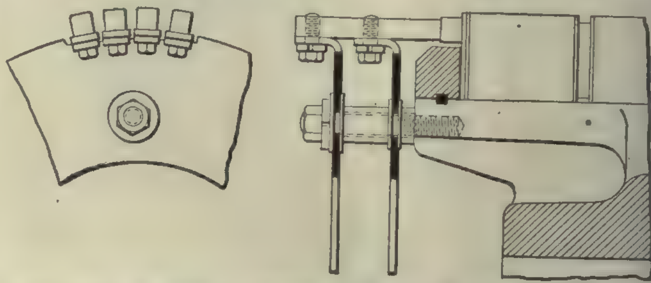
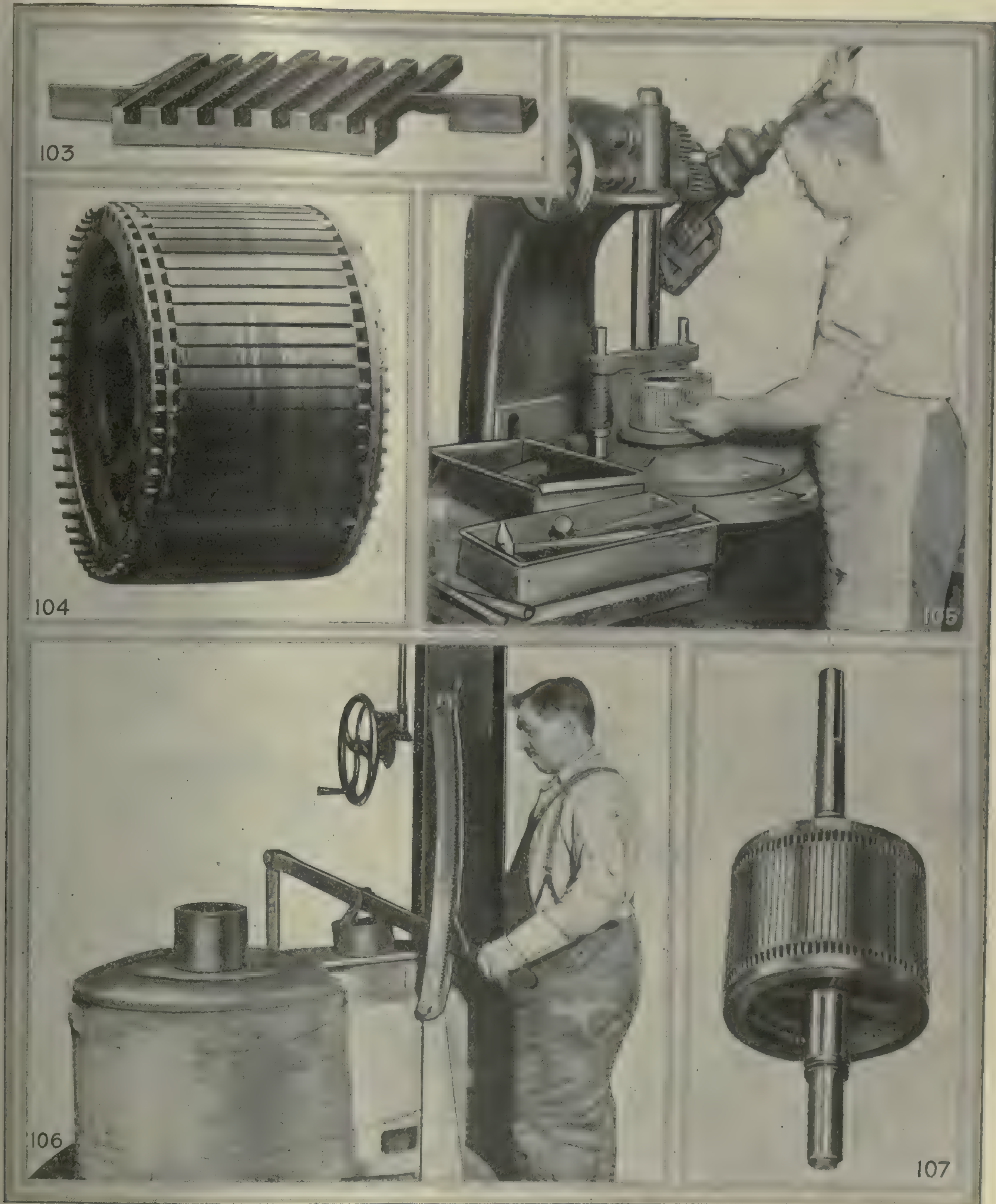


FIG. 102. PARTIAL VIEW OF SECONDARY WINDING, SHEET-METAL RINGS BOLTED ON

A considerable advance over this construction was made in 1911, by a practically fireproof and indestructible rotor, Figs. 107 and 108. Instead of the paper insulation around the bars, a fireproof, oilproof, and waterproof cement is used in the rotor slots. After imbedding the bars the whole rotor is baked in ovens at about 150 deg. for 12 hours. The resistance rings are again of cast materials as in the earlier construction, but are cast directly onto the bar ends. There are no bolts and spring washers to work loose and result in poor contact, and the bars fuse directly with the molten copper or brass, in pouring the ring. A reason for this method, apart from manufacturing considerations, lay in the fact that with modern rotors and their high performance the best design electrically can be obtained only through the use of a large number of bars. With bars only ⅛ in. to ¼ in. thick, bolting-on or even electrically welding is no longer practicable, but the casting process is independent of both the size and the number of the bars.

Difficulties in Testing

This has been realized by many manufacturers in this country and abroad; many have tried casting, mostly with brass which is easier to cast, rarely with copper. But one large manufacturer only, has had the persistence and resources to solve the difficult problem which lay principally in controlling the pouring temperature and shrinkage of the metal. As the metal in the ring cools, the ring diameter tends to decrease; and if prevented from shrinking by a large number of stiff bars, cracks in the ring will result. This has been overcome, partly by ingenious construction of the bar ends; partly by foundry methods which we are not at liberty to state in detail. Further, if the metal is poured too hot it is likely to burn the bars, and if poured too cold imperfect fusing will result. These difficulties have been overcome by the installation of temperature-controlling devices and the rigid training of men. A great deal of time and money have been spent in developing this



FIGS. 103 TO 107. MANUFACTURING METHODS FOR ROTORS

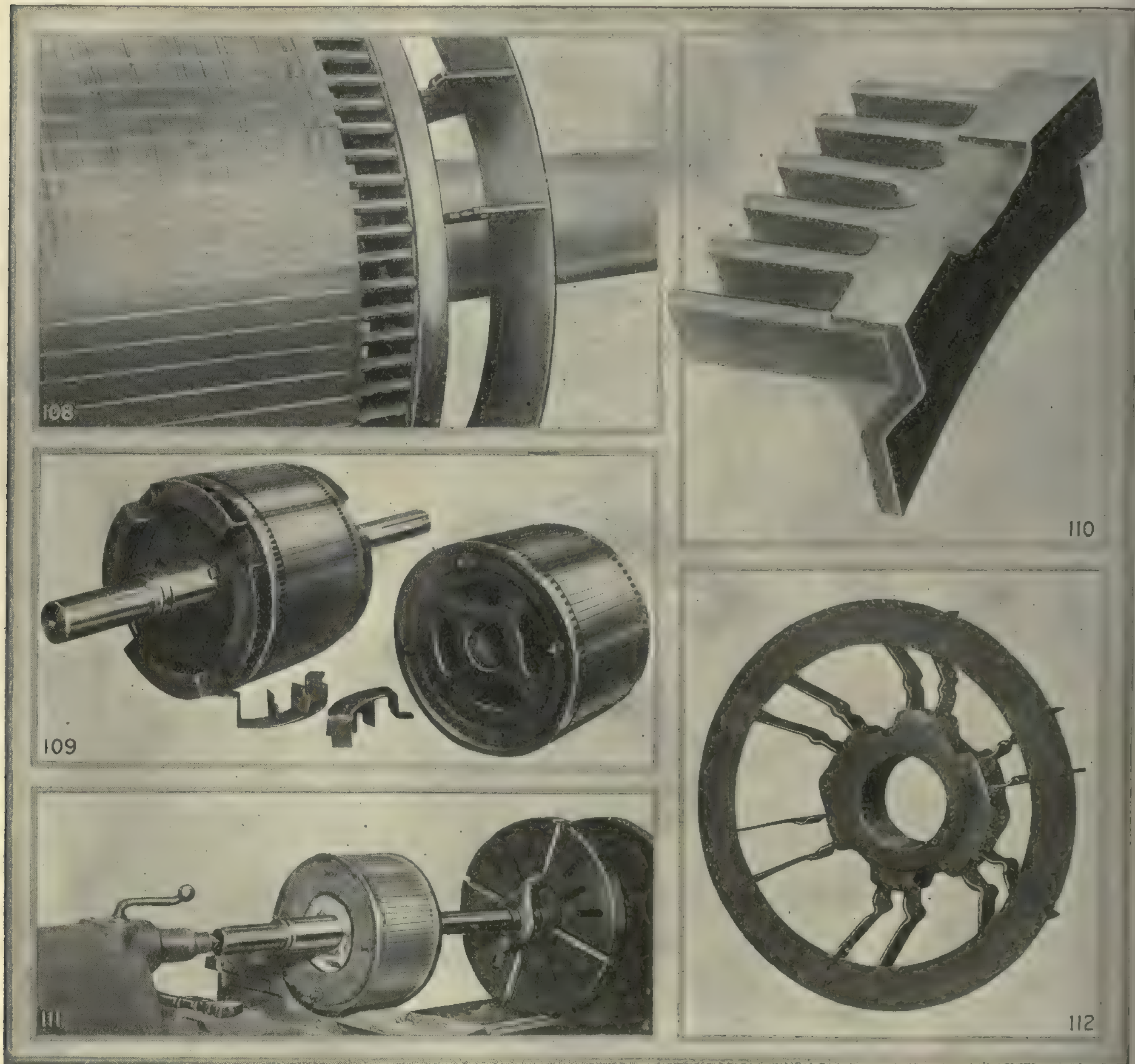
Fig. 103—Electric welding of rotor bars and end rings. Fig. 104—Pressed-on, segmental type of end rings for smaller sizes of motors. Fig. 105—Arbor press for pressing on segments. Fig. 106—Soldering segments. Fig. 107—Rotor with cast-on, resistance rings, complete

process, with the result that many thousands of cast rotors have been in satisfactory service for many years. However, art in engineering and manufacturing methods does not stand still.

The high cost of the cast-on type, and the element of workmanship entering into its manufacture have been disadvantages. It is difficult also to detect on inspection incipient cracks or flaws and to observe brittleness if such has occurred in the bars by too rapid cooling from high temperature. What is needed today in manufacture is a foolproof construction. An efficiency of 99 per cent. may seem high, but if one piece out

of every hundred should fail in service with a production of thousands every month, a very serious condition would arise, both in production and the reputation of the manufacturer. The fact is that efficiencies far better than that are obtained and the difficulties of achieving this are not always appreciated by the buyer, even though he himself may be a practical shop man.

These demands for an absolutely safe construction have been met in the latest construction of rotors by a semiautomatic brazing process which has not been described heretofore and which is thoroughly covered by patents. We depend more on the conscientiousness of the workmen than we do on this new brazing process, which permits the operator to watch the melting and flowing of the spelter at every bar. The heat of the furnace is definitely fixed, the spelter is not fed in by hand but lies in a fixed position on the work and in such a way that all the surrounding parts have to come up to the proper welding temperature before the spelter flows. This uniform heating and uniform slow-cooling is another very essential point of superiority of this construction as it does not permit a melting heat at one point and cold metal a few inches away, a condition which would cause changes in the structure of the material, and result in brittleness and the possibility of breaks. The rings in this construction are pressed from sheet copper or brass and have a groove all around the outer edge, and are then bolted to the rotor core with the bar ends engaging the groove. The spelter which fills the space between the bars in melting, is the result of an exhaustive study of the best chemical composition for a material which combines when melting, the best fusing qualities with strength and free-flowing. The melting point of this special material is around 850 deg. C., and inasmuch as no paper or cement is used, the rotor, bars and slots being so proportioned



FIGS. 108 TO 112. VARIOUS PARTS AND OPERATIONS IN MANUFACTURING ROTORS

Fig. 108—Rotor with cast-on, resistance rings, detail view. Fig. 109—Brazed rotor winding (right-hand half). Fig. 110—Sectional view, showing brazed end ring construction. Fig. 111—Turning of finished rotors. Fig. 112—Cast-hub type of blower

as to give a drive fit of the bar in the slot, this rotor would in fact withstand any temperature below that of the melting spelter. No paper insulation is there, likely to chafe away, nor cement to come out under vibration. A possible shifting of the rotor bars in service is prevented by 8 to 12 bolts which pass through the resistance rings into the core; and to guard against a loosening of these bolts or studs they, themselves, are brazed on in the brazing operation. From all indications it seems fair to assume that with this construction the ultimate rotor design has been reached. A number of these rotors have been put in service during the last two years, in particularly unusual conditions; service conditions under which no other rotor winding has stood up any length of time—as in heavy electric traction work and certain steel-mill applications. In all these cases the brazed rotor construction has stood up successfully. In Fig. 109 one of these rotors is shown. Fig. 110 is a sectional view showing the details of this construction. The construction of the special furnaces used in this process is the result of a thorough study of all the known types of furnaces which might be suitable for this work, whether gas, electric or oil operated. After brazing, the shaft is pressed into the rotor core and the core surface and outer diameter of the resistance rings turned or ground accurately to gage, Fig. 111.

Blowers Used on Alternating Current Motors

In connection with rotors it is desirable to call attention to one or two types of blowers used principally on alternating current motors. In Fig. 29 of a preceding article the direction of air current through the stator was indicated. This air current is produced by blowers mounted either on the rotor shaft or on the rotor itself. Fig. 112 shows a blower of the cast-hub type. The vanes and shroud are punched from sheet steel, assembled by riveting, and then cast into a hub which is bored and keyseated to fit the motor shaft. This construction is strong and at the same time light; it requires, however, a considerable amount of labor in punching, assembling and machining; and further, the casting-on of the hub is not the most desirable operation.

Molding Manhole Frames

By J. V. Hunter

The features for the efficient molding of manhole frames described on page 560, Vol. 47, might give the foundryman some trouble if he attempted to apply them to other forms of frames that are a common problem in some foundries. The handling of the problem, where a specially constructed cope is spoken of as being necessary for lifting the deep pocket of sand in the center of the pattern, is entirely unnecessary, as this can be much better taken care of by the loose sand-cheek method as shown in the illustration.

Many of our manhole designs are not as simple as those described in the article referred to; nor will many designing engineers permit the removal of the ring on the under side of the base, since for work in connection with electrical conduit construction, where a fairly water-tight manhole is desired, these rings are set down into a thin concrete grout as an aid in making a tight joint. Personally, I would have some misgivings as to the ability of the molder to set in 6 loose cores, and ram them into the sand in a manner that would produce a satisfactory ring which would be free from the danger of rocking and accident.

The manhole frame shown in section in Fig. 1 is of a class where the peculiar shape of its base and the additional ring on the lower face of the base will not permit it to be poured in an open-top mold, as open-top molding produces very ragged looking castings, and necessitates the very careful leveling of the mold drag, if any sort of evenness is to be obtained in the thickness of the flange. The manhole, shown in Fig. 1 is in position on a special follow board, which has been laid down for ramming up the drag. Note, also, the stool *S*, resting in the center of the board with its

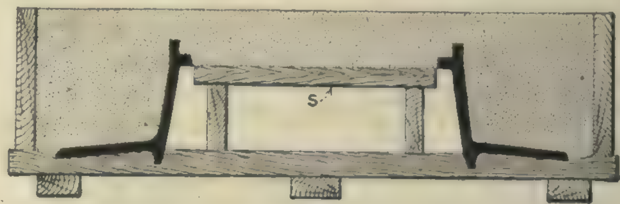


FIG. 1

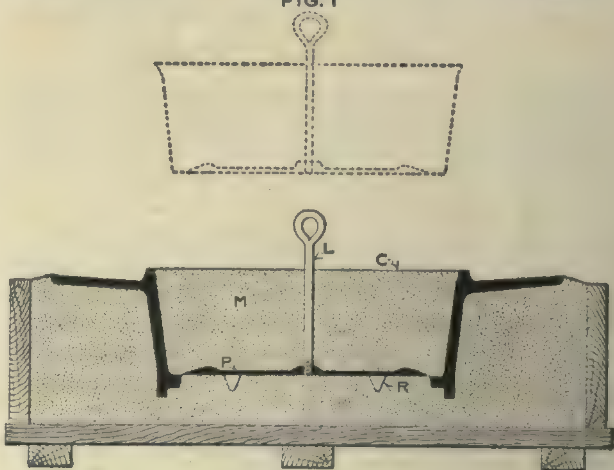


FIG. 2

FIGS. 1 AND 2. MOLD FOR MANHOLE FRAME

top face level with one edge of the cover ring; this will form a parting at this point without going to the labor of digging out all of this sand after the drag has been rolled over.

In Fig. 2 the bottom board has been laid on, and the drag rolled over; then the thin cast-iron plate *P* as shown in section is laid in place. This plate is of circular shape, only a fraction of an inch less in diameter than the frame opening, and has been drilled and tapped in the center for a good stout eye-bolt *L*. On the bottom of this plate are tapered lugs *R* about 2 in. in height. When this plate is laid in place these lugs are pressed firmly down into the sand bed until the plate itself comes down to the parting line. The plate should have a coat of clay wash on its upper side.

This center portion of the frame pattern is now rammed up with sand (the eye-bolt should be in place during this operation), and the top dressed off for the cope-parting as shown at the line *C*. Now, the eye-bolt is removed and the hole covered with a piece of cardboard to prevent the sand of the cope from filling it while the cope is being rammed.

Finally, when the cope has been rammed and removed, the eye-bolt is again inserted, and after marking the

upper surface of the cheek M to insure its replacement in the same relative position, a light crane will lift it out by means of this eye-bolt.

The pattern is now free for removal without sand interference, and following any necessary cleaning of the mold the cheek can be lowered into place. The small taper lugs R, previously mentioned, are of service during the replacement of this cheek, for they act in a way similar to the pins on a flask, and in this case serve to guide the cheek back into exactly the position that it occupied before removal.

It will be noted that the method just described gives a complete green sand mold. The nature of the support of the cheek should always insure its successful removal with but a minimum amount of patching required on the mold. It can be equally well applied to the manhole frame with vertical sides, as described in the previous article, or to the frame with receding sides as shown by the illustrations in this article, which in turn could not be handled by the previous method without coring the whole inside of the frame because of its very apparent backdraft at this point.

Status of the Engineering Department

By ROBERT G. PILKINGTON

The executive department should not seek to usurp the functions of other departments; neither should any one department be given undue prominence over another, but all should work together, that the product may represent their collective knowledge and ability.

NOT long ago I had an interesting conversation with an experienced motor car friend who had recently resigned a position as general manager of a firm engaged in this line, and one of his casual statements made a lasting impression on my mind. He said, "We made our chief engineer use a certain standard size of drawings." The question which immediately suggested itself to me was, why should any executive outside of the engineering department assume the authority to dictate the standard size of drawings?

I must, of course, speak as the partisan of the engineering department, but there is no reason why even a partisan should not consider the viewpoint of coördinating departments. What I emphatically wish to urge is that these departments should be coördinating, and that if the engineering work is worthy of the name, it should not be subordinated to the views of either the sales or production departments. It should work hand in hand with them as a matter of course, but I have always believed that the motives which actuate both the sales and the production departments, are almost diametrically opposed to those which actuate the engineering department.

While each of the former departments want the product to be made as cheaply as may be, the reasons which they advance for it are somewhat different, and both may be opposed to the use of good engineering in the design. The sales manager insists, almost as a *sine qua non,* that the cost of production be kept so low that he can make a fair profit and still undersell his competitor if sharp bidding becomes necessary. The production manager wants no materials that are difficult to work, no large or difficult pieces to jig, and in short, he is in some cases willing to go to almost any length to control the design in order to serve the ends of the production department. It is only fair to say that this does not often happen, but when it does, it involves a loss to the stockholders that is hard to trace.

If new equipment of importance is desired, the engineering department should be called into consultation early in the buying negotiations; and if the engineering work upon the new material is weak, the purchasing department should look elsewhere before buying, even though the desired product is for the production department; this, to be sure, being true only if there is a choice, and the production department does not insist upon a certain make.

It is certain that no product can be successfully marketed if the engineering, production, and sales departments do not work together enthusiastically to the same end; but since the means by which the other departments reach that end are so different, one from the other, the engineering department must not only produce a design that is recognized by competitors as good engineering, but the chief engineer must be tactful enough to satisfy the legitimate demands of both production and sales departments.

A competitor's product may be so good that the sales department may want to enter the same market and imitate the competitor's product as closely as may be wise or proper. The only proper place to begin work is in the engineering department. It is emphatically not the duty of the sales, nor yet of the production department at this stage of the work, to attempt to analyze the competitor's design. Neither the work of the sales department nor of the production department is such that the ability to analyze design is developed, but if an attempt is made to market a new design, no matter how careful the analysis of the engineering department, without the most intimate consultation with both the production and sales department, there is grave danger of trouble and possible failure.

It is admittedly the tendency of the engineering department to make a product as good as it possibly can be made, and it is nothing but experience that teaches the chief engineer the proper point at which to begin to compromise. Very few new designs are laid out and carried to the point of revealing—if the production manager is called into consultation as he invariably should be—details of very costly, or even impossible manufacture.

One sales department may know from the reports of its road men or the branch managers that a competitor is selling where it should sell. Why is the competitor able to do it? In very few cases is the sales manager able to diagnose the case. He may know superficially that the competitor's price is lower than his own, but

what causes the difference? Taking it for granted the difficulty does not lie with unwise selling expense, then the trouble is caused either by the production expense or by an expensive design.

Unless the competitor's design is laid out on the drawing board and compared in detail with the one that is causing loss, there is no authoritative way of finding out. Many a time I have been called into consultation as to what the cause might be of a competitor's ability to undersell, and it would be found upon close analysis to be one of the most innocent looking details, but one upon which hinged a whole series of other operations.

Time after time I have submitted designs to the production department, designs of which I was proud, and have had the cold white light of the production methods show me that the work was as good as wasted. Again, I have produced a design that would stand the criticism of both the engineering and production departments, only to have the sales department show that we would be undersold by one competitor and beaten in design by another.

To sum up: the engineering department should not be subordinated to any other department, if the engineering part of the work is of enough importance to affect the total. If the general manager is the chief executive officer, and he wishes to bring out a new product, he should be above dictating to the chief engineer what the size of his drawings are to be. Drawings are, first and foremost, made for the convenience of the production department, and there is no paramount reason why the manager should be vitally interested, while there are several reasons why the chief engineer may want to dictate the sizes.

Best Procedure

When a concern determines upon a new product, the best method of procedure is for the general manager to call into consultation the heads of all three departments, and go into the reasons for entering the market. He will probably call attention to what is furnished by competitors, and to their good points as brought out by reports from users and the sales department. He will say that, since the competitor is already in the market, and it is to be a job of sharing with him, the price should be placed a little below the competitor's, if possible. But as to how the low price shall be made possible, he will not say if he is tactful. Generally speaking, he will not know at first hand.

It is here that the analytical art of the chief engineer is called upon to prove its value. His design will be the result of a careful digestion of all available information compiled from other catalogs, from the work of the product while in use, and from the opinions of the users. Personally, I always get the last information first. Nobody knows the actual value of a product as well as an intelligent user. As an example: a couple of improved types of hairpins have recently been put on the market after several hundreds of years' use of the old types. If I were the chief engineer of a company that proposed to put on the market a competing hairpin, I should be apt to lay considerable stress on the importance of getting the views of many users, to study how they got them into their hair, how well they stayed, and what made them fall out the oftenest; but I would not feel that the views of the production manager were for serious consideration at this time.

The sum and substance of the whole thing is that the methods of organizations are growing with the evolution of society. Very few general managers now consider it necessary to so far interfere with the details of any department as to say what the sizes of drawings shall be, whether the production manager shall use carborundum, crystolon or emery wheels, or whether the sales manager shall employ male or female stenographers.

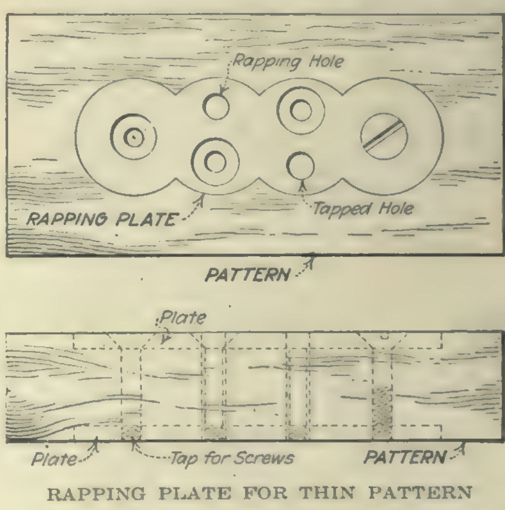
In the manufacture of a new product, it is never safe to allow any one man's views to control the work at all stages of the preparatory work. The ultimate result should be an embodiment of all the information that can be obtained, but it is very much the duty of the general manager to coördinate it. His skill in selecting the final method or style, and his tact in putting forth satisfactory reasons in case of dispute, will be the measure of his success.

Rapping Plates for Patterns

By M. E. Duggan

Some patternmakers might call the following an expensive way of attaching the wrapping plates to a pattern when only a few castings are wanted, but rapping plates are only put on very large patterns and standard patterns from which a large number of castings are to be produced.

Attaching a single plate with screws to a pattern which is thin in section, is a rather difficult job for the patternmaker, as it soon works loose. The proper method is to put two plates on thin patterns in the manner shown in the sketch. The plates come in pairs:



RAPPING PLATE FOR THIN PATTERN

plain holes in one, tapped holes in the other, secured with brass screws screwed into the wood and plate.

The writer suggests to makers of rapping plates that stock plates be made with holes for wood screws in the outer circles; the inner circles having one hole for rapping and one tapped hole for lifting. To attach the plates more securely, without increasing their size, they should be made with four holes instead of two for the wood screws, thus doubling the security of the plate to the pattern when only one plate is put on. The zigzag position of the holes prevents splitting the wood.

Lubrication of Ball Bearings—I

By OTTO BRUENAUER

Before setting forth certain definite rules and suggestions for the lubrication of ball bearings, it might be well briefly to point out some of the principal characteristics of oils and greases as affecting lubrication under various conditions.

OIL may be of a vegetable, animal or mineral base. For purposes of bearing lubrication of any kind nothing but mineral oil should be used, for the principal reason that both vegetable and animal oils contain or develop acid which, of course, is most injurious to any form of bearing. Since it is the purpose of lubrication to decrease friction in a bearing, and at the same time keep its surfaces bright and polished by protecting it against rust and other damaging influences of acid, it is obvious that lubricating oil must be and remain perfectly free from acid. Castor, rape, linseed, cottonseed, and other vegetable and all animal oils will easily gum up, and become sticky and rancid. Mineral oils of hydrocarbon base, on the other hand, readily can be refined into a perfectly durable product which is free from any trace of acid. This is being done by a chemical process of eliminating all unstable hydrocarbons, sulpho-compounds, and other impurities.

Since the total absence of acid in the lubricating oils is of such vital importance for the proper and permanent function of bearing, it is advisable to test the oil for presence of acid. There are two simple and reliable methods for finding acids in oils. The first is called heat test, and may be conducted as follows:

A clean bottle is filled about half full of oil and heated over an open flame. Depending upon the flash test of the oil (which term is explained later on), the heating must be continued up to a certain temperature at which yellow vapors will appear above the surface of the oil. At this temperature the heat should be held for 15 min. The oil will have darkened in color, but should remain perfectly clear. There should be no sediment after 24 hours' standing. If the oil turns black, however, and forms a sediment after standing for 24 hours, this may be taken as proof of the presence of sulphuric acid compounds.

Another method of testing hydrocarbon oils is the emulsion test: take a 6-oz. bottle and put in 2 oz. of water and 2 oz. of the oil to be tested; cork the bottle and shake it thoroughly for half an hour; let it stand for 24 hours. If the oil stands clearly separate on a line above the water, and the latter remains perfectly clear, there is no acid in the oil. If, however, there appears a curdled mass between the oil and milky colored water, this may be taken as a proof of acid compounds being present.

Having ascertained the required purity of the oil, we must consider some other qualities for its proper selection as a ball bearing lubricant, which will depend largely upon the speed as well as upon the temperature to which the bearing (and the oil) will be exposed. For the accurate definition of the desired characteristics of a bearing lubricant, the following terms are used, which are herewith briefly explained.

Viscosity: Syrup is highly viscous for instance, whereas gasoline is extremely non-viscous. Viscosity of a liquid is expressed as "the number of seconds required for a definite volume of oil under an arbitrary head, to flow through a standardized aperture at constant temperatures," or, "an empirical expression of the molecular cohesion (internal friction) of fluids." The viscosity test is made at a temperature of either 100 deg. C. or 212 deg. F.

Gravity: The gravity of oil is the ratio of its weight to an equal volume of pure water.

Flash: When oil is heated vapors will arise. The flash test of an oil is the lowest temperature at which these vapors can be ignited without setting fire to the oil itself.

Fire Test: The fire test of an oil is the lowest temperature at which it will ignite from the flame of its vapors when the flash test is made.

Cold Test: The cold test of an oil is the lowest tem-

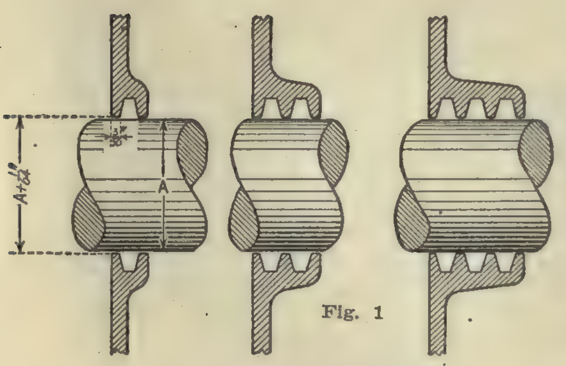


Fig. 1

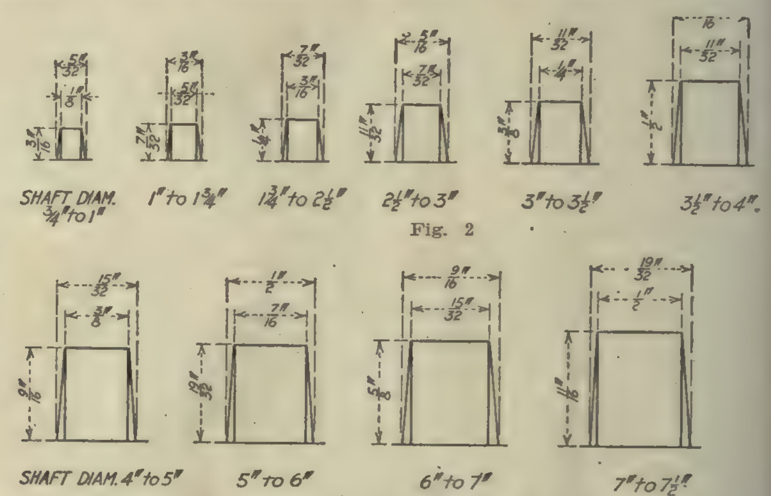


Fig. 2

FIGS. 1 AND 2. GROOVES ON THE INSIDE OF THE HOUSING AND SOME OF THE SIZES USED

perature at which it will pour or flow through pipes without pressure. No conclusion should be drawn from the cold test of an oil as regards its lubricating qualities.

With reference to the speed at which a ball bearing is to be run, the viscosity of the lubricating oil is certainly an important consideration. The higher the speed of the bearing the less viscous must be the oil. At speeds exceeding 5000 r.p.m. the correct viscosity of the oil becomes a matter of vital importance. If the oil is too heavy, it will offer sufficient resistance to the balls plowing through it to heat up the bearing.

With reference to the heat and cold test properties of oils for ball bearing lubrication, but little need be said. Ball bearings made of highest grade materials will in nowise be effected by temperatures up to 250 deg. F. Since none of the oils suitable for their lubrication have a flash test of less than 300 deg. F., this characteristic becomes one of minor importance.

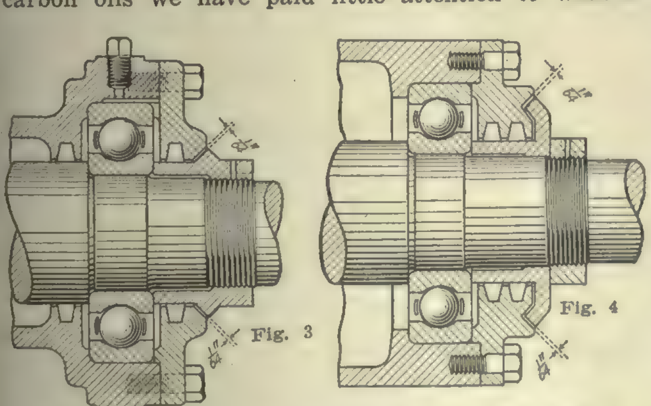
The cold test, on the other hand, deserves consideration only if the ball bearings may have to be operated at very low temperatures, under which the oil in the lubricating chamber surrounding the bearing becomes too stiff properly to perform its function. Since it is being fed through pipes only under high-speed conditions, the cold test in the full sense of its meaning becomes important only when such high-speed machines are operated at temperatures considerably below normal.

The following table shows the various physical characteristics of ball bearing lubricating oils in appropriate relation to varying speeds. Oils whose characteristics come reasonably near to the values in the accompanying table may safely be used:

Physical Characteristics	Speed of Ball Bearings in R.P.M.				
	1,000 to 2,000	2,000 to 4,000	4,000 to 8,000	8,000 to 12,000	12,000 to 50,000
Viscosity	150 at 212 deg.	102 at 212 deg.	192 at 100 deg.	140 at 100 deg.	60 at 100 deg.
Cold test	40–60	34	27	25	20–25
Flash test	530	475	400	390–400	335
Fire test	615	550	.....	.....	.....
Gravity	25.3	26.5	28.1	28.5	32

Grease, Semi-Fluid Oil and Compound as a Bearing Lubricant

It will be remembered that while speaking of hydrocarbon oils we have paid little attention to what is

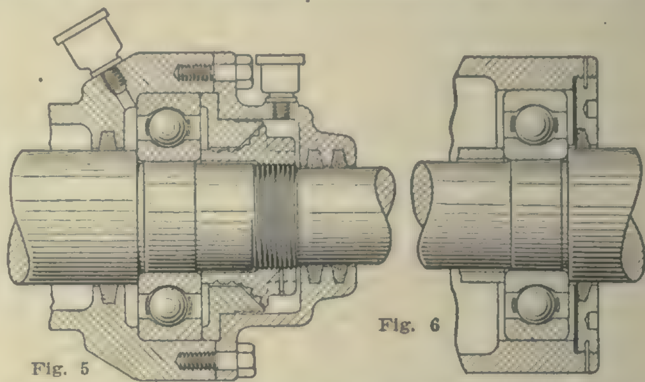


FIGS. 3 AND 4. TWO TAPERED FLANGES AND A VARIATION OF DESIGN

called lubricating qualities. This, for the reason that all mineral oils possess lubricating qualities of the highest order, and no apprehension need be felt in this respect. Grease and its relatives, called semi-fluid oils and compounds however, must be carefully tested for their lubricating qualities and presence of free alkali in addition to testing them for acid.

Let us first consider the greases. They are manufactured by saponifying fatty oil in the presence of water. This soap is formed either from mineral or vegetable oil by the addition of a caustic. Then a hydrocarbon oil is added to form a cup grease, the varying amount of the latter making a soft or hard grade of grease.

Great care and experience is needed in compounding the soap. If this is not correctly done, free alkali will be present in the grease. Alkali will pit or etch the



FIGS. 5 AND 6. A GREASE AND DIRT SEAL AND AN ARRANGEMENT FOR SEALING WITH FELT

surface of steel in practically the same manner as does an acid. The lubricating qualities of a grease depend largely upon the proportion of soap and hydrocarbon oils. The less soap is used the better will be the grease from a lubricating standpoint. Cheap greases contain much soap, often a filler, and likely as not have been compounded with a cheap gas oil on the order of kerosene. Unfortunately, the appearance of the finished article does not permit any definite conclusion to be drawn as to its quality. It is, therefore, advisable definitely to ascertain the analysis of any grease that is to be used for ball bearing lubrication before adopting it as a lubricant or recommending a certain brand to be used.

An easy way of testing grease for the presence of acid or free alkali is to cover a highly polished steel surface with the grease and expose it to the sunlight for about two weeks. If the grease contains either one of these injurious elements, the surface of the steel will show etchings or pit marks.

Another danger to the bearing is hidden in all greases. They contain, as we have seen, more or less combined water. If certain temperatures are met with, this condition will cause the soap and hydrocarbon oil permanently to separate. The soap is for our purposes a nonlubricating matter. It will clog up part of the surfaces of the races and balls, and actually protect them against lubrication by the free oil, providing the latter does not readily run out of the bearing housing, which usually is none too oil-tight if designed for grease.

This separation of the grease of a cheaper quality often takes place at 115 deg. to 125 deg. F. For ordinary conditions of bearing lubrication a grease should not separate at temperatures lower than 175 deg. or 200 deg.

Semi-fluid oils are compounded in the same manner as grease, with the only difference that a very much smaller quantity of soap is used in combining it with the hydrocarbon oil.

Compounds, often called gear compounds, are made by blending a sponge with a high quality hydrocarbon oil, selected for its suitability for this purpose. The sponge consists of fatty oil, saponified with sodium or potassium hydroxide in the presence of water. All of the water, in turn, is then boiled out before the hydrocarbon oil is added. Various proportions of these constituents will produce a compound of light, medium, or heavy weight, which when heated becomes fluid and returns to its original consistency when allowed to cool. These compounds are as a rule good bearing lubricants, providing they are not made of a mixture of paraffin wax and oil. Paraffin wax has absolutely no lubricating qualities.

Graphite an Excellent Lubricant

Graphite, if very finely deflocculated and added in proper proportion to a grease or oil, is an excellent lubricant, in that it forms a tough and enduring film over the metallic surfaces. For this reason, it is highly recommended for the lubrication of gears. As applied to ball bearing lubrication, however, its value is at least doubtful, and quite often decidedly detrimental results have been obtained. The principal causes seem to be the difficulty of dividing the graphite into small enough particles, and then of blending it in the right proportion with oil or grease. The experience of the writer is offhand proof that graphite greases and compounds marketed today for the specific purpose of combined gear and ball bearing lubrication, are far from giving uniformly satisfactory results.

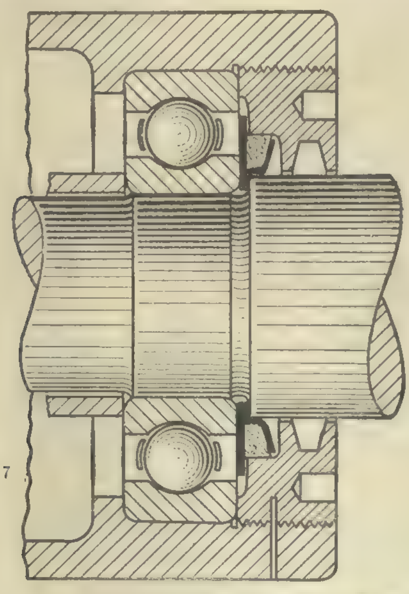


Fig. 7

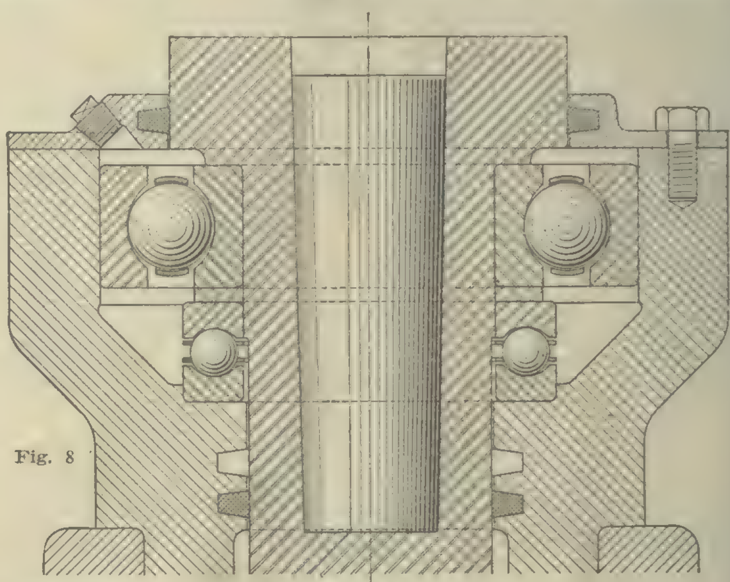


Fig. 8

FIGS. 7 AND 8. SEALS FOR USE IN A LIMITED SPACE AND ON A VERTICAL SHAFT

Graphite Gear Compound

In the transmission of an automobile, where principally radial loads on the ball bearings obtain, graphite gear compound, recommended for this purpose by the manufacturers, showed not the least injurious effect upon the bearings after 6000 miles. At this time, however, the ball thrust bearing in the steering gear became locked, after having offered for some time previously great resistance to rotation. Its lubrication had not in the least been neglected. The ball races showed at regular intervals around their surfaces, accumulations of graphite in the form of little mounds, apparently caused by the balls piling it up and packing it down harder and harder every time a turn of the wheel was made, until the balls become finally locked.

Ball bearing manufacturers have made repeated tests with graphite lubricants, and the results were far from being uniform. Some stated that the graphite seemed to act as an abrasive, causing wear of the ball races, whereas, others had quite satisfactory, or at least no detrimental results. In view of these varying experiences, it does not seem opportune at this time to recommend graphite as an adjunct in ball bearing lubricants, much as it is to be desired that ball bearings should benefit from its peculiar action in the same manner as do gears.

Lubrication for High Speeds

Any grease or compound which does not possess those qualities as have been previously pointed out as detrimental or injurious to ball bearings, may be used for their lubrication at speeds up to 3000 r.p.m. For higher speeds oil lubrication must be employed.

As we have seen, it is easier and more reliable to specify and test an oil than it is to make sure about the proper qualities of a grease. Oils having adequate characteristics can be used as ball bearing lubricants under all possible conditions. Greases, on the other hand, are unsatisfactory at high speeds and low temperatures. However, the average conditions of speed and temperature under which ball bearings operate are such as to permit the use of either one of these two forms of lubricants. The question therefore arises: which, if either, is to be given preference? The only apparently outstanding redeeming feature of grease lubrication is the fact that it is an easy matter to retain it in the bearing housing. A little more elaborate seal is necessary to retain oil under like conditions. However, an oil used where grease would answer the purpose, must be of rather heavy body. In the majority of cases the greater expense of a suitable housing to retain oil, is a matter of consideration. The manufacturer who provides for oil lubrication of the ball bearings in his machinery, unquestionably reduces to a large

extent the dangers incident to the application of unsuitable lubricants by the users of his product. Because of the all-around greater reliability of oil, designers have begun to favor its universal application, which tendency deserves decided encouragement.

Examples of Designs for Grease, Oil and Dirt-Proof Housings

A high-grade ball bearing, if loaded within its capacity, properly lubricated, and thoroughly protected against foreign matter, is practically indestructible. Its life under such perfect operating conditions, as a rule by far exceeds that of the machine in which it is mounted. The condition of load entails only the proper selection of the size and type of bearing suitable to meet the requirements. The matter of lubrication and dirt exclusion is one not so easily solved in practice. Rarely is it possible to create ideal conditions in this respect; hence, the service obtained from the bearings depends largely upon the degree to which their operating conditions approach the ideal. It is entirely erroneous to assume that because of its low inherent friction a ball bearing will run continuously without lubrication. The so-called point contact between balls and races exists only in theory or in the imagination of the opponents of ball bearings (the wish being father to the thought). In practice, the balls contact with the races on a surface of approximately elliptical shape. The area of this surface depends largely upon the contour of the raceway and its deflection under varying loads, which again depends upon the elasticity of the materials. These surfaces, as well as the surfaces between balls and separator, must be lubricated. Still more important is the matter of excluding grit, dirt, sand, etc. These foreign substances, if allowed to enter into the bearing, act as abrasives which will quickly destroy the highly polished finish of balls and races, grind out the races to a larger diameter, and at the same time reduce the diameter of the balls. The bearing will become loose and in consequence is in the majority of cases condemned by the user because of its supposedly poor wearing qualities.

Correct lubrication and dirt-proof housing of ball bearings are therefore very important conditions for their successful employment

The simplest form of grease seal is a groove on the inside of the housing or its extended flange, as shown in Fig. 1. The groove should be at least $\frac{3}{16}$ in. deep, and the width of the lips at least $\frac{3}{32}$ in. The edges of the lips must be sharp and not rounded. The inside diameter of these lips should be turned so as to be not more than $\frac{1}{64}$ in. larger than the shaft diameter A. If such a groove is filled with grease, it acts as a resilient packing, which retains the bearing lubricant fairly well and at the same time serves to prevent foreign matter from entering into the housing.

In Fig. 2 are shown various sized grooves for shaft diameters from $\frac{3}{4}$ up to $7\frac{1}{2}$ in. They will accommodate felt sizes of such dimensions as are readily obtainable from stock, and their adoption as a standard is therefore recommended.

Nothing but the highest grade of pure wool felt should be used for felt washers. Such material will retain its resilient qualities almost indefinitely. A cheap grade of felt will soon pack and become stiff, leaving an opening around the shaft, and thus becomes absolutely worthless.

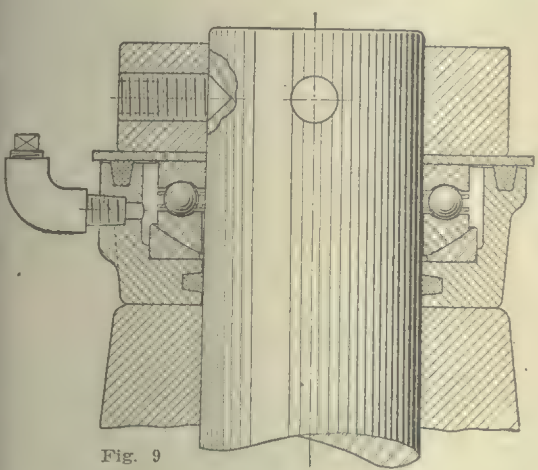


Fig. 9

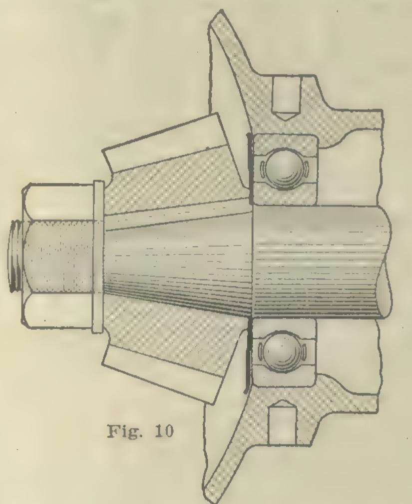


Fig. 10

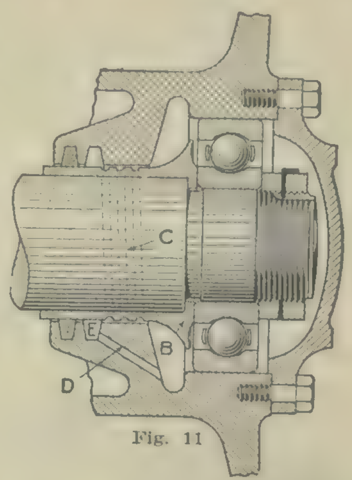


Fig. 11

FIGS. 9 TO 11. VERTICAL SHAFT LUBRICATION, THE USE OF A PRESSED STEEL WASHER AND ANOTHER FORM OF OIL SEAL

The arrangement is intended for low speeds and the use of a grease of fairly heavy body. However, it will not satisfactorily protect the bearings under severe operating conditions where grit, emery, cement, road dust or water are present in quantities, and a more effective seal will have to be designed.

In Fig. 3 is shown the use of two tapered flanges with a running clearance of about $\frac{1}{64}$ in. or less. Centrifugal force acts to throw out foreign matter which may enter between these flanges. Adjoining them is the groove containing the grease packing. A moderate overflow of grease in outward direction is desirable. On the opposite side of the bearing and inside of the housing a felt washer serves to check the overflow of lubricant in this direction. The grease is admitted through a plug hole which may be placed directly above the bearing, if the space on either side of it is limited. A sufficiently large chamber for the lubricant should always be provided on one or both sides of the bearing. An arrangement as shown here will exclude dirt rather effectively, regardless of the direction of rotation of the shaft. Where still more severe conditions must be met with, a variation of this design as shown in Fig. 4

will answer the purpose. No felt should be used in the grooves, which must be kept well filled with grease.

A still more elaborate variety of this type of grease and dirt seal is that shown in Fig. 5. The grease is admitted from one side of the bearing into a chamber of ample size, the overflow into the housing being checked by one or two felt washers. On the other side of the bearing the end cap of the housing is designed so as to leave a running clearance between it and the

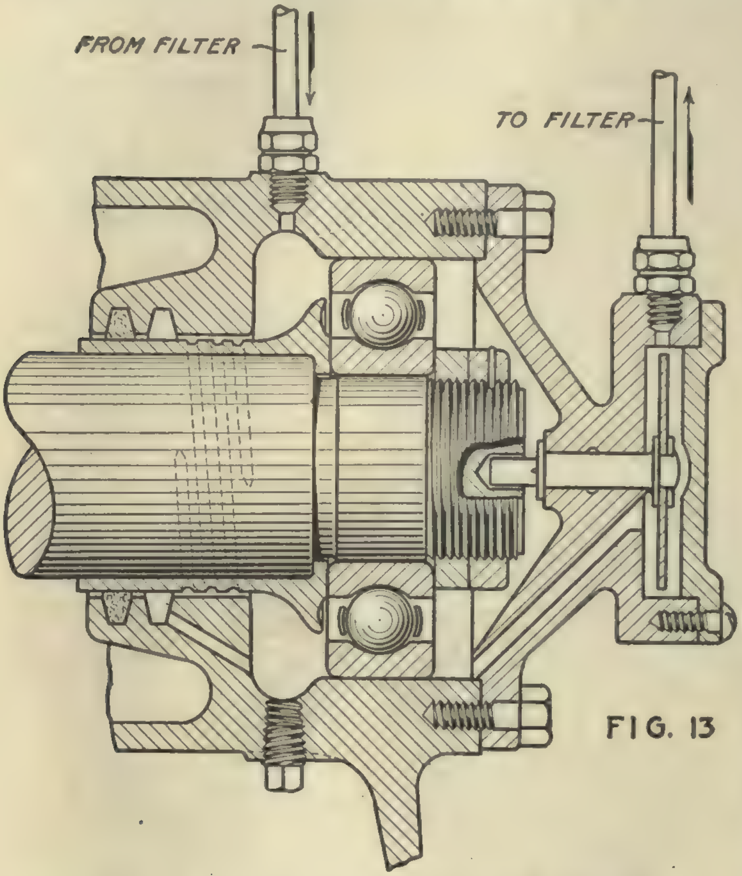


FIG. 13

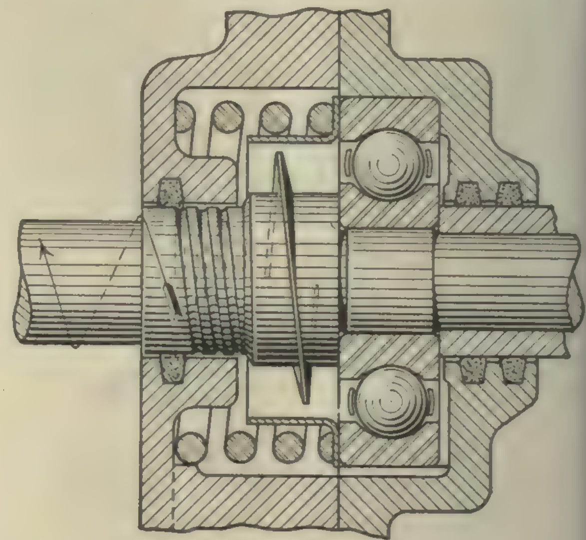


FIG. 12

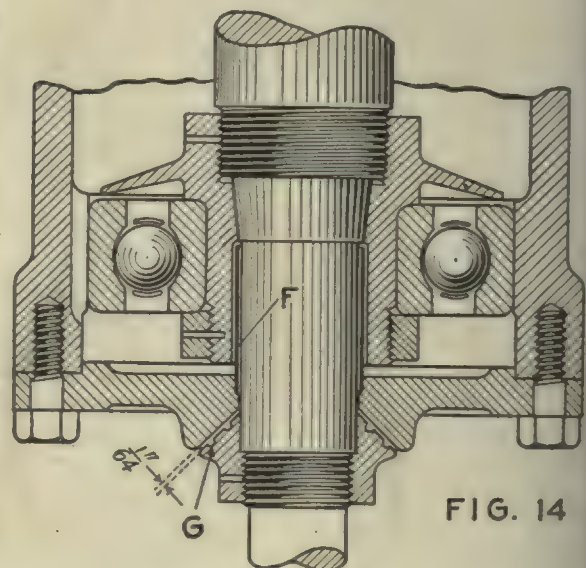


FIG. 14

FIGS. 12 TO 14. VARIOUS LUBRICATION ARRANGEMENTS

nut on the shaft. On the straight and tapered surfaces of this nut, spiral grooves are provided so as to lead away from the bearing into an auxiliary grease chamber which serves as a reservoir from which the two grooves on the end of the housing receive their supply of grease. The action of the spiral grooves sets up a slightly forced and steady outward flow of lubricant against the direction of inflowing water, grit, or other foreign matter. This design is highly effective and practically dirt- and water-tight. If the shaft rotates in an alternating direction, the spiral groove must be omitted.

Where space is limited, a felt washer may be resorted to as the principal means of sealing the bearing. In Fig. 6 is shown such an arrangement applied to a rotating shaft and stationary housing. A steel washer prevents the felt from touching the bearing and from being ground up by the separator and balls. Unless such provision is made, a felt washer will do more harm than good. Fig. 7 illustrates the same principle, with the addition of the groove as applied to a stationary shaft and rotating housing.

The method of sealing a grease-lubricated bearing on a vertical shaft is practically identical to any of the designs previously illustrated and applied to horizontal shafts. Figs. 8 and 9 show a typical application of this kind.

Lubrication of ball bearings in gear cases appears at first hand to present no difficulties whatever because of the abundance of gear lubricant present. In transmission cases, however, particularly rapid wear of the bearings is a frequent occurrence, despite the fact that the pressures on the bearings are very moderate. This is readily explained if we consider that the continuous rubbing action of the gear teeth and the shifting of the gears tend to shave off minute particles of steel which become mixed with the lubricant. These fine particles are a most efficient abrasive, and the gear lubricant if used also to lubricate the bearings, will thus supply them freely with a cutting compound and frequently with chips. Rapid wear of the bearings is a logical consequence. Quite often this condition becomes aggravated by the fact that the gear cases were not thoroughly cleansed when assembled, and more or less sand, chips, or filings were left in the bottom. The lubricant will pick these up and deposit them in the bearings. As a rule, but little thought and care are given these conditions, with the result that bearing

troubles are frequent when they could easily be avoided by lubricating the transmission bearings independently of the gear lubrication. Fig. 10 shows how to accomplish this purpose by the use of a pressed steel washer.

Where moderate speeds prevail in connection with oil lubrication, an oil chamber of sufficient capacity should be provided into which the bearing is partly

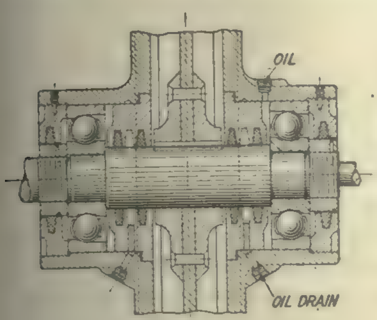


Fig. 15

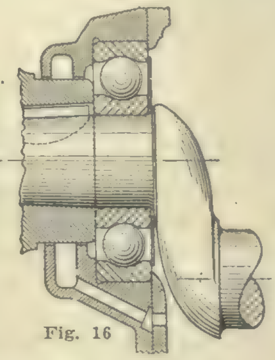


Fig. 16

FIGS. 15 AND 16. TWO FORMS OF HOUSINGS

submerged. It should be remembered that too much oil is not better than enough. If the oil seal is effectively designed, the oil level is of sufficient height if the bottom balls of the bearing are submerged. The oil should not stand up to the shaft. In Fig. 11 is shown a typical and very effective form of oil seal. An oil slinger *B* is provided which may be integral

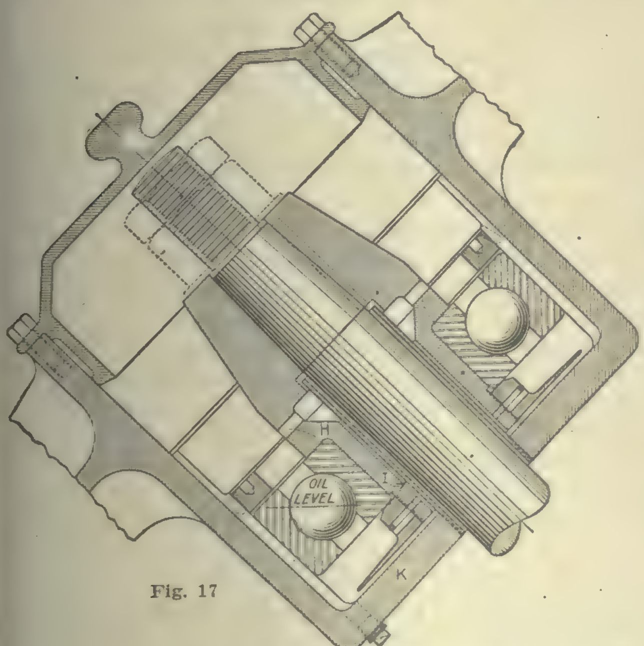


Fig. 17

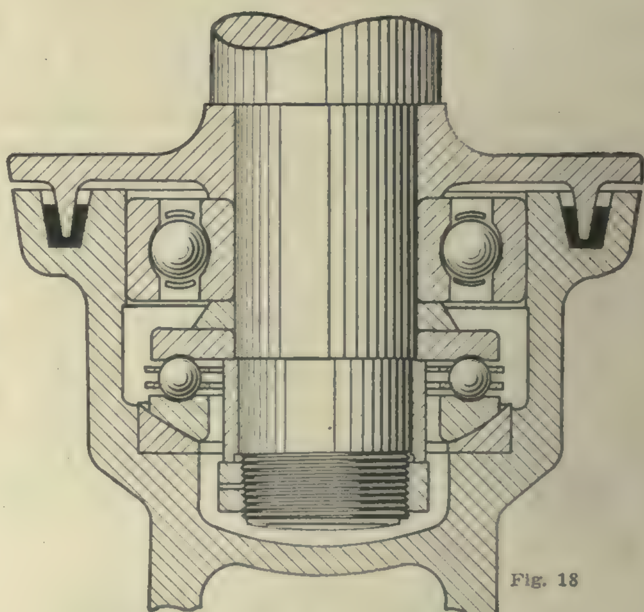


Fig. 18

FIGS. 17 AND 18. ANGULAR BEARING LUBRICATION AND ANOTHER FORM OF SEAL

with the shaft. Such amount of oil as will not be thrown back by this slinger into the chamber will be pumped back by the action of the spiral groove *C*. If for the reason of alternating direction of rotation a spiral groove cannot be employed, the by-pass *D* leading from the bottom of groove *E* into the chamber, will revert the overflow. As an additional safeguard, a felt washer is inserted into the second groove in the housing. If leakage of oil is a matter of no importance, a less elaborate arrangement may be made. Care must be taken, however, to have this leakage take place at all times in an outward direction, so as not to draw dirt into the oil chamber.

Variations of this design are shown in Figs. 12 and 13. The bearing in Fig. 12 is for high speed and is kept supplied with a stream of oil thrown up by a spiral slinger fastened to the shaft. A return-flow on the opposite side is provided for. The arrangement of an oil pump as shown in Fig. 13 may become necessary where it is impossible to keep dust out of the oil—as may be the case in suction fans, etc. The oil is pumped up to a filter and fed back to the bearing by gravity.

Fig. 14 illustrates an oil seal applied to a vertical shaft. The bearing is mounted on an adapter which is drawn up on a tapered seat of the shaft. The sleeve *F* pressed into the end cap prevents leakage around the shaft, except in the case of too much oil being supplied. The spiral groove *G* in the running clearance, acts as a dirt excluder. Where it is practically impossible to keep dirt, grit, emery, or fine abrasions of steel out of the oil, a pump and filter with gravity-feed will have to be applied as previously shown.

The housing illustrated in Fig. 15 is designed for a steam-turbine bearing mounting. Three grooves are provided on each side of, and close to the rotor. The one on the inside is packed with asbestos and the one nearest to the ball bearing with felt. The center groove remains empty and serves to collect the overflow of oil which is allowed to run out through a drain.

A simple and effective method of checking the overflow of oil from a crank case into the clutch housing is shown in Fig. 16. A flat washer is clamped between the inner ring of the bearing and the check of the crank web. It fits snugly to the outer ring of the bearing. Slight rubbing against this outer ring at the beginning will do no harm, as the washer very quickly wears down to the desired small clearance sufficiently to let enough oil in for the lubrication of the bearing.

The method of retaining the lubricant in a bearing which is mounted on a shaft inclined to the horizontal

or perpendicular, is illustrated in Fig. 17. The bearing is mounted on an adapter *H*. There is a clearance between the inside of this adapter and the shaft into which a tube *I* is screwed or otherwise fastened at *K*, into the housing supporting the outer ring. This tube should extend considerably beyond the normal oil level. A by-pass is provided in the housing as well as between inside of adapter and outside of tube. The locking nut which clamps the inner ring of the bearing on the adapter is shaped so as to act as an oil slinger.

An interesting form of seal is the one shown in Fig. 18. The housing is provided with a wide and deep circular groove filled with a very heavy oil or mercury into which extends a V-ring on the rotating member. This permits only very low speed, also an oscillating movement of the shaft. It is evident, however, that this seal will be effective if submerged in water, mud, etc.

The exigencies of the design on hand must of course govern the details of a suitable seal for the ball bearings. If the principles as shown by the foregoing illustrations are understood and followed, it will be an easy matter to design bearings that will meet any conditions which may arise in practice.

The Periods of Lubrication Depends Upon Several Conditions

The intervals at which ball bearings must be lubricated depend of course upon several conditions. Hard and fast rules cannot be given. Assuming, however, that the lubricants used are of good grade and well sealed, the user of ball bearings may be governed to some extent by experience gained under various operating conditions.

In shaft hangers, industrial motors, wheel hubs, gear cases, pumps, etc., and machines operating under similar conditions, a fresh charge of lubricant twice a year is ample. In many cases renewal of the lubricant once a year will be found sufficient. The old lubricant should be removed, the housing washed out with gasoline whereever possible, and filled with fresh lubricant. Exposure of the machine to heat will make necessary more frequent lubrication. For railway motors, journals, and such machines as are constantly exposed to the influence of weather and outdoor conditions, a fresh charge of lubricant four to six times a year is recommended.

Light oil lubrication requires closer attention, and the oil should be replenished whenever it reaches a low level.

The "Monkey-Wrench" Machinist Protests

By James Tate

In an article by Mr. Hawley, page 64, Vol. 47, entitled, "Keeping Machines on the Job," the following paragraph occurs:

"In these days of heavy mechanical production, the machinist is likely to call himself a toolmaker, and demand a toolmaker's rate in the tool department. The money-wrench mechanic is then called a machinist, the machinist's helper a repairman, etc."

Mr. Hawley has correctly diagnosed the situation, but be should be more careful in flinging his terms about, as they are likely to become poisoned arrows which rankle in the heart of the "monkey-wrench" mechanic, and provoke him to a campaign of *"Schrecklichkeit"* against those who call him names.

Joking apart, there is a very great tendency among all. classes of machine shopmen and manufacturers to class as inferior mechanics, all those grimy individuals who keep their equipment up to the mark, and who, in despite the fact that it is impossible for them to keep a white collar or apron in its original state of purity for more than five minutes at a stretch, are indispensable. Look at the order in which we are classed: toolmaker, then machinist, monkey-wrench mechanic or repairman, and last machinist's helper.

The next time Mr. Hawley or anyone in his position has a broken-down, complicated machine, let him take his 60- or 70-cent-an-hour, machinist toolmaker who can juggle "tin thousandths and sines and sich-like things," and have him go to it and repair the machine in the same time as his repairman would! I have seen cases where a first-class man on the tool bench, spent a whole day in mussing up his clean apron and shirt and sinning his soul by calling on the saints and not a few devils to help him; and who, when at last reduced almost to babbling idiocy by the crankiness of that darned machine, called in the despised mechanic—not worthy of the name of "machinist"—who put the trouble right in half an hour. Yes siree! when I have a breakdown job to be patched up in a hurry and in a way to stay—be it steam engine or sewing machine—give me the man who is in the repair business for the love of the game; and that there are "sich animiles" I know, for I am one myself, and I will guarantee a first-class job.

Of course, there are dubs of repairmen, just as there are dubs in every other line; but choose a good mechanic, which is not an impossible job if one keeps one's eyes open and studies the tribe. If you pay him decent wages and give him fair working conditions, there is something radically wrong if machines are not kept in first-class condition.

As a parting shot, the last in my quiver, I will bet that the "Original Mechanic" pictured for us in Berton Braley's fine poem, page 1112, Vol. 46, was neither toolmaker nor machinist, but a gritty, grimy repairman.

Breaking of Roughing Tools

By H. Lauterbach

On page 1049, Vol. 47, there appeared an article by Charles L. Yost, describing how he overcame the trouble caused by breakage of high-speed-steel tool shanks under pressure of the toolpost screw, and due presumably to the unevenness of the surface which prevents the tool from getting a good bearing upon the cradle or other support.

In our shop we experienced the same difficulty, but as our tools are of the small kind that are held in toolholders, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$ and $\frac{3}{4}$ in. square, it would be impossible to follow Mr. Yost's suggestion of placing a piece of iron under the tool to act as a cushion. We overcame this trouble by drawing all our high-speed tools to 700 deg. Since we have done this we have not had a single breakage.

The Broad Point of View on the War and the Industrial Situation

BY WINGROVE BATHON

THE Capital of the United States has now become the center of the universe. The kaleidoscope of big happenings here, moves swiftly, and great visions flash all too rapidly across the sight. But the trained observer sees some things clearly, and some of the pictures are dark ones. In finance, particularly, that is so.

We Must Raise Ten Billion Dollars

A few days ago the United States Treasury disbursed $86,000,000 in one day, and now it is getting to be pretty well understood around Washington that it is necessary to raise before the end of the fiscal year, for the war needs of the United States and the Allies the sum of $10,000,000,000. The mind does not grasp that sum. A cartoonist drew a set of pictures not long ago, entitled "Trying to Comprehend a Billion." The pictures began with the birth of Christ—the familiar vision of the lowly manger—and ran a series, showing famous scenes in history, such as the Crusades, the signing of the Magna Charta, the Reformation: all the great things which have happened since Anno Domini, I. One billion minutes, approximately, have made the record of time in which those big things and all the little things have happened from 1 A. D., to 1918 A. D.

Where is this $10,000,000,000 coming from? No one in Washington knows now. No secret is betrayed when it is stated that officials of the Government are frankly worried, and it is also an open secret that the banks of the United States are still clogged with the bonds of the Second Liberty Loan which the people have not bought. So that the broad point of view in Washington on the war and the industrial situation must begin with a survey of finance; and as patriotic Americans, with our shoulders to the wheel to win the war, we must attempt to interpret some of the things that are happening here and abroad.

War Finance Corporation Is Proposed

The sum of $10,000,000,000 must be raised with which to run the war; but there must be money raised as well, with which to run business, so that business may produce in taxes the money with which to run the war! In this situation, now being driven home with force in Washington, it is proposed that Congress shall create what is to be called a War Finance Corporation, with a cash capital of $500,000,000, and with authority to issue and sell $4,000,000,000 in short term notes, for the purpose of financing private war industrial operations. These phrases are other terms for the creation again of priorities: this time, priorities in money; this time for private industry, not for the Government—although, one might comment, everything that is being done now is being done for or by the Government; or, if not, the tendency is more and more that way. Obvious instances will spring to mind to prove that this is so.

It is a trifle early to say what Congress will do in regard to the proposal: since the differences of opinion between the Senate and Fuel Administration over the Heatless Monday orders, the so-called revelations in regard to alleged profiteering involving criticism of members of committees of the Council of National Defense, and the requests of the Food Administration for more stringent control, there has grown up in Congress a tendency to balk at proposals to place increased power in the hands of the executive officers of the Government.

The Best Judgment Favors the Idea of Corporation

Be that as it may, the best judgment, the most sound opinion obtainable in Washington where so many leaders in the industrial world are now living for the period of the war, is that some form of War Finance Corporation to keep private industry going has now become a vital necessity. The word, industry, is used in the broad sense, to include commerce and transportation, even electric railway transportation, and there must be devised some plan by which conductors of small operations not needed for the prosecution of the war can be prevented from taking capital actually needed by concerns engaged in industry essential to the war. The fact that comparisons are odious is old: the greatest row that has been stirred up in industry since we entered the war has revolved around the question of what is essential and what is less essential; but with no intention of hurting anyone's feelings, as a case in point it ought to be plain to the average business man that it is a mistake, in view of the good oil situation in the United States, for an independent oil-well prospector or producer to be allowed to grab off a million dollars of capital from a friendly group of banks, while a public utility company furnishing power or transportation for war production is unable to obtain additional capital for machinery, rolling stock, or other needs. There must be devised some plan by which public utilities engaged in war work shall obtain capital as needed, over the heads, if necessary, of unfriendly public utility commissions. These are the sorts of troubles the proposed War Finance Corporation will be able to smooth out.

Moreover, if such a corporation seems necessary to the business world now, how much more will it seem necessary a little later when business is asked to produce the major part of that $10,000,000,000 in more taxes and in the purchase of more bonds! Business then will find that profits are being turned into the Government in taxes, and that there is very little money left for working capital.

England Begins Upon Work for After the War

In the meanwhile, those who are preparing in this country now for additional war taxes, will do well to turn their eyes toward England. England has already begun plans for after-the-war construction. The English government is developing a great plan to reclaim and colonize Mesopotamia, where 25,000,000 people will live in what is now a desert. Incidental thereto it is reported, are large harbor developments, railroad construction suitably located, etc., and from this will start

the rehabilitation of the valley of the Tigris and the Euphrates upon such a stupendous scale that to compare what was done with the Nile and the Assouan Dam would serve to show the latter as a small affair.

If England is able to reach out and do after-the-war work now, why should not the United States be able to do so? Does not this story of England's enterprise carry with it a lesson for the American business man? England's revenues, according to the latest official figures which have reached Washington, have expanded beyond the estimates. From that fact we must take comfort, for if they continue to expand perhaps England will not need to raise so much money in the United States as she has needed in previous loans from this country. England's revenues for the third quarter of the present fiscal year did not expand so much as in the first two quarters. The expansion—that is, the excess of actual, over estimated receipts for the first three months of the fiscal year—was $209,000,000, due chiefly to augmented returns from the excess-profits tax; that for the second quarter was $324,000,000, and in this gain the income tax receipts assisted; for the third quarter the gain was but $80,000,000, approximately; for the nine months, the gain was $523,000,000. The excess-profits taxes alone amounted to $336,357,900 above the budget estimate of the Chancellor of the Exchequer.

With this showing, Washington is beginning to wonder how much England intends to borrow from the United States the coming year; and in the face of the fact that here in the United States we are plainly and admittedly in difficulties to do our own war financing of the present moment, Washington is also beginning to wonder how much after-the-war work is England going to do with the world's war money.

French Contracts Are Canceled in This Country

Many other very interesting things are coming to the surface in Washington. A good portion of the money that was tied up in Russian contracts is of course diverted; and recently the French government, pointing out that nothing is to be gained by paying for machinery and materials in this country unless ships can be furnished to bring the machinery and materials to France, had its representatives here discuss with American contractors a basis for the liquidation of contracts here, and millions of dollars worth of machinery contracts were so liquidated.

Russia's Future Is Not a Cause for Grave Alarm

As to Russia, in particular, business men who are now in Washington insist that there is no cause for alarm concerning the future. One of these business men is Col. William Boyce Thompson, of New York, who has just returned from a six months' trip to Russia. He is now in Washington endeavoring to persuade Secretary Lansing of the State Department, members of the Senate and House Foreign Affairs committees, and other officials of the Government, who are concerned with our foreign relations, that it would be the part of wisdom for the United States to recognize the Bolsheviki forthwith. There are indications in Washington that something of that sort may be done: if not a recognition, at least, some words of encouragement may be sent. Col. Thompson, while in Russia, sent $1,500,000 out of his own pocket to the Bolsheviki that they might use the money for propaganda purposes among the workingmen of Austria-Hungary and Germany, in order that the example of Russian democracy might find expression in revolution in Austria-Hungary and continuous agitation in Germany against the aims of the German general staff. This is written while the State Department is still receiving dispatches confirming the news reports of widespread strikes in the central empires. No comment is necessary beyond the statement that if this is a coincidence, it is a strange one, indeed.

Russia is a great market. Col. Thompson delivered a speech the night of Jan. 23 before the Rocky Mountain Club in New York which did not get to the public in a form that might be considered adequate in view of the fact that the speaker had been head of the American Red Cross mission to Russia.

Col. Thompson said among other things: "Do not be alarmed as to the future of Russia. Some of my newspaper friends are taking frantic alarm that the Russian national debt may be repudiated. Well, it hasn't been repudiated yet; and I very much doubt whether the Russia that is emerging from this turmoil will ever repudiate any obligation, even though it may have been incurred in trying to hold the Czar on his throne. All we need is a great patience, a great fairness, and a great sympathy. Russia will soon learn that capital and labor must go hand in hand. Russia's vast resources must be developed for the benefit of the Russian people. That will be realized by the Russians quite as rapidly as we are realizing that the employers of labor must coöperate with labor to bring about the best possible results. The freedom of Russia was as inevitable as the natural laws governing the rotation of the earth. The uniting of all forces in Russia in a democratic social system is just as inevitable."

Growing Power of Secretary of the Treasury

World markets and the international aspects of industry, however, are not completely occupying the attention of the Washington observer. There is much gossip going around in regard to the growing power and responsibilities of Secretary McAdoo of the Treasury Department: a subject that seems to be a fitting part of this letter, inasmuch as most of it has been devoted to finance. If there is one thing that will stand in the way of the easy passage by Congress of the War Finance Corporation bill, it is the fact that Secretary McAdoo has had thrust upon his shoulders almost too much work, almost too much responsibility. A fiend for work, he has seemed not to be burdened by the many additional duties he has inherited, but the Washington observer is wondering when there will come an end to the making of demands upon his time.

Secretary McAdoo is now one of the most important men in the United States; and now that the Congressional elections of the coming fall are in sight, and the campaign committees are meeting in Washington and elsewhere to prepare for the elections, there is a renewed and general interest in national politics in the United States, with the campaign cry already rising from the Republican ranks that Secretary McAdoo is being given too much power.

In the first place, it is pointed out that Secretary McAdoo is a cabinet officer, and as such, he is charged with the negotiation of the loans to the Allies, the placing of the Liberty Loans, and the placing of the War

Savings Certificates, in addition to his work in connection with the Federal Reserve Board. He has charge of the administration of the Farm Loans and Rural Credits. He has charge of the War Risk Insurance and the Soldiers' Insurance. The President has just issued an Executive Order giving him full measure of control over all foreign exchange transactions to protect the United States from enemy use of its banking and exchange facilities. He is the Director-General of Railways of the United States, and when the railroad law is passed by Congress, he will undoubtedly have charge of all railroading financing. Finally, if Congress passes the bill for the War Finance Corporation in its most likely form, Mr. McAdoo will have a measure of control over the financing of all private war industry.

Mr. Stettinius Seems to Have Been Pocketed

Not so much power and responsibility, on the other hand, have been thrust upon another big man, much to the mystification of the Washington observer. Why, the question is being asked, is Edward R. Stettinius, formerly of J. P. Morgan & Co., the man who, for more than three years, has had absolute control of the purchases of the Allies in the United States, been brought to Washington as a surveyor-general for army purchases, only to report to the highest authorities through a series of steps beginning with an army colonel? The idea of Mr. Stettinius *reporting* through a number of boards and councils and subordinates, in view of the fact that he is one of the best qualified men in the United States to *direct* all war purchasing, is absurd.

If the war council of the Secretary of War decides that it is policy to purchase a large quantity of this or that, General Goethals, the new acting quartermaster general, is informed; and then General Goethals asks Col. Palmer M. Pierce, the new director of purchases, to go ahead; and then Colonel Pierce refers the request to Mr. Stettinius. The latter's recommendation then goes to Colonel Pierce, and from him to General Goethals, and the latter is to let the contract. In case of a disagreement, Secretary Baker is to act as referee.

It seems a roundabout method for a man of the caliber of Mr. Stettinius to work, and there is talk of reassigning Mr. Stettinius, yet perhaps it is not such a roundabout method in practice as it looks. The best thing to do in Washington, as elsewhere, is to have confidence; and to drive, drive, drive ahead, getting the thing done every day, and to feel that everyone is doing his level best, and that the mistakes are of the head and not the heart.

Inspection Without Reason

By A. R. De Kuzelewski

Chief Engineer Russo Baltic Car Works.

An article under this heading, page 22, signed A. A. Dowd, attracted the writer's attention, as he had a very similar case—except that the outcome, was just the opposite and would rather tend to disprove Mr. Dowd's opinion.

There was a matter of establishing a standard thread and getting a set of gages to be used for reference only. There were 36 male and 36 female master gages to be made to the various sizes specified, and we mailed a set of blueprints to six different gage shops, specifying manufacturing limits to be plus or minus 0.00005 in. It has to be stated here that an argument arose regarding these limits, but our gage designer who was supposed to be an expert in this line, insisted upon those close limits and he had his way. Four concerns refused to quote, stating that the limits were too close; and one of them, a leader in this line of work, would guarantee only plus or minus 0.0005 in. The order was given to a medium size shop from which was quoted a price about 40 per cent. higher than the average, because of the extreme accuracy required.

Now for the result: our inspection department, being a temporary establishment, did not have means to inspect so close as that, and we requested the manufacturer in question, to submit the master gages for inspection to a well-known institution that specializes in taking close measurements. The manufacturer refused flatly, and gave as an excuse that the slightest change in temperature would affect the gages considerably. By the way the last sentence is taken word for word from his letter. To this day the matter has not been settled, as it is impossible to accept the gages ordered (at a high figure because of the demand for extreme accuracy) without inspection; and on the other hand, the manufacturer will not agree to have them inspected by the institution mentioned above.

The question arises now: what is the use of making a gage to such close limits! The shop or toolroom where these master gages will eventually be used for reference, may have all kinds of temperatures during the year. It is very nice and very important to have the work done as close as conditions require, but to pay 40 per cent. more for accuracy which cannot be either obtained—as in this particular case—or properly utilized, can hardly be justified. In our particular case, especially as the management does not approve of expenses which do not bring some results, someone had to stand the racket.

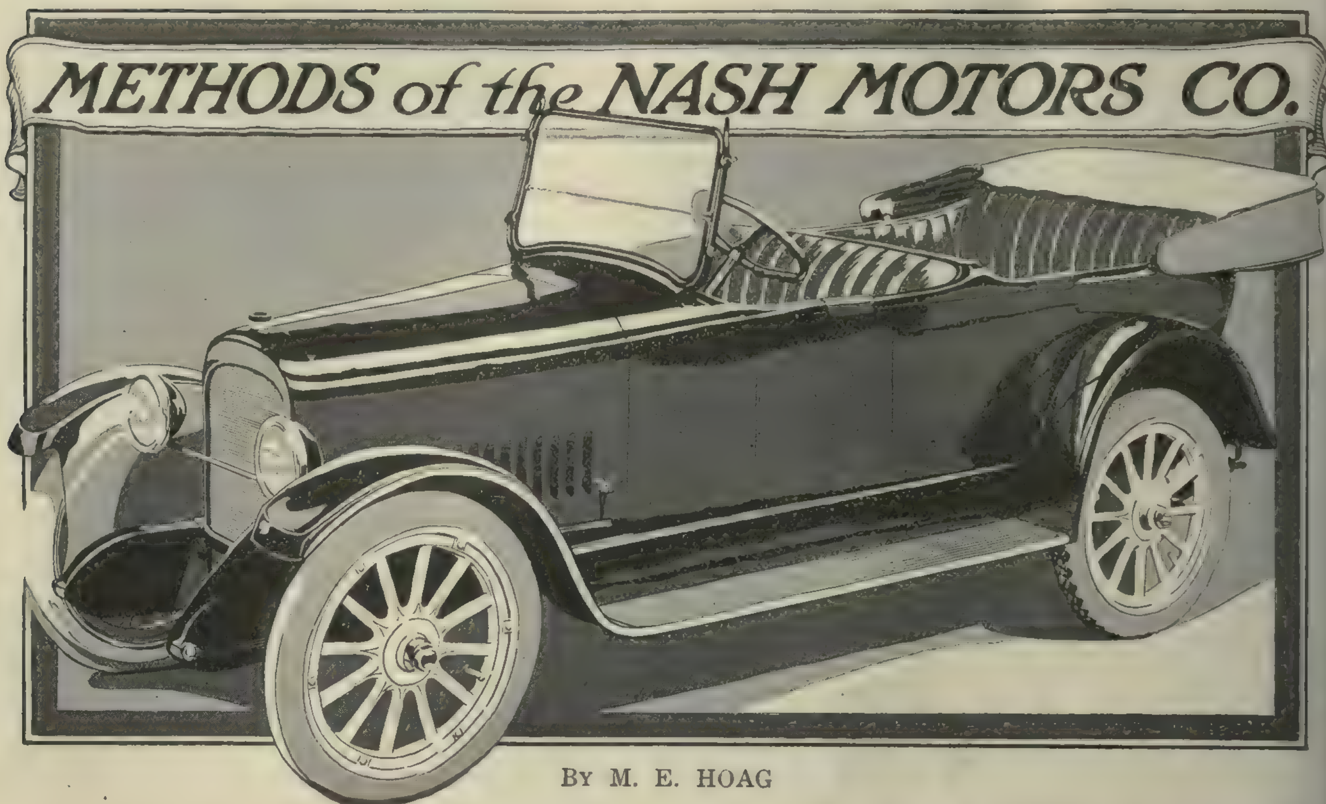
Conserving Motive Power

Reports which have been received from all divisions of the Pennsylvania Railroad lines east of Pittsburgh and Erie, show that as a result of the reductions in passenger train service made effective on Jan. 6, 1918, when 104 week-day and 51 Sunday trains were taken off, the following economies in motive power and man power have been achieved: locomotives saved per day, 29; locomotive crews saved per day, 55; train crews saved per day, 47; train miles saved per year, 2,708,212.

The locomotives which have been saved are being used in part to replace others in the passenger service which are urgently in need of repairs, and in part for moving lighter forms of freight.

The engine and train crews saved have been assigned to new duties in accordance with the seniority rules of the railroad. In most cases the crews actually affected, remain in the passenger service; but the junior men in the various grades of employment on each division, have been transferred to other duties, either in the freight-train service, or elsewhere in the passenger-train service.

Thirty-five lines of parlor and sleeping cars were discontinued in the general reduction; each parlor or sleeping car taken off being replaced by one or more day coaches of approximately triple the carrying capacity.



By M. E. HOAG

III. Making Roller Bearings

It is quite unusual for automobile manufacturers to make their own roller bearings, but it is practical for them to do so, as may be seen from the methods employed in the Nash shops.

THE roller bearing as applied to axles, etc., is made up of four parts: the cage, which holds the rollers in place; the cone, on which the rollers work and which is pressed on, or otherwise fastened to the axle; the outer cone, which fits into or is part of the hub, and the rollers themselves. The only parts that require special dies and fixtures in their manufacture are the cages and the rollers, so it is with these parts only that we shall deal in this article.

A cage in its various stages of manufacture is shown in Fig. 23. The first operation is blanking and drawing in a double-acting press with the punches and dies shown in Figs. 24 and 25; the resulting blank is shown at *A*, Fig. 23. The next operation is swaging in order to give the cone shape shown at *B*. This is a simple operation and is performed with the punch and die seen in Fig. 26.

Trimming Operations

After the swaging the cup is trimmed on the edge, with the machine shown in Fig. 27. The blank is slipped into the hollow chuck *A*, and the revolving plug *B* in the tailstock is forced into it by pressure on a foot lever. This produces sufficient friction between the piece and the chuck to hold it in place and drive it while the tool in the post *C* is trimming it to length. A stop on the tool-lever slide *D*, gages the length of the trimmed blank.

The next operation is rolling the rim to the form shown at *C*, Fig. 23, and is handled very rapidly in the spinning fixture, Fig. 28. The tailstock is belt-driven and is brought into working position with a lever. The flange *A* of the spinning fixture is of sufficient size to engage the small end of the blank and hold it in position against the headstock plug before the flange *B* starts to roll the edge into shape.

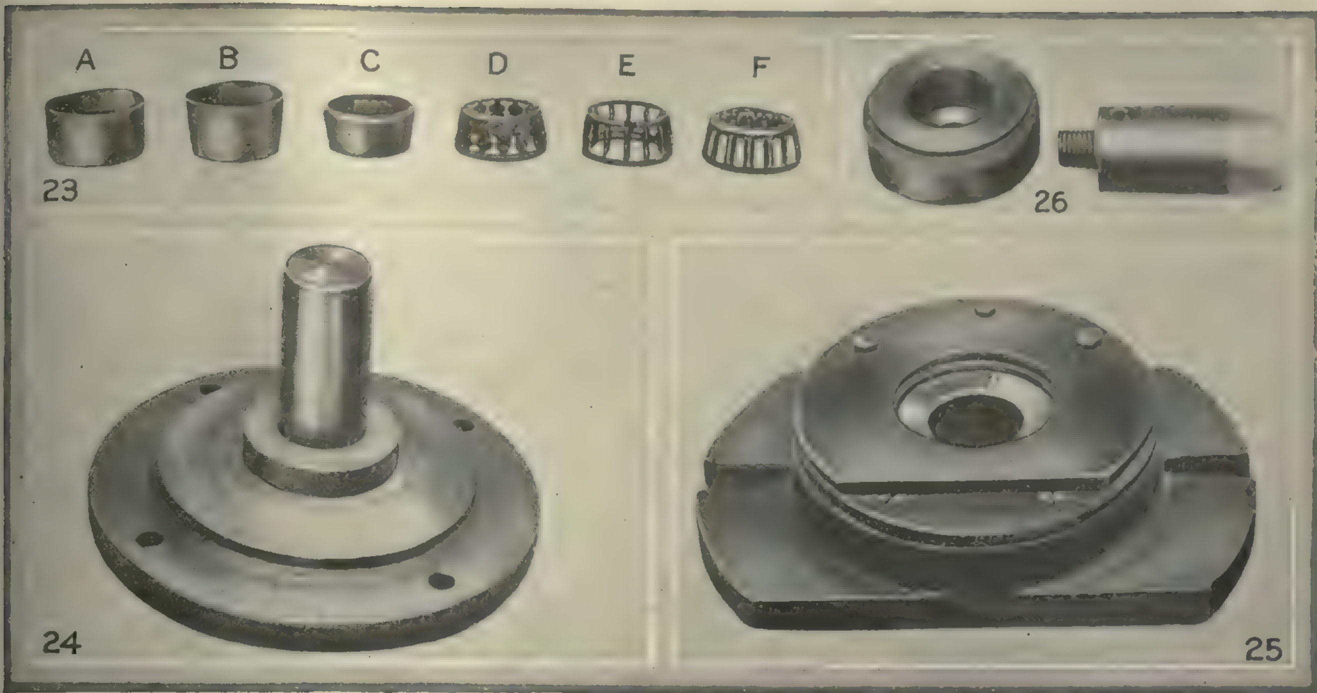
After rolling the rim, the bottom is punched out with the punch and dies shown in Fig. 29. The cage is then slotted as shown at *D*, Fig. 23, with the indexing die, Fig. 30. The head *A* of this die is fixed and so made that the punchings fall through and drop out at the bottom. The other member *B* of the die is movable, and slides in a slot cut in the base of the die holder. After placing a cage on the die *A*, the member *B* is brought up against the end of it and the key *C* locates in one of the notches punched in the preceding operation and prevents slipping while indexing and punching.

Bending the Flange

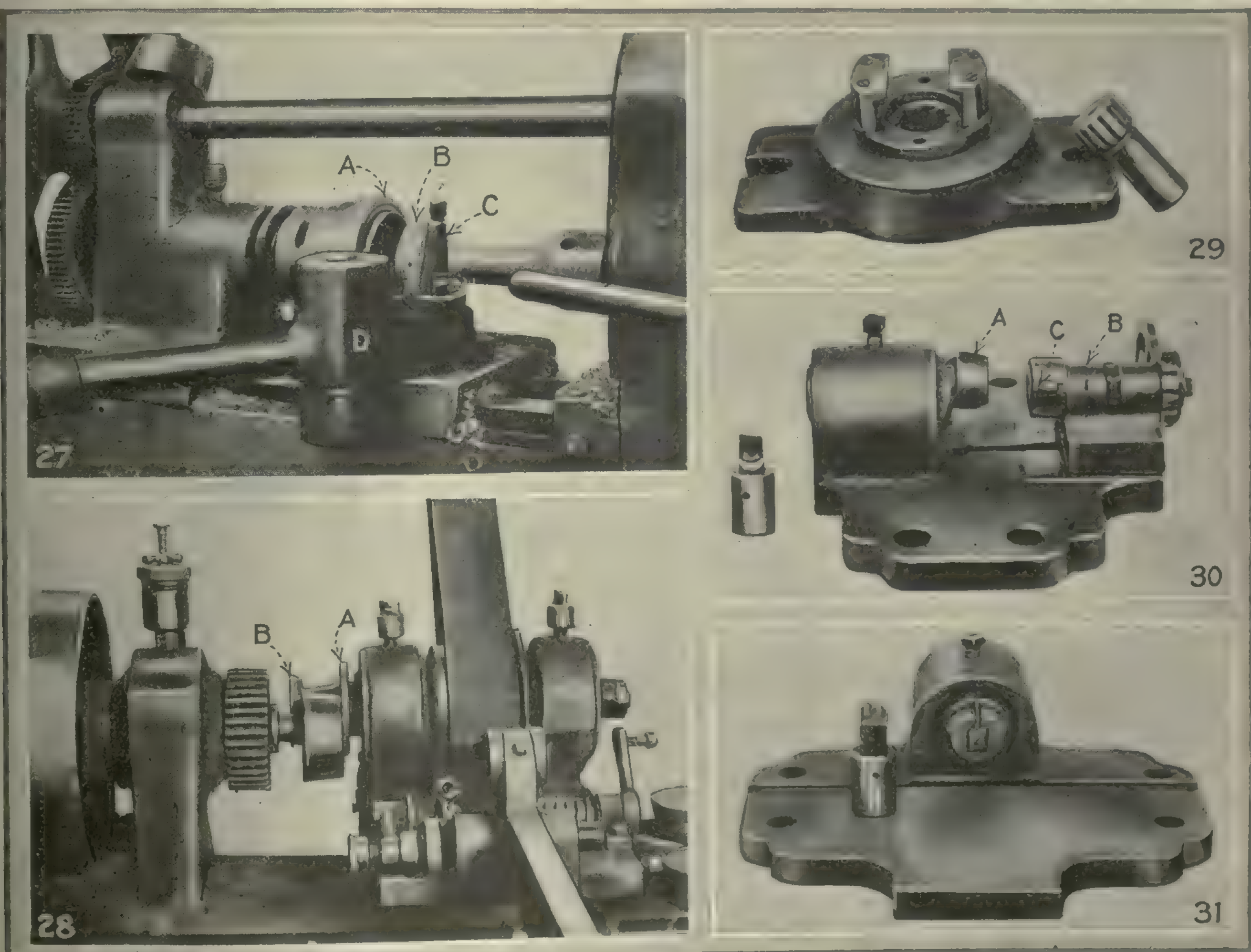
The next operation is performed with the punch and die, Fig. 31, and bends down the flanges that hold the rollers. These are then closed in with the dies seen in Fig. 32, the partly closed flanges being dropped between the jaws *A*, and closed the proper distance by the punch *B*. This completes the cage and leaves it in the shape shown at *E*, Fig. 23. *F*, Fig. 23, is a bearing complete with the rollers in place.

The rollers are formed to the shape shown at *A*, Fig. 33, by automatic screw machines, and one end is squared in a simple indexing die with a number of holes bored to fit the taper of the roller. As the operator feeds them in, the die carries them under a swaging punch, which forms the square end which is later used to drive the piece while grinding.

The rollers are then rough-ground nearly to size, be-



FIGS. 23 TO 26. THE WORK AND SOME OF THE DIES FOR PRODUCING IT
Fig. 23—Roller-bearing cage in various stages. Figs. 24 and 25—Blanking and drawing dies. Fig. 26—Taper-swaging die.



FIGS. 27 TO 31. SOME OF THE MACHINIES AND DEVICES USED
Fig. 27—Trimming machine. Fig. 28—Spinning rim on cage. Fig. 29—Punch and die for bottom opening. Fig. 30—Indexing punching die. Fig. 31—First flange forming die.

fore hardening. A hollow center in the headstock takes the squared end of the roller, and a female center in the tailstock takes the pointed end, *B;* this grinding is handled very rapidly and accurately by skilled operators.

After hardening, the rollers are rough- and finish-ground to gage. This is followed by another grinding operation on the shoulder *C*, the piece being held in a hardened and tapered chuck which locates the roller

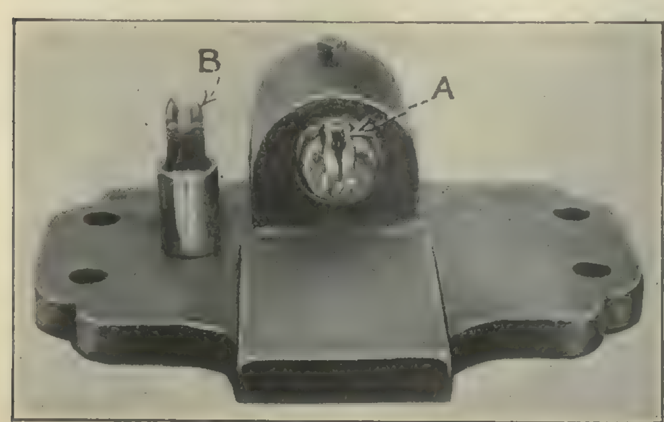


FIG. 32. FINAL FLANGE FORMING DIE

by the finish-ground taper and so controls the size of the roller with relation to the shoulder *C.*

The pieces are now passed to the inspection department where they are gaged to size and sorted to meet very close limits. A dial indicator is mounted on a base which carries a hardened plug with a ground hole that fits the taper of the rollers. The inspector drops a roller into the gage and with a light blow of a lead hammer, seats it; the dial indicator is then swung over until the plunger strikes the ground shoulder *C.* The reading of the dial shows a variation of 0.001 in., which

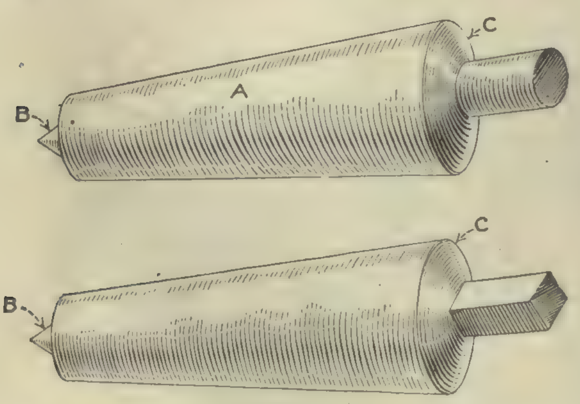


FIG. 33

FIG. 33. BLANK, AND FINISHED ROLLER FOR BEARINGS

is the limit allowed on various-size rollers. It will be readily seen that by taking the readings in this way with 0.001 in. limit, the actual variation in the diameter of the rollers at any given point is very small, this precaution insuring perfect running of the finished bearing.

The rollers are assembled in the cages, as shown at *F*, Fig. 23, by hand, there being sufficient spring in the flanges to hold the rollers in place. Each bearing is tested to insure perfect running before it is passed to stock.

Boring a Hole Around a Corner

By G. A. MacGregor

If a man should ask you to design some means of boring a hole around a corner, you would probably wonder if he had not "fallen off the wagon." At least, that is what passed through my mind when the chief put the matter up to me in just such a manner.

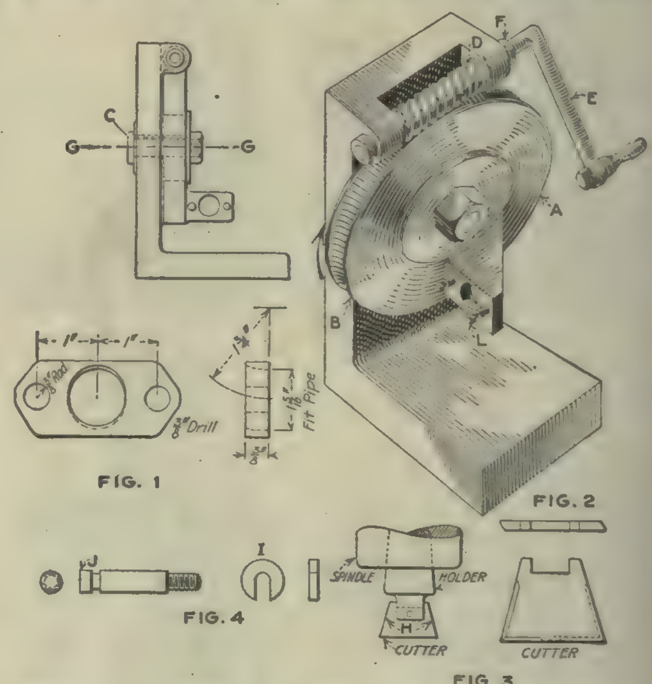
The blueprint boy suggested using a rubber drill; but strange as it appears, the chief rejected the idea, much to the surprise and consternation of the kid. However, a glance at the accompanying sketches will convince you that the problem is not as difficult as it sounds.

In Fig. 1 is shown the work, which is a bronze casting with a $1\frac{5}{16}$-in. hole bored on a radius to fit a bent copper pipe. This casting has been milled to the required thickness, and two $\frac{3}{8}$-in. holes have been drilled previous to the boring operation. The center hole is cast out with sufficient metal left to finish out in boring.

Fig. 2 shows the fixture, which is a steel casting with generous base for clamping to the table. At *A* is a wormwheel, also of cast steel, with teeth halfway around in the direction of the arrow from the point *B.* This wheel has a lug cast on it to which the work is clamped, and is held to the base by a stud, which is keyed to it and held by a nut and washer. At *D* is the worm keyed to the crank *E* and held in position by two collars *F* pinned to the crank.

Fig. 3 shows the cutter in the spindle. The bottom of the cutter should be on the center *GG*, Fig. 2, and the sides *H*, Fig. 3, should be ground so as to clear the work as the hole is being bored.

Fig. 4 shows the style of studs for clamping the work. There are two of these, which are used with slotted



FIGS. 1 TO 4. BORING FIXTURE, TOOLS AND WORK

washers *I* and hexagon nuts and washers on the other end. The diameter *J* is made to slip through the $\frac{3}{8}$-in. holes in the work. In use, the work is clamped by the studs at *L*, Fig. 2, with the center line of the cutter in the correct position. Then the handle is turned and the work slowly fed upward, boring the hole as in Fig. 1.

Reorganization of the Ordnance Department

SPECIAL CORRESPONDENCE

FURTHER details of the reorganization in the Ordnance Department are given in office order No. 104, issued by Brigadier General Charles B. Wheeler, acting Chief of Ordnance. In this order the department is placed on a functional basis instead of having several divisions with duplicating functions as before. There are now certain branches, designated as Bureaus, which constitute and are a part of the administrative office of the Chief of Ordnance. These bureaus perform certain functions for the several divisions and act so as to supervise and coördinate matters within their jurisdiction.

Other branches are designated as divisions, and perform definite functions in the procurement, production, inspection supply and distribution of Ordnance stores.

All of the functions of the existing gun division, carriage division, small arms division and equipment division will be taken over by the bureaus and divisions established by this order. Certain of the existing divisions will become sections of the bureaus established as described herein.

Officers and employees of existing divisions which will become sections of the bureaus hereby established, will continue to perform their present duties, and officers and employees of existing divisions, the several functions of which are to be combined respectively in the new divisions hereby established, will continue to perform their present duties so far as may be consistent with the changes in plan or organization made herein.

The officers designated as chiefs of bureaus and divisions will be responsible for taking over that portion of the work, records, office equipment and personnel of the existing divisions which pertain to the function of their respective bureaus or divisions, and for effecting the changes as rapidly as possible consistent with the avoidance of confusion and interruption of work. All concerned or affected are requested to coöperate and afford such assstance as may be necessary to the attainment of this end.

The Bureaus established are:

General Administration Bureau

The General Administration bureau will be in charge of William S. Pierce, and will include sections which will handle or supervise and coördinate, for the Ordnance Department, all matters as follows and the work connected therewith:

Arsenal Administration Section: (exclusive of manufacturing and storage and matters directly related thereto, inclusive of all matters relating to arsenals as military establishments) will conduct matters relating to, and the handling of appropriations and allotments for arsenal, repairs, barracks, officers' quarters, arsenals grounds, office administration at arsenals, etc

Mail and Record Section: distribution, classification recording and filing of correspondence; coördination and supervision of operation of all file and record and mail control branches in the various divisions and sections of the Ordnance office.

Civilian Personnel Section: will procure, appoint and assign all civilian employees for the Ordnance office, arrange for and record all changes in the Civil Service status of employees in the Ordnance office, including promotions, demotions, transfers, resignations, suspensions and discharges; will be responsible for the handling of all matters which must be taken up with the appointment division of the War Department and the United States Civil Service Commission, such as preparation of specifications for examination, and arrangements for examinations, and for employment in accordance with the rules of the Civil Service Commission, or executive orders of the President; will administer the regulations for the administration of the Civil Service in the Ordnance Department at large; will keep a roster of the employees of the Ordnance Department, showing their Civil Service status, and will keep such other records of civilian personnel as may be necessary; will handle all matters relating to health and recreation for the benefit of the civilian employees of the Ordnance Department in the city of Washington; will assist the efficiency board in developing and preparing efficiency records for employees of the Ordnance office and will be custodian of such records, as well as of copies of records of the same character applying to the Ordnance Department at large.

Commissioned Personnel Section: will conduct all matters related to recruiting, examining, assigning, and otherwise keeping track of the commissioned personnel of the Ordnance Department, and supervision of the examination of candidates for commissions; will supervise and control the work of such branches as may be established for handling matters relating to commissioned personnel in the various bureaus and divisions of the Ordnance office.

Enlisted Personnel Section: will conduct all matters connected with recruiting, examining, assigning; will otherwise keep track of the enlisted personnel of the Ordnance Department; will supervise and coördinate the work of training enlisted personnel.

Finance Section: will conduct all matters relating to keeping track of appropriations and allotments, cost accounting work in connection with cost-plus contracts, including the stores' accounting, connected therewith; will handle all payrolls for the Ordnance office; will audit contracts and accounts.

Property Section: will conduct all matters relating to property accountability for ordnance material issued to the military forces, depots, arsenals, and the bureaus and divisions herein created; will supervise and require accountability for additional plant facilities paid for by the United States, and when no longer required for production will take charge, protect and dispose of such facilities; will also prescribe the methods for accounting for materials furnished under contracts.

Legal and Advisory Section: will be prepared to advise the various divisions of the Ordnance office in all matters of a legal or semilegal character; will be the agency through which all matters shall be taken up with the office of the Judge Advocate General; will supervise and coördinate the work of a legal nature of the several divisions and bureaus of the Ordnance office; will supervise relations with the legislative and judicial branches of the Government and with the Comptroller and Auditor for the War Departments; will supervise relations with representatives of foreign governments, except those matters pertaining to supply and distribution of Ordnance material; will analyze and codify all War Department publications (general orders, Army regulations, etc.) and laws having a bearing on the work of the Ordnance Department; review all books published; collect and digest all clippings from newspapers and magazines; and will bring new information so derived to the attention of all parties concerned; will review and analyze the Congressional Record, and all Senate and House of Representative bills, resolutions, etc., which may have a bearing upon the work of the Ordnance Department, and will bring such matters to the attention of all parties concerned; will prepare or supervise the preparation and issue of such new publications, other than those of a technical nature, as may be necessary; will draft proposed general orders and general statements relating to the work of the Ordnance Department; will maintain and operate the Ordnance Department

reference library; will serve as a general source of information, particularly with reference to matters of common interest to the various bureaus and divisions; will cover general matters not specifically falling within the jurisdiction of any other bureau or division, and schools of instruction for officers and enlisted men.

The several divisions of the Ordnance office now handling these matters will become sections, under their present heads, of the general administration bureau, and such additional sections as may be necessary will be established.

The Control Bureau

The Control Bureau, in charge of Lieut.-Col. Tracy C. Dickson; Major Person, office manager: will handle, supervise and coördinate for the Ordnance Department all matters and the work connected therewith relating to:

Requirements section, in charge of Col. Rostz; supervises the preparation of estimates and schedules of requirements serving as a basis for purchase, production and supply of Ordnance and Ordnance stores and supplies. In this connection, it will ascertain what purchases are made or are to be made by the expeditionary forces, and will make proper allowance therefore in the schedules prepared. It will compile and prepare the estimates of funds required for procurement of ordnance and ordnance stores and supplies for presentation to Congress.

Plant section, in charge of Major Brill: will furnish the procurement division with lists of plants and arsenals that should be given orders for manufacturing ordnance and ordnance stores and supplies, taking into account such factors as plant capacity, organization, labor conditions, facilities for procuring raw materials, transportation facilities, etc.; to this end it will, (1) from information and data obtained from the production division and other sources, prepare lists of plants available and best adapted for the manufacture of ordnance and ordnance stores and supplies; (2) receive reports from the production division showing the extent to which the facilities of various plants with which contracts have been placed, are utilized; (3) determine what new plants, additions to plants, what machine tools and other manufacturing equipment shall be provided at the expense of the United States.

Progress section, in charge of Major Thompson, handles: coördination and control of the work of the division charged with procurement, production, inspection and supply. To this end it will be furnished by the divisions concerned, such periodic reports as may be required, which it will consolidate into suitable graphic or tabular forms in such a way as to bring out failures or prospective failures of production, and will keep pace with requirements, and the causes thereof; it will inform the divisions concerned, of such cases, indicating and directing action necessary to correct or ameliorate the condition found, and will follow up such instructions to insure appropriate action being taken.

Transportation section, in charge of Major Johns: will handle or supervise all work of the Ordnance Department connected with the transportation of ordnance material, conducting all dealings relating thereto with the other branches of the Government or authorized civilian agencies.

Plant Inspection Section, in charge of Major Bates: independently of the other bureaus or divisions, its representatives will visit plants engaged in the manufacture of ordnance and ordnance stores and supplies; will submit reports on conditions found. Wherever conditions indicate the necessity thereof, will initiate and follow up appropriate action to forestall difficulties which may interfere with production and correct them if found to exist. These reports will cover personnel, system, duplication of duties, complaints, etc.

Complaint section, in charge of Col. Crews: will investigate and adjust, on behalf of the Ordnance Department, any complaints or disputes that may arise between the various divisions of the Ordnance Department and manufacturers, and between various bureaus and divisions.

Industrial Service section, in charge of Dean Schneider: will deal on behalf of the Ordnance Department with all questions of wages, labor and employment affecting the production in arsenals or privately owned plants of ordnance and ordnance stores or supplies. Its work will include, (1) investigation and adjustment of disputes between employers and employees; (2) employment problems, including the providing of adequate labor supply and the training of employees; (3) establishment and maintenance of proper standards of working conditions, wages, hours of labor, housing, etc.

External Relations section, in charge of Col. Crews: will conduct or authorize and supervise the conduct of all dealings of any divisions, bureau or section of the Ordnance Department with other departments or bureaus of the Government (excepting legislative, judicial, Comptroller and Auditor of the War Department) and other authorized external agencies, in all matters relating to the procurement and distribution of ordnance material. This will include the obtaining of priority, and commandeering of facilities; will be the exclusive agency of the Ordnance Department supplying information relating to requirements, production and supply of ordnance material to other branches of the military service and to other authorized governmental agencies, such as the Council of National Defense.

Planning and Control section, in charge of Major Cheney: will analyze all reports received from the military forces, orders and communications received from the General Staff, and communications and data received from other sources that are not of a routine nature incident to the work of the several divisions; it will bring such matters to the attention of the divisions or bureaus concerned for action, indicating the action required, and will follow up to insure their being promptly and adequately attended to.

Organization and Methods section, in charge of Lieut-Col. Hathaway: will study the work and organization of the various bureaus and divisions of the Ordnance office, and will be charged with bringing about such changes as may be necessary properly to coördinate their work, and secure uniformity of methods, elimination of duplication of effort, and insure adequacy of system; it will, where necessary, develop and supervise the installation of new methods, and will make such inspection of the operation of methods established, and will exercise such supervision as may be necessary to prevent the lapse of methods that have been established.

The Requirements and Statistics section, the Industrial Service section, the Organization and Methods section, and the Progress section described by office orders No. 80, 81 and 82 and the sections or branches of the present divisions now handling the subjects assigned to the control bureaus will become parts thereof. Such additional sections will be established as may be necessary to the performance of the functions indicated.

Engineering Bureau

This bureau has as its head Lieut.-Col. John H. Rice, and will handle and be responsible for all matters and work connected therewith relating to:

Design; preparation and supply of drawings; preparation of bills of material; preparation of specifications and instruction pamphlets; determination and adoption of types; tests other than those incident to inspection; experimental and development work; supervision of all proving work pertaining to experiments and the establishment of types and control of proving grounds, other than those specifically assigned to the inspection division; research work, especially of materials, including supervision of laboratories and laboratory investigations of defective material.

All ordnance, ordnance stores and supplies and the materials entering thereinto must be approved as to type and quality, and covered by specifications prepared or approved by the Engineering Bureau before purchase orders are issued. All questions of departure from design and specifications will be referred to this bureau.

Operating Divisions

There are established the following operating divisions:

The Procurement Division, in charge of Col. Samuel McRoberts: will handle all matters and the work connected

therewith, relating to the placing of orders with private manufacturers and arsenals to meet the schedules of requirements for ordnance and ordnance stores and supplies, and for the repair or alteration thereof, in accordance with specifications and drawings prepared by the Engineering Bureau, and the schedules and lists of manufacturing plants prepared by the Control Bureau. All contracts will be executed by this division.

Production Division, in charge of Col. Guy E. Tripp: will handle all matters and work relating to securing the production of ordnance and ordnance stores and supplies for which orders and contracts have been placed by the Procurement Division; will collect and codify all information relating to processes of manufacture and equipment and their use for the production of ordnance material; it will make or cause to be made studies of methods, machinery and tools, so as to indicate the best methods of manufacture, the production that should be attained with various types of equipment, tools, etc.; will compile or cause to be compiled, data of this character in such forms as to facilitate the making of estimates of production and enable the comparison of actual production with that which the estimates show should be attained, and will furnish such information to the Control Bureau; will be prepared to assist new manufacturers to get started, supplying them with such data concerning equipment, methods of manufacture, sources of raw material, etc., as may be necessary; will assist the manufacturers already established by disseminating the results obtained in various plants manufacturing the same articles, systematically making available to all manufacturers the practice of the best with a view to enabling all to reach the highest standards with respect to quantity and quality of output; to this end, it will maintain a corps of qualified experts who may be sent to plants that are having difficulties in meeting their schedules, to assist them in overcoming their troubles; will compile for the Control Bureau, statistics covering existing facilities for production, comparing the same with the requirements; investigate facilities of prospective contractors, the suitability or adaptability of existing manufacturing plants engaged in or intended for other lines of manufacture but which might be utilized for Ordnance Department work; will handle all matters relating to fuel and power supply connected with the production of ordnance and ordnance stores and supplies.

Inspection Division, in charge of Lieut.-Col. B. W. Dunn: will handle all matters and perform all duties relating to inspection of all ordnance and ordnance stores and supplies procured by purchase or manufacture, excepting at arsenals; will follow the results of all operations and processes in such detail as will keep it fully informed of the quality of the product during all stages of manufacture; will receive reports of proving-ground tests made for the acceptance of material; will control such proving grounds as may be specifically assigned to it. The Inspection Division or branches and sections thereof will render property returns for all gages and apparatus belonging to the United States, used by that division in the performance of its duties.

Supply Division, in charge of Major Odus C. Horney: will perform all duties connected with the storage, supply and distribution of ordnance material as covered in office orders Nos. 7, 27 and 36; will operate all store-houses including those at arsenals used for the storage of ordnance and ordnance stores and supplies for issue to the military forces, and is made a separate responsibility from that of manufacture at arsenals; the Supply Division or branches and sections thereof, will render property returns for all property of the United States received, issued and handled by it wherever situated.

In addition to the foregoing, the Nitrate Fixation Division, with Col. John W. Joyes as its head, and the Division of American Ordnance Base Depot in France with Lieut-Col. D. M. King as its head, will continue to perform their respective functions as covered by existing orders.

There is also established the function of Supervisor of Manufacturing Arsenals to which Col. S. E. Blunt is assigned. This function will include the handling on behalf of the Chief of Ordnance, of all matters relating to the operation of Arsenals as manufacturing plants and their general administration.

Col. Jay E. Hoffer, Ordnance Department, and Col. John T. Thompson, U. S. A., retired, will report in person to the acting Chief of Ordnance as soon as the transfer, to the bureaus and divisions created herein, of the duties and personnel of their present respective divisions, is completed.

This order will, from time to time, as may be necessary, be amplified or modified by supplementary orders.

Six Thousand Lumberjacks Wanted for Foreign Service

Additional men to the number of 600, are wanted at once to bring the 20th Engineers (Forest) Regiment up to full strength, according to officials of the Forest Service, who have been requested by the War Department to aid in securing the necessary number of new recruits.

This is the second forest regiment formed by the War Department and will be the biggest regiment in the world. The first forest regiment has been in France for several months, busy in cutting and getting out of the French forests timber, lumber, and other material for our Army. Some battalions of the 20th have also gone across, and others will follow as their equipment and preliminary training are completed. Men who enter this unit are therefore assured, the officials say, of early service abroad.

Men can join the regiment by enlistment, if not of draft age and if within the age limits, which are from 18 to 40. Registrants under the selective draft law who have not been notified to hold themselves in readiness to report for duty at a camp, can be inducted into the regiment if they can show that they are qualified for it.

Applicants for enlistment or induction may apply by letter to The Forester, Washington, D. C., or to the various listing officers who have been receiving local applications for places in the forest regiments. Letters of application must contain a full statement of experience in any of the various lines of work involved, with names and addresses of employers.

There will be wanted, 3000 lumberjacks, sawmill workers, and men experienced in building and operating logging railroads. The other 3000 will make up three road- and bridge-building battalions which will serve as auxiliaries to the logging and sawmill units. For these road-building battalions, men who are familiar with the operation of rock crushers, road rollers, scrapers, and graders, motor-truck drivers, and laborers experienced in road work are required.

The lumbering and sawmill battalions will be made up of men skilled in every phase of manufacturing and delivering lumber and other forest products needed in the conduct of the war. Sawyers, teamsters, axmen, tie makers, cooks, and charcoal burners are some of the classes wanted for the woods operations that will be undertaken abroad.

Graders, track layers, track bosses, locomotive engineers and firemen, brakemen, machinists, and laborers, are needed to construct and operate logging railroads. Men skilled in all kinds of work around sawmills, including filers, stationary engineers, boilermakers, truck and tractor operators, and laborers for lumber yards are required.

Building Motors With General Purpose Machines—II

SPECIAL CORRESPONDENCE

In this article will be described some of the principal operations on the T-head cylinders together with jigs, fixtures, etc., used.

THE first machining operations on the cylinders consist in rough-boring and chamfering, finish-boring and chamfering, and milling the bottom face. These operations are all handled on a Beaman & Smith horizontal, multiple-spindle boring mill as shown in Fig. 12.

The fixture for this work is very rigid and simple in construction. To operate the fixture, the setscrews in the swinging clamps *A* are released and the clamps dropped down out of the way; the set of cylinders is put into place and located against the setscrews *B* in the back plates. The front plates *C* are profiled to receive the necks of the cylinders. Heavy steel pads *D* under the setscrews prevent distortion of the cylinder walls by the pressure of chamfering.

Cutting Heads

The machines spindles *E* carry adjustable, inserted-tooth heads; one set for rough-boring and one set for finishing; they are so spaced that one hole at a time is bored in each pair of cylinders. The collar *F* on the spindles carries the chamfering cutter at *G*. A steel strap is fastened over this cutter blade and avoids danger of catching in the workmen's clothes.

When the first set of holes has been rough- and finish-bored and chamfered, the spindle head is moved over and the second set bored. The fixture is now indexed halfway around which brings the bored cylinders in front of the milling cutter *H* which is carried in the traveling head of the machine. This cutter takes a cut across the bottom faces of the cylinders while the workman is setting up and boring another set of cylinders. This method of handling these operations insures that the faces of cylinders are square with the bore, which is an important feature.

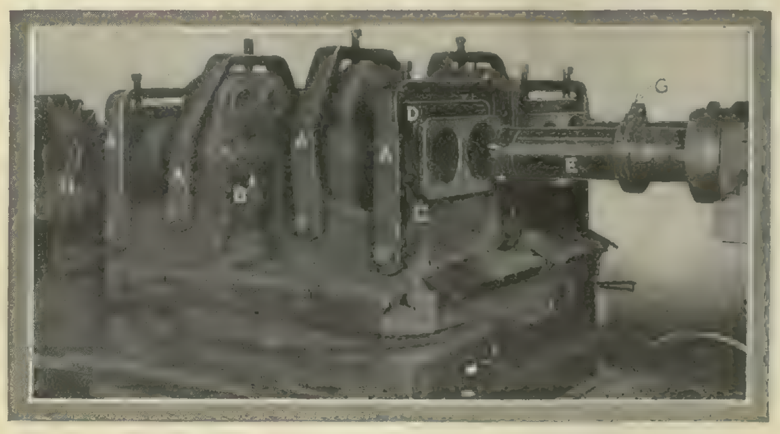


FIG. 12. BORING AND FACING CYLINDERS

The plugging of the four core holes in the water jacket is a simple matter and is handled on a single-spindle drilling machine. The workman uses a cradle to rest the work in while he drills and reams the holes. He then drives in a pressed-steel cup and faces off the boss with a counterbore.

The next operation of importance is drilling the bolt holes. For this, simple bushed plates are used; the workman locating them by the edges of the cylinder flanges, and clamping them in place. A multiple-spindle drilling machine drills all the holes at once.

The cylinders are now reamed with the adjustable blade-cutter head shown in Fig. 13. The jig for holding the cylinders is of very simple construction. Studs on the under side of the plate *A* enter the drilled bolt holes in the cylinders and locate them. Two clamps, one of which is shown at *B*, engage the cylinder flange and draw its milled surface up against the plate. This operation leaves about 0.010 in. for grinding.

OPERATION SHEET

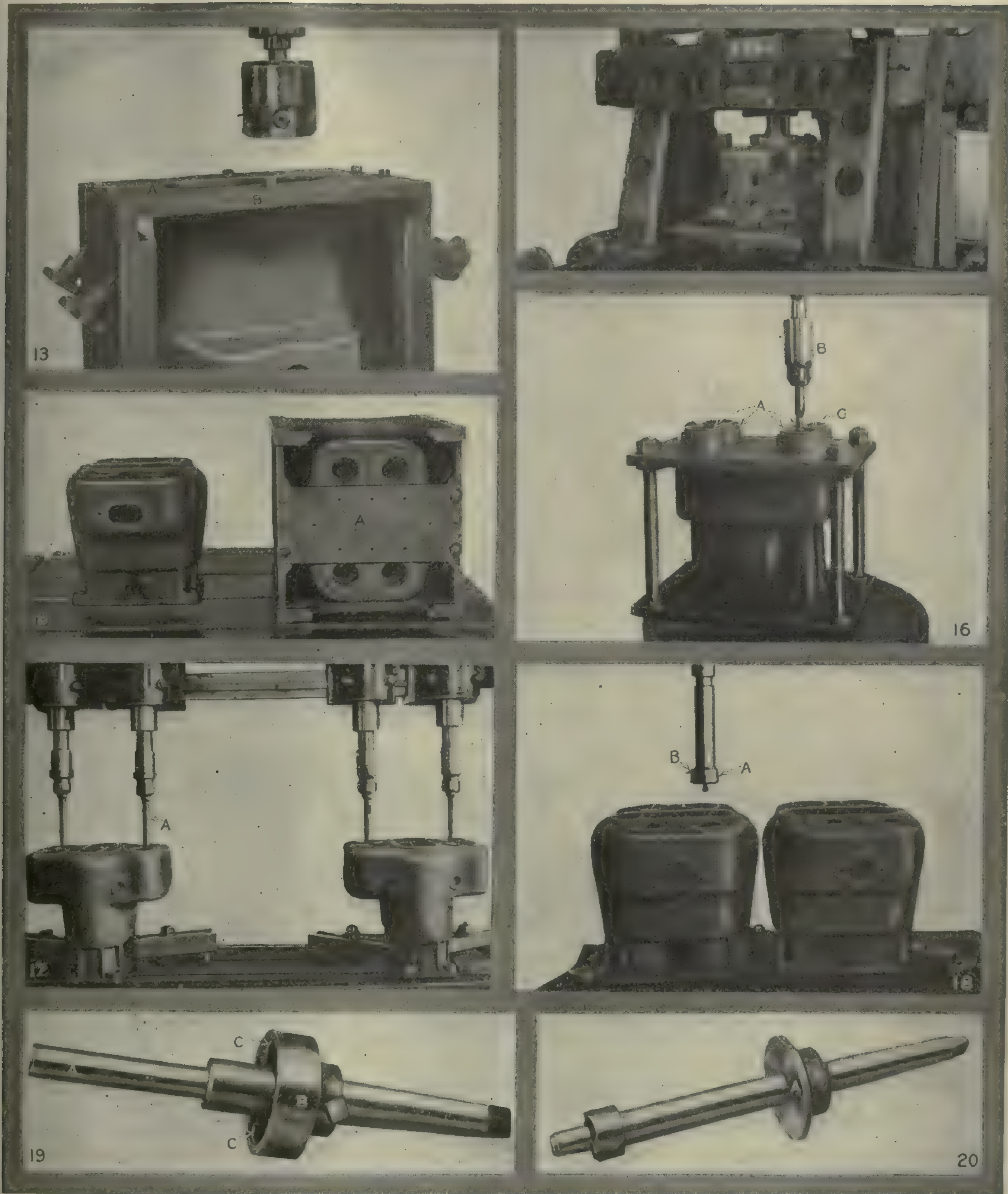
Cylinders

1. Rough- and finish-bore and mill bottom.
2. Plug 4 holes in water jacket.
3. Drill and tap for pet-cock.
4. Paint.
5. Bake.
6. Drill bolt holes.
7. Finish-ream bore.
8. Mill top and sides.
9. Mill inlet pad.
10. Grind bore.
11. Drill valve-guide holes and all stud holes.
12. Tap stud holes.
13. Spot-face bolt holes.
14. Face valve-guide bosses.
15. Rough-bore valve-cover holes.
16. Finish-bore valve-cover holes and ream valve-guide holes.
17. Counterbore valve-cover holes.
18. Face valve-cover holes.
20. Flash-cut bottom.
21. Wash.

The tops and sides of the cylinders are now milled on an Ingersoll milling machine as shown at Fig. 14, three cutters operating at once. The cylinders are located on the plate *A* by studs which enter the bolt holes, and are clamped down as shown in the illustration. After the roughing cut the cylinders are passed back through the machine and a light finishing cut taken to insure good seats for the gaskets. After milling the inlet pad, the cylinder bore is ground on a Heald cylinder grinding machine in the usual way.

The valve-guide holes and all stud holes are now drilled on a Baush multiple-spindle drilling machine, Fig. 15. The jig used is of simple box-type construction and carries bushings for 18 holes. To insert the work, the plate *A* is removed and the cylinder lowered into place and located by studs in the bottom plate, which enter the bolt holes. Arms cast on the inside of the jig carry the bushings for the valve-guide holes.

The valve-cover holes are rough-bored on a Moline drilling machine, and the valve-guide holes reamed with jig and tool shown in Fig. 16, the piece being again located from the bolt holes as in previous operations. The bushings *A* guide the tool *B* which carries



FIGS. 13 TO 20. VARIOUS FIXTURES AND TOOLS FOR OPERATIONS ON CYLINDER CASTINGS

Fig. 13—Reaming cylinders. Fig. 14—Milling tops and sides of cylinders. Fig. 15—Drilling jig for valve-guide and stud holes. Fig. 16—Boring valve-cover holes and reaming guide holes. Fig. 17—Finishing cover holes and valve seats. Fig. 18—Tool for facing valve holes. Fig. 19—Tool for counterboring valve-cover holes. Fig. 20—Tool for facing valve-guide holes.

a reamer at *C* for the valve-guide holes. The body of the tool roughs the valve-cover hole and the valve seat.

No jigs are used for the finishing operations on the valve-cover hole and valve seat, as is shown in Fig. 17. The pilots *A* on the boring tools, enter the valve-guide holes and guide the boring and seating tools, thus insuring absolute alignment of seats and guide holes. Each tool head carries two inserted blades.

The valve seats are faced with the tool shown in Fig. 18. It is ground off at *A* to fit the valve hole which guides and supports it while the tool bit *B* sweeps the face of the valve seat.

The valve-cover holes are tapped with a Geometric tapping head of standard construction, after which the top thread is counterbored with the tool shown in Fig. 19. The pilot *A* of this tool enters the valve-guide

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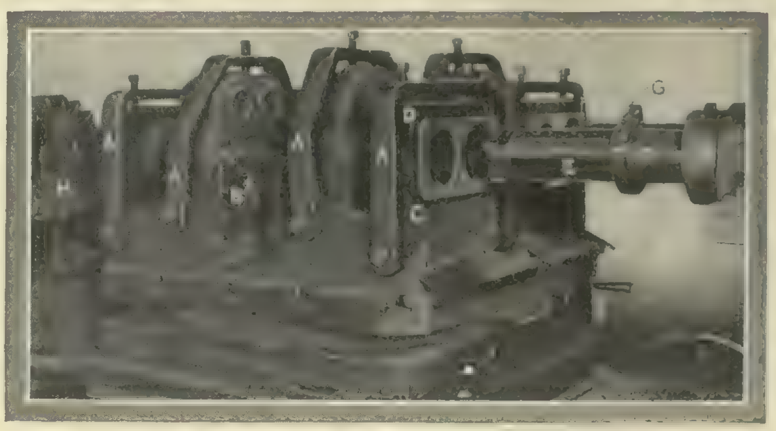

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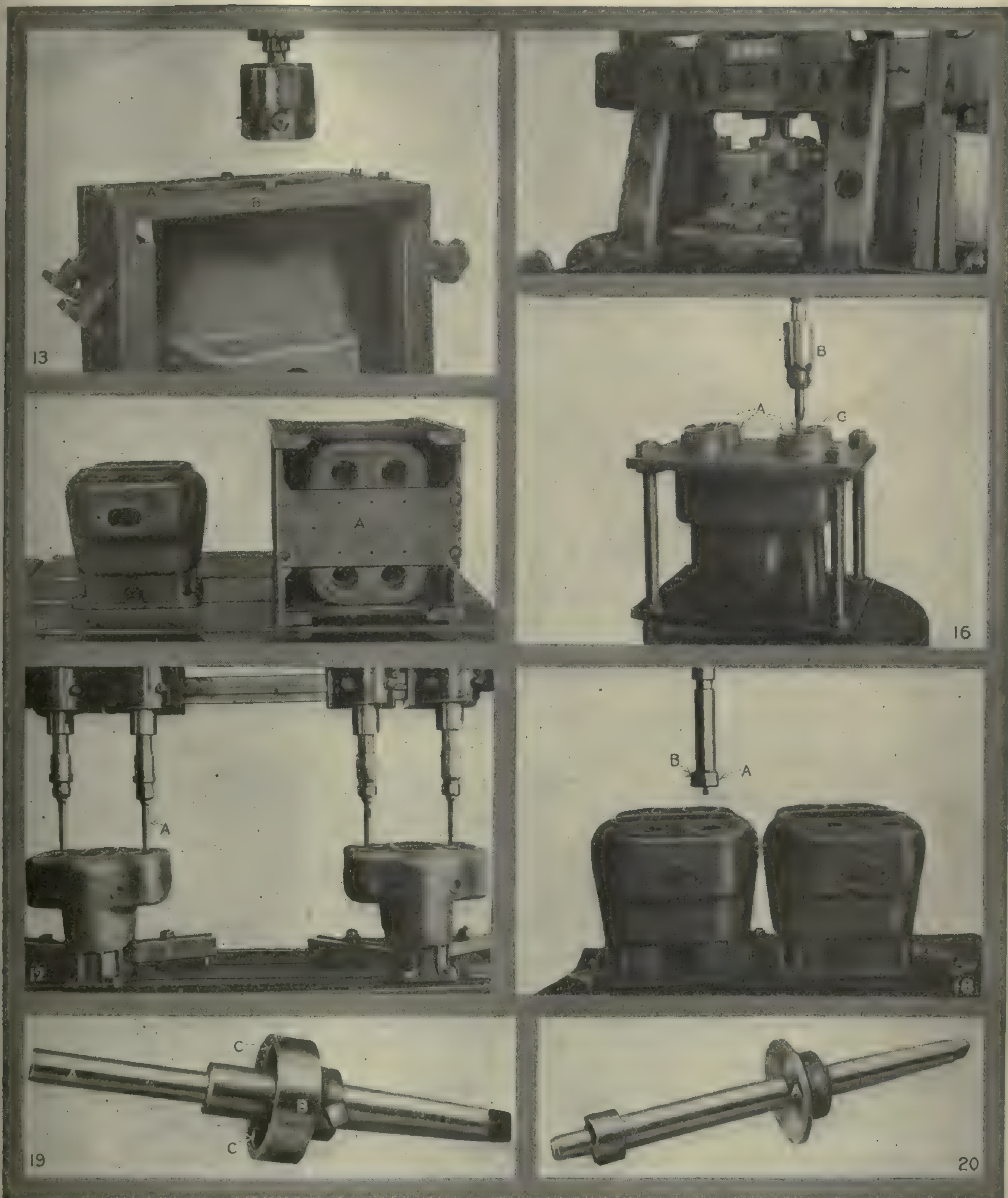

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hole which centers it with the work. The hardened adjustable collar B acts as a stop when it comes in contact with the top face of the cover hole. The tools C are held in place by taper pins.

The valve-guide holes are faced with the pilot counterbore shown in Fig. 20. The adjustable collar A acting as a stop in the same manner as the one on the tool shown in Fig. 19.

The operations required on the cylinders are given in the operation sheet. In the last operation the bottoms of the cylinders are given a light milling cut to insure a perfect seat for the gaskets.

The next article will describe the making of pistons and connecting rods.

Kind of Work for a Trade-School Machine Shop

By Wesley McArdell

Mr. Forbes, on page 1052, Vol. 47, takes me to task because of certain constructive criticism which I advanced on page 906, Vol. 46.

It is quite evident that our experience in machine matters has been along radically different lines. It may be that I am somewhat prejudiced in my views because my entire life has been spent in and around machine shops. One conclusion at which I have arrived after long experience, is that combination tools in general, fall short of accomplishing any one of the several purposes they seek to accomplish.

For a trade-school machine shop, the logical chuck is the steel-body, four-jaw, independent chuck. I have seen combination chucks, and iron-body independent chucks tried out, and the only chuck that stands up is the steel-body, four-jaw, independent chuck. This is my experience covering several years in a trade school running night and day, where real cuts at real feeds are taken.

If I were playing at the machine business, I would get a combination chuck; one of those affairs with a 10-32 screw sticking out of the back, with a knurled nut that would be about right as an attachment for a sewing machine.

I can see how a combination chuck would afford a drawing room a "very nice exercise" if the drawing room were just teaching drawing, and not mixing with the drawing-room work, machine-shop ideas. Think what a fine job it would be to draw an assembly view of such a chuck, showing all the pinions in mesh, with the scroll plate, jaws, latches, etc., in their proper places. and then think what a horrible example of how *not* to do it, the whole thing would be!

Trade schools are places where machines and tools are subjected to the hardest kind of service. Why have a piece of equipment that is structurally weak, that has a multiplicity of parts, when one can have something which is simpler to understand and stronger structurally?

I have yet to see an advertisement of a combination-chuck manufacturer, wherein the statement is made that their chuck is as strong as their independent chuck, weights being equal!

Compare what happens when a piece of work is gripped in first one and then the other chuck. Reason out what happens, and why. Tighten up the independent chuck and then the combination chuck. Is the work held with the same grip in each case? I think not. The independent chuck will have several times the gripping power that is possessed by the combination chuck.

Mr. Forbes naively admits this when he describes how distortion of the circular rack (he is probably referring to the bevel gear that is integral with the scroll plate) is prevented by "tightening up on each screw lightly, several times." We do not do it that way at our school.

Concerning reamers: there is something wrong with the course of study in a trade school if it does not include in its scope the making of a reamer. This reamer, of course, will not be of the same high grade as if it were purchased outside, but it should ream a smooth, standard-size hole; also, if the school has adequate equipment, it will not harden reamers in the blacksmith's forge as Mr. Forbes advocates.

I regret I cannot accept Mr. Forbes' challenge to raise funds for a trade-school shop. We do things of that sort differently in New York. We do not go around to machine shops and ask them to contribute funds to found and support another machine shop. This is fortunate, as if we had to raise funds in this way, we would have to submit to every little whim and insular prejudice of the several contributors, and one of them might be an exponent of combination chucks!

I am glad Mr. Forbes is frank and admits that the statement I made about machine-shop work being nothing but applied mathematics, is beyond him. This attitude is commendable and indicates progress, as the first step toward knowledge is a recognition of one's limitations.

I am afraid I must leave the last word in this discussion with Mr. Forbes. I have just volunteered for service in the Ordnance Department, and shall have little time or inclination to discuss the relative values of various types of chucks for a trade school.

My hope is, that when an American shell drops in a piece of German machinery, all that the Boches may have with which to repair the damage, will be some combination chucks; but this is a false hope, as the Germans are too clever to standardize on something of questionable utility.

The Locomotive Shortage

In 1913 American railroads ordered 3467 locomotives; in 1916 they ordered 2910, and in 1917, 2704. At least 5000 new locomotives are needed each year by the railroads of the United States. In 1916 foreign orders for locomotives totaled 2983; in 1917 our Allies ordered 4938 railroad engines, of which 2057 were for the United States operations in France. Deliveries of locomotives have been in about the same proportion. United States railroads received 5332 locomotives in 1913; 1251 in 1915; 2708 in 1916, and 2585 in 1917. Deliveries to foreign countries in 1917 were 2861. Locomotives built for Russia and France cannot be used generally in the United States, due to the different gage and height of the Russian locomotives, and to the increased height of the French locomotives. These facts give a fairly clear idea of where some of the trouble lies, that has caused such tremendous freight congestion.

Delays Prolong the War
Delays Mean WASTE
Carelessness Causes Fires, Spoiled Work, Sickness and WASTE
Delays Mean More Lives Must be Sacrificed
Fatigue Causes Spoiled Work, Accidents, Sickness and WASTE
Save Lives, by Preventing Delays
HIRING & FIRING
Poor Light Results in Bad Eyes, Spoiled Work, Accidents and WASTE
Labor Turnover Causes Idleness, Needless, Transportation, Housing Congestion, Spoiled Work and WASTE

Sidelights

EDITED BY D. BACON

The President has proclaimed as follows: "I, Woodrow Wilson, President of the United States by virtue of the authority vested in me by the Constitution and the laws of the United States, do hereby, for the protection of such forces (military and naval), proclaim to all whom it may concern that, under the pains of penalties prescribed by the laws of war and the statutes of the United States, throughout the present war no exposition of aircraft shall be held in the United States or its possessions."

This proclamation has just been made in order that by such exhibitions aid and comfort may not be given to the enemy. Exhibitions of aircraft are bound to reveal their newest devices, and distribute information that must be kept within the knowledge of our war and navy departments.

Spring Plowing in Europe, Through Manufacturers in America

The United States Food Administration is shipping hundreds of farm tractors to France, and by these, the spring plowing will be done. This will lessen the food-tonnage of our shipping and increase the agricultural acreage abroad. The Food Administration alone, is shipping 1500 tractors. The first hundred of these is on its way. There will be independent shipments made.

Henry Morgenthau, Jr., went to France with these tractors, and he is directing their operation. By March the entire number will have reached Europe, and Mr. Morgenthau will have established schools where men and women can learn to operate these machines, and he will have the assistance of the. French Minister of Agriculture in making the distribution.

Since the war began there has been a decrease of 38.7 per cent. tons of food raised in France. Half a million acres can be plowed by tractor, in the spring, and 1,000,000 acres can be turned up for the planting of fall wheat. The 500,000 acres will produce 1,500,000 tons of potatoes, and by just so much will reduce our shipping of very necessary food. The 1,000,000 acres will produce 450,000 tons of wheat and add so much tonnage to the room for shipping machinery and other things needed in Europe. In round numbers, the shipping of 1500 tractors to Europe, between now and Mar. 1, leaves 1,950,000-tons room in ships, for other things during 1918.

Calls for Labor: The Replacement

Out of 500 factories in New York State, 176 are calling for laborers. The concerns making the urgent call are airplane and seaplane, ordnance and amunitions factories; iron and steel castings and forgings shops; factories making scientific instruments and optical supplies; knit goods factories; electrical apparatus and supplies factories; the needle trades; machinery and tool factories and hardware.

The demand is for 34,155 workers in the State of New York, alone. With this augmentation of labor needed in these specified trades, there are vast numbers of workers being freed from other industries, as the carpets industries, fine leather, fine kid gloves, trunks and suit cases, high-grade woodwork, wagons and parts, mattresses and spring beds, typewriters, brass and bronze castings and art-metal work, tin cans, differentials for pleasure cars, paper-box making and sewing machines. The replacement service is very limited thus far. That which has taken place is creating trouble, since the women are paid less than the men. The only manner in which this matter of pay is likely to be adjusted for some time, is by the unusual speeding up by women. It is positively stated by one establishment that the poorest operator on certain lines, among the women, turns out more work than the best man worker in the same line; and that the percentage of come-back on inspected work, is greatly less. As women are paid only on a piece basis, it depends entirely upon individual ability to bring the individual wage up to that which men get by working at days' wages.

The number of women thus far employed in the replacement service is only about 300, and they are engaged in manufacturing instruments and tools.

A Great Highway Freight System

Since November last, the engineers who represent the Office of Public Roads of the Department of Agriculture have, with the engineers of the army corps, been working out a routing system for the Quartermaster Department, by which an enormous amount of army-truck delivery may be accomplished without the agency of the railroads. This is meant to serve two purposes: relief of railroad congestion, and the teaching of drivers to operate the army truck. A main road between Chicago and New York is planned, with as many tributary routes as may be necessary to connect the great automobile manufacturing plants with the main road. In December the first section of what is meant to be a great fleet of 30,000 army trucks, started from Detroit on its way to New York. If the entire plan is carried out, it will restore to the railroads for other uses, 15,000 freight cars which had been meant for the transport of these trucks. This is an enormous proposition which is already undertaken by starting trucks from Detroit.

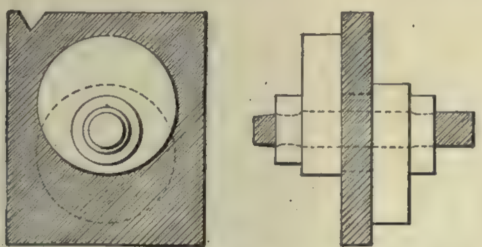
The proposed routes will cover a mileage up to 800, and this will give drivers an experience absolutely necessary to their work in Europe. The master driver must have a certain emergency experience such as cannot be had in ordinary circumstances. On a 400- to 800-mile drive, in winter weather, over roads of every description, the drivers of these army trucks will experience difficulties fairly similar to those they must expect to experience in Europe—in less degree of hardship perhaps, but perhaps not even that. The roads will eventually be put in shape, but meantime the test of the plan has begun, with its difficulties of every sort of weather, road and accident that may be anticipated.

Double-Throw Eccentric Pattern

By F. R. Calkins

The making of a large double-throw eccentric pattern involves a considerable amount of lathe work if the usual method of procedure is followed. The pattern as a rule is split or jointed laterally; and if built up after turning and then sawed, painstaking workmanship is necessary to insure accuracy.

To mold from such a pattern requires no especial skill, but a drawback is encountered if the mold be not carefully cleaned; or if a slight crush occurs in closing, the loose sand will rise to the strap surface, and if the fact is not discovered in the scratch yard, it will surely show up in machining.



AN EASILY MOLDED PATTERN FOR A LARGE DOUBLE-THROW ECCENTRIC

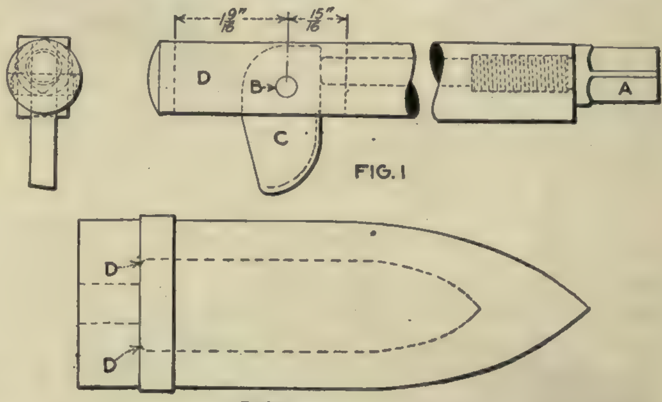
An improved method of pattern construction is shown in the sketch. This pattern is built up from a square block or base which forms a core print of the same thickness as the distance between the two eccentric disks. The throws of the two eccentric disks are laid out on either side of this print and the disks secured thereto. The cope disk may be doweled if preferred, to assure a clean lift in molding.

The disks, hubs and core prints for the shaft core may be cut on the band-saw and sanded or turned in the lathe. Sufficient finish is allowed on the cope half of the hub, to guarantee a clean casting should any sand particles rise to the surface. The drag or nowel shaft-core print is made deeper than usual in order accurately to center the shaft core. The square cake core is V-notched on one edge to insure proper location, and the shaft core can readily be centered through this. Whatever sand holes may occur in the cope face of the disk is of slight matter as no machining is required here. A pattern of this style is what molders term a mere "brick" and the daily output is greatly increased by its use. Not only is the output good but the quality of the castings is first class and they are close to size.

Inside Finishing Tool for Shells

By R. S. Myers

The tool shown in Fig. 1 is used to finish the base thickness inside of 5-in. shells at points *D* in Fig. 2. To operate, the tool is held in the lathe toolpost and the cutter end inserted in the shell opening. The high-speed steel cutter *C*, Fig. 1, is pivoted to bar by pin *B*, and can be folded forward in the slot *D*, thereby allowing it to enter the hole in base of shell where it will drop by gravity to position as shown. It is then locked by tightening screw *A*. When the work is completed the screw *A* is loosened and the bar and cutter backed out of the shell.



FIGS. 1 AND 2. A SHELL-FINISHING TOOL AND THE WORK

Pipe Inspector's Mirror

By Joseph K. Long

Boilers makers, inspectors and repair men having difficulty in examining pipe interiors and other dimly lighted sections of their work, will find the mirror shown in the accompanying sketch a valuable aid.

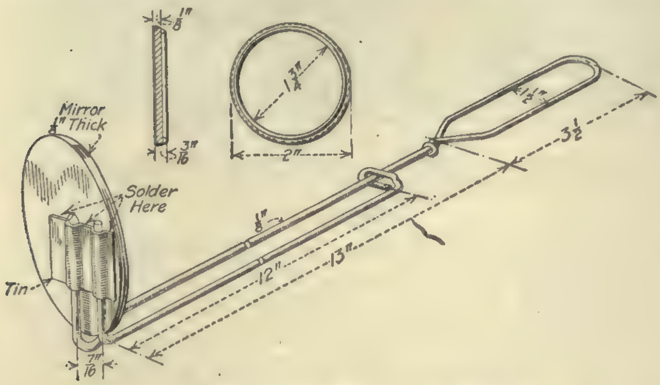
This mirror may be inserted in a pipe, flue or other orifice for a distance of 6 or more inches, and by turning at different angles, any interior defects will be plainly revealed. The device shown in the accompanying illustration may be readily made by any mechanic, and the cost is trifling.

A thin mirror of the size desired is backed and edged with tin. The handle on which the mirror is pivoted is of ⅛-in. stiff wire, having a hand grip looped or formed at one end. At the mirror end this handle is bent at right angles, with a slight loop or rounding at the apex of the angle. The short leg of the angle passes through

and turns in a socket attached to the tin back. The end of this wire is slightly hooked to prevent the mirror from slipping.

A second but shorter $\frac{1}{8}$-in. wire has one end looped about the grip end of the handle wire. The mirror end of this wire is also bent at an angle and inserted in a socket a short distance to the side of the handle socket.

By sliding the loop end of this wire back and forth along the handle rod, the mirror is turned to the angle



MIRROR FOR INTERNAL INSPECTION

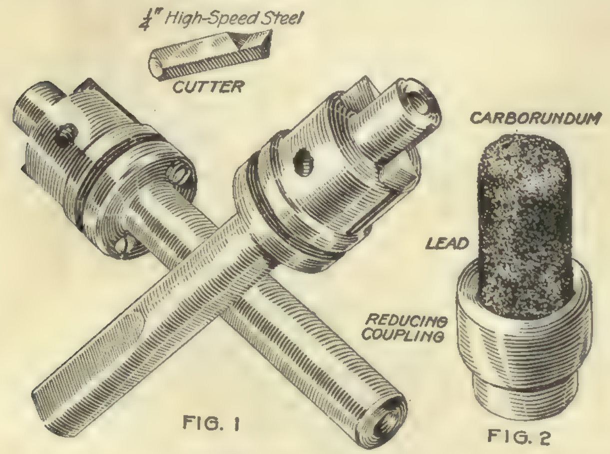
desired and the interior of any dimly lighted portion of pipe or machine may be readily inspected.

This little device may be operated with one hand by gripping the handle and moving the short wire back and forth with the forefinger. This leaves one hand free to hold a lamp or torch.

Two Useful Tools

By M. L. Lowrey

The illustrations show two tools that I have found very useful, and they have the advantage of being easy to make. The first is a pin drill or counterboring tool. The body of the tool is of cold-rolled steel and is to be



FIGS. 1 AND 2. THE COUNTERBORE AND TOOL FOR TRUING GRINDSTONES

casehardened. The cutters are of high-speed steel and can be removed for sharpening, also they are easy to set for height, by the headless setscrews at back end of cutters. I have been using these tools for several months and they have given perfect satisfaction. The boys in the shop like them, which is sure proof that they are good tools.

The second is a tool for truing grindstones. In the small shops here it is the custom to true up the grindstone by using a piece of $\frac{1}{2}$- or $\frac{3}{4}$-in. pipe as a truing tool. It is a slow process and no one likes to do it and the result is that the grindstone is usually in very poor condition.

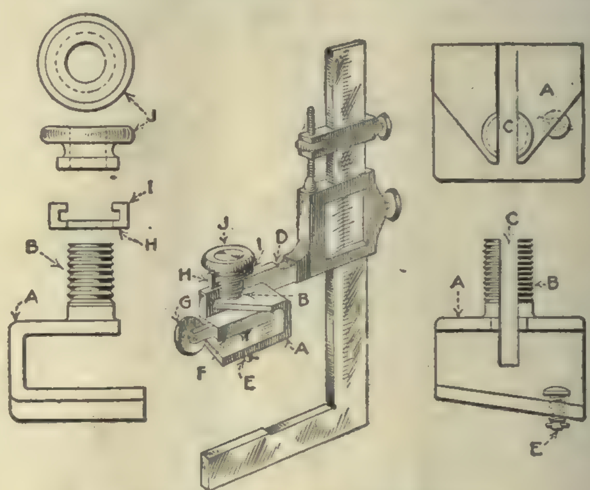
This tool cuts easily and fast, and since I made it I have had no trouble with the grindstone as the boys keep the stone true without being told to true it—a very unusual thing in my experience.

The tool is made from a piece of coarse and very hard carborundum wheel, and is chipped into shape with light blows of the hammer and a cold chisel or dull center-punch, and can be sharpened in the same manner when it becomes dull. It is secured in the pipe fitting by pouring melted lead around it, and for a handle we screw a piece of pipe into the sleeve.

A Micrometer Clamp Attachment for a Height Gage

By L. C. Blomstrom

It is frequently necessary, especially when chucking tapered plugs, to make use of a micrometer attached to a height gage. In the illustration the clamp shown affords a simple, quick and effective means for com-



MICROMETER CLAMP ATTACHMENT

bining the two tools, and by which they will be rigidly held in position.

The construction and application of the clamp is substantially as follows: a bracket *A* has a threaded stem *B* extending from its upper face. The stem *B* is slotted through as at *C*, and this slot is extended down into the bracket *A* to permit the latter to be slid upon the projecting jaw *D* of the height gage. The lower inner face of the bracket is inclined as shown, and a threaded opening is provided to receive a screw *E*, which is designed to bear against the under side of the micrometer frame *F* carrying the micrometer *G*, thus permitting the frame to be adjusted to bring the spindle parallel to the surface or work plate, and to hold it in adjusted position.

A plate or washer *H* having the inturned lips or lugs *I* is fitted on the threaded stem *B*, and bears against the upper face of the bracket *A*. The inturned lips *I* engage a circumferential groove in a nut *J*, which engages the stem *B*, thus securely clamping the bracket *A* and micrometer frame *F* on the jaw of the height gage.

Decimal-Equivalent Table Useful in Gear Work

By Taft S. Armandroff

When laying out gearing it is frequently desirable to consult handbooks for tables giving the decimal equivalents of common fractions. These tables of course, are of value if the diametral pitch of the gears under consideration corresponds to the denominators of fractions shown in the tables; but this coincidence does not always favor the person who makes the calculation. A complete table of decimal equivalents for those fractions which would be of greatest help, has long been desired, and as the center distances and diameters of gears are generally given in decimals, the need for such a table is obvious.

Consider for example, two spur gears of 22 diametral pitch, having 36 and 42 teeth: by dividing the sum of the teeth in both gears by twice the diametral pitch, we find the center distance to be $(36 + 42) \div (2 \times 22) = 78 \div 44 = 1^{34}/_{44}$ or $1^{17}/_{22}$.

From the accompanying table it will be found that $^{17}/_{22}$ equals 0.7727, hence the center distance is 1.7727 inch.

DECIMAL EQUIVALENTS OF FRACTIONS OF AN INCH

Terms (Denominators)	Numerators 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
3	0.3333	0.6667																	
4	0.2500	0.5000	0.7500																
5	0.2000	0.4000	0.6000	0.8000															
6	0.1667	0.3333	0.5000	0.6667	0.8333														
7	0.1428	0.2857	0.4286	0.5714	0.7143	0.8571													
8	0.1250	0.2500	0.3750	0.5000	0.6250	0.7500	0.8750												
9	0.1111	0.2222	0.3333	0.4444	0.5556	0.6667	0.7778	0.8889											
10	0.1000	0.2000	0.3000	0.4000	0.5000	0.6000	0.7000	0.8000	0.9000										
11	0.0909	0.1818	0.2727	0.3636	0.4545	0.5455	0.6364	0.7273	0.8182	0.9091									
12	0.0833	0.1667	0.2500	0.3333	0.4167	0.5000	0.5833	0.6667	0.7500	0.8333	0.9167								
14	0.0714	0.1428	0.2143	0.2857	0.3571	0.4286	0.5000	0.5714	0.6429	0.7143	0.7857	0.8571	0.9286						
16	0.0625	0.1250	0.1875	0.2500	0.3125	0.3750	0.4375	0.5000	0.5625	0.6250	0.6875	0.7500	0.8125	0.8750	0.9375				
18	0.0556	0.1111	0.1667	0.2222	0.2778	0.3333	0.3889	0.4444	0.5000	0.5556	0.6111	0.6667	0.7222	0.7778	0.8333	0.8889	0.9444		
20	0.0500	0.1000	0.1500	0.2000	0.2500	0.3000	0.3500	0.4000	0.4500	0.5000	0.5500	0.6000	0.6500	0.7000	0.7500	0.8000	0.8500	0.9000	0.9500
22	0.0455	0.0909	0.1364	0.1818	0.2273	0.2727	0.3182	0.3636	0.4091	0.4545	0.5000	0.5455	0.5909	0.6364	0.6818	0.7273	0.7727	0.8182	0.8636
24	0.0417	0.0833	0.1250	0.1667	0.2083	0.2500	0.2917	0.3333	0.3750	0.4167	0.4583	0.5000	0.5417	0.5833	0.6250	0.6667	0.7083	0.7500	0.7917
26	0.0385	0.0769	0.1154	0.1538	0.1923	0.2308	0.2692	0.3077	0.3462	0.3846	0.4231	0.4615	0.5000	0.5385	0.5769	0.6154	0.6538	0.6923	0.7308
28	0.0357	0.0714	0.1071	0.1428	0.1786	0.2143	0.2500	0.2857	0.3214	0.3571	0.3928	0.4286	0.4643	0.5000	0.5357	0.5814	0.6071	0.6429	0.6786
30	0.0333	0.0667	0.1000	0.1333	0.1667	0.2000	0.2333	0.2667	0.3000	0.3333	0.3667	0.4000	0.4333	0.4667	0.5000	0.5333	0.5667	0.6000	0.6333
32	0.0312	0.0625	0.0937	0.1250	0.1562	0.1875	0.2187	0.2500	0.2812	0.3125	0.3437	0.3750	0.4062	0.4375	0.4687	0.5000	0.5312	0.5625	0.5937
36	0.0278	0.0556	0.0833	0.1111	0.1389	0.1667	0.1944	0.2222	0.2500	0.2778	0.3055	0.3333	0.3611	0.3889	0.4167	0.4444	0.4722	0.5000	0.5278
40	0.0250	0.0500	0.0750	0.1000	0.1250	0.1500	0.1750	0.2000	0.2250	0.2500	0.2750	0.3000	0.3250	0.3500	0.3750	0.4000	0.4250	0.4500	0.4750

Terms (Denominators)	Numerators 20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
14																				
16																				
18																				
20																				
22	0.9091	0.9545																		
24	0.8333	0.8750	0.9167	0.9583																
26	0.7692	0.8077	0.8462	0.8846	0.9231	0.9615														
28	0.7143	0.7500	0.7857	0.8214	0.8571	0.8928	0.9286	0.9643												
30	0.6667	0.7000	0.7333	0.7667	0.8000	0.8333	0.8667	0.9000	0.9333	0.9667										
32	0.6250	0.6562	0.6875	0.7187	0.7500	0.7812	0.8125	0.8437	0.8750	0.9062	0.9375	0.9687								
36	0.5556	0.5833	0.6111	0.6389	0.6667	0.6944	0.7222	0.7500	0.7778	0.8055	0.8333	0.8611	0.8889	0.9167	0.9444	0.9722				
40	0.5000	0.5250	0.5500	0.5750	0.6000	0.6250	0.6500	0.6750	0.7000	0.7250	0.7500	0.7750	0.8000	0.8250	0.8500	0.8750	0.9000	0.9250	0.9500	0.975

If the pitch diameter of some gear is to be found—for example a gear of 22 diametral pitch, having 36 teeth—we divide the number of teeth by the diametral pitch, with the result $36 \div 22 = 1^{14}/_{22}$. From the table $^{14}/_{22} = 0.6364$. Hence the pitch diameter of the gear equals 1.6364 in., while the outside diameter equals pitch diameter plus twice the addendum, thus: $1^{14}/_{22} + ^{2}/_{22} = 1^{16}/_{22} = 1.7273$ inch.

When the outside diameter of the same gear is required, without knowing the pitch diameter, we add two to the number of teeth and divide the sum by the diametral pitch, giving $(2 + 36) \div 22 = 38 \div 22 = 1^{16}/_{22}$. According to the table $^{16}/_{22} = 0.7273$. Hence the outside diameter of the above gear equals 1.7273 inch.

I have found it a most useful table when calculating gear trains, and trust it will be appreciated by the readers of the *American Machinist*.

Moving Machinery

By H. Lauterbach

In an article under the above title on page 1060, Vol. 47, Oscar C. Koehler describes a method of laying out floor positions by means of templets of wood, made to the dimensions of the machines to be moved.

While there can be no doubt of the certainty of this method, the writer has a plan which he believes will insure quite as satisfactory results without the expense involved in making and placing the templets.

First, lay out to convenient scale on the drawing board a diagram of the floor space to be occupied, together with all permanent obstructions, as pillars, piping, etc. On a separate drawing lay out to the same scale and in any convenient position, all tools, machines and work to be placed on the floor, marking each outline plainly for identification. With a pair of scissors cut out the pieces outlined on this second drawing and place them upon the first drawing, according to the previously determined arrangement; any interference will be promptly checked and the pieces may be moved about until a satisfactory arrangement is found; indeed, it would be an unusual case where such movement would not suggest a more advantageous arrangement than the one first planned.

We have located all machines for a new plant and have made several changes due to expansion, using this method with uniformly satisfactory results.

Overcoming Loose-Pulley Trouble on a Special Drive

BY J. LIMBRUNNER

In Fig. 1 is shown the general arrangement of the driving pulleys on the shaft of an extractor (textile machine). A different size of pulley is mounted at each end of the shaft. When the machine is not in use the belt at each end is running idle on the loose pulley.

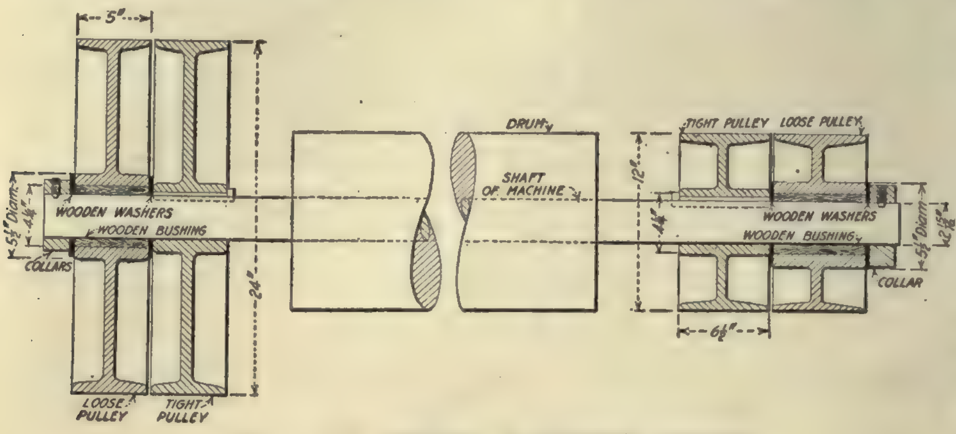


FIG. 1. OLD METHOD OF BUSHING PULLEY

When winding goods on the drum, which is secured to the shaft, the belt is shifted to the large tight pulley, and the drum will then run at 27 r.p.m., while the small loose pulley runs at an approximate speed of 410 r.p.m.

The goods being all wound on the drum the belt is shifted back on the large loose pulley and the belt at the other end moved to the small tight pulley thus making the drum run about 410 r.p.m. The outcome is that the shaft revolving inside of the large loose pulley at this high speed acts as a lap; the result being the rapid wearing of the bushing in the pulley.

All kinds of bronze and wood bushings were tried, but none of these stood up very long, and the repair of the machines became quite an expense.

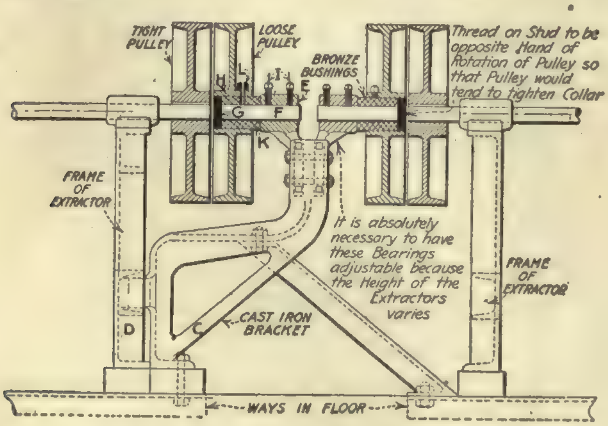


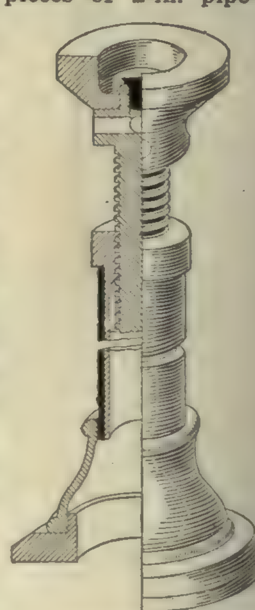
FIG. 2. IMPROVED METHOD OF MOUNTING PULLEY

Finally the writer worked out the following plan, which has now been tried on two machines for about a year, and has been found to be successful as no bushings have had to be replaced on these machines during that time. Improvement, as applied to two machines, is shown in Fig. 2, and consists of a separate cast-iron stand *C*. This stand is secured to the side frame *D* of the machine. At the top of the stand *C* is fastened a cast-iron bearing bracket *E*, which serves to hold a stationary stud *F*. This stud which has a head *G* at one end large enough to be a running fit in the pulley hub *H*, is held in the bracket *E* by means of two setscrews *I*. The pulley is provided with a bronze bushing *K*, and an oiler *L* of the talcum-candle type. From the illustration it will be seen that the loose pulley is absolutely independent of the shaft. Consequently, no matter how fast the shaft may be running the loose pulley is not affected and the bushing does not wear out. I will say, however, that this plan was used only for holding the large, and slow-running pulley, because this one caused most of the trouble, and not much would be gained by mounting the small loose pulley in the same manner. While this improvement is used on textile machinery there is no reason why it could not be applied to all kinds of machinery where a somewhat similar set of operating conditions have to be contended with.

Handy Screw Jacks

BY R. W. DERBY

Being in need of a pair of jacks in our shop and not caring to go to the expense of making a pattern for the body and base, I hit upon the idea of making them from pipe parts. Two pieces of 2-in. pipe 7 in. long were cut and threaded on one end. These were screwed into two 3-in. to 2-in. reducing couplings. A pattern was made for two base flanges which were cast, finished and threaded to fit the large end of the coupling as shown in the accompanying sketch. Two cast-iron bushings for the 2-in. pipe were made from some old forge weights, were drilled and threaded inside to a depth of 2 in. to fit a $1\frac{3}{8}$-in., 5-pitch square-thread screw. The remaining length of the bushings, which were 8 in. over-all, were counterbored for screw clearance. The screws were made from $2\frac{1}{16}$-in. discarded shafting. Handles for carrying were made of $\frac{1}{4}$ by $\frac{3}{8}$-in. machine-steel bolted on with capscrews. While patterns were required for the base and cap castings, the only other parts not worked out of scrap were the reducing couplings. The illustration shows the cross-section of the jack.



CONSTRUCTION OF SMALL SCREW JACK

War Industries Being Brought Under Modern Engineering Control

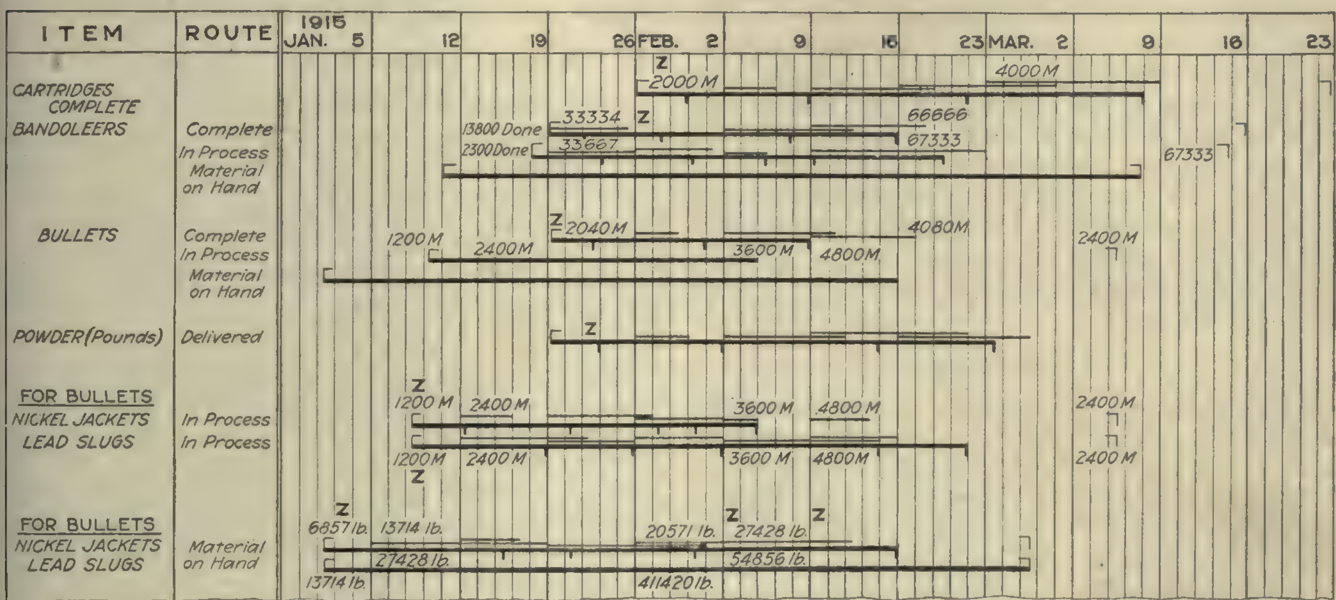
BY MONT SCHUYLER

Associate Editor, "Engineering News-Record"

GERMANY had prepared for a six months' war. Her supplies, her armies, her transportation system were all tuned for this period. For the general staff had figured the campaign with such precision—so they thought, at least—that any greater extension of preparation would be a waste of national effort. Only one man in the empire felt that the chance of plans miscarrying was of sufficient importance to provide against. His suggestions to Gen. Falkenhayn were laughed at.

This man, an engineer high in the counsel of the Allgemeine Elektricitäts Gesellschaft, felt that to enter into a project as subject to failure as a military campaign, without a plan whereby every resource of the nation might be concentrated on the effort, was suicidal. But his feelings ran counter to the convictions of the all-high command. He had to wait for the stalemate of December to obtain the opportunity of putting the whole of the industrial resources of the country on a planning and progress chart basis.

This sidelight on the military situation in Europe at the beginning of 1915 is neither invention nor rumor. It is fact, well vouched for by men of undoubted reliability. Therefore, it should be welcome news to the engineers of America to know that a start in the proper direction has already been made in this country. The Office of the Chief of Ordnance has had for some time a planning division in certain of its own shops, and is now extending this most important work to all the factories which are making supplies for the office. The Progress Section of the Control Bureau, this last functioning as a division of the Ordnance office, keeps its mind on the progress of all war orders within its jurisdiction. Under Major Sanford E. Thompson a corps of men, volunteers holding commissions in the U. S. Reserves, and all specialists in this work in their civil capacities, keep in touch with the promises and performances of manufacturers, determine wherein lies the cause of delays and what steps must be taken to keep production up to the schedule of requirements which have been determined as necessary to our full and successful participation in the war. No simple task, this. With ordinary statistical methods it is probable that no appreciable result would have been attained, for the complexity attending the manufacture of an item so small as a ball cartridge involves the coördination of an amount of data that would be utterly undigestible unless reduced to a form which is visually understandable.



COMPLETE HISTORY OF WORK IS GIVEN ON ONE CHART

The use of "progress charts" is known to engineers as one of the significant contributions to the industrial development of the past few years. Here was a situation of a size that would prove, once and for all, the value of these charts and their adaptability to the greatest problems of today—for never before has such a trial been made. If the success which is indicated at the present moment is attained, it is safe to say that a new rationality will have come into industry to stay. For no plant which has once had the opportunity of benefiting from the application to production of sound engineering principles, of which the progress chart is an example, would willingly go back to the antediluvian, hit-and-miss method of ordering, routing, and shipping. If once these principles attain a firm footing in the factories, there is no doubt that the application of progress charts will find wider fields. There seems to be no reason why futures of other and more general character should not be provided against in a similar manner.

The method is the logical outcome of the scientific management movement of the past decade. It purposes

to set before the planning board of an industry the speed at which various parts of a mechanism or product must be completed, in order to avoid the delays which attend an unordered process. To do this properly presupposes a knowledge of the processes, an organization to collect the data during the period of manufacturing, and a body of men who are to reduce this statistical matter to comprehensible form, The difference between the progress engineer and the statitician lies somewhere in this last step. There have been statisticians in Washington before. There still are some there—and of value in the steps preceding the final analysis.

Leaving out of consideration the charts which show the demands as voiced by the general staff—not only because of their complexity, but also because of their nonengineering interest—attention is drawn to the accompanying illustration which shows, as an imaginary, not an actual, example, the planning involved in and the follow-up applied to an order for ball cartridges. Certainly there is something startling in the series of lines, light and heavy, which tells the whole story of the progress being made at a hypothetical plant. Yet one accustomed to an interpretation of such graphs could indicate the point at which the factory organization fell down, and, if at all cognizant of the processes connected with the manufacture of cartridges, could point out wherein the failure lay, what steps should have been taken to prevent the obvious delays, and what should be done now to remedy past mistakes and to avoid future trouble.

Use of the Chart

Before going into a somewhat detailed description of this particular chart, which is of the type evolved by H. L. Gantt, and originally introduced by him in the Ordnance Bureau, a short explanation of the various conventions and symbols is in order. Given a full understanding of the meaning of these, there is nothing recondite or even difficult about the scheme or its application by any engineer who has once mastered the basic idea. He should have no trouble in applying the method to his own work, whether it be road construction or the manufacture of structural steel members.

The angle of the lower right quadrant, drawn in light lines, indicates the date on which the material should be on hand, started in process, or the time when final assembly should be initiated. This date is determined upon by the Government inspector after an examination of the plant and a consultation with the management. The terms of the contract also enter at this point, for obviously the date of delivery has much to do with the time at which the work should be started and the speed with which it should be prosecuted.

To the right of these angles will be found a figure which indicates the number of pieces scheduled for completion during the week. Until a different figure appears on the same horizontal line, this holds as the schedule. The light line below is the percentage of that week's allotment which was completed during that period. For instance, the light angle in the top line is witness to the fact that complete cartridges should be available at the beginning of the week of Feb. 2, and the figure shows that 2,000,000 should be delivered during that week. The small letter "z" (zero) records that no deliveries were made, while the light line in the next week's space, extending over three of the five divisions, signifies that 60% of the number expected during that week were completed. Similarly, in the following week, 140% of the 2,000,000 allotment was completed.

In some other cases, as under "Bandoleers Completed," more were finished during the weeks beginning Feb. 9 and Feb. 16 than were scheduled for these periods. In such cases, the lines would overlap, so they are separated by a slight vertical displacement of the second week's line.

As a final step in the recording of any item entering into the complete cartridge, the light horizontal lines are added and the combined length is drawn as a heavy line, beginning at the point set by the light angle as the date upon which the route should be taken. Thus it may be seen that at the end of the week of Feb. 16 only 4,000,000 cartridges had been finished, although an adherence to schedule would have made 6,000,000 available. This deficiency was corrected during the following weeks, as may be seen from the chart.

Chart Gives Information Quickly

This information can be obtained from a mere glance, and is surely more immediately apparent than a similar statement in figures. Furthermore, the same chart, in a space that the eye can easily cover at one glance, yields information which allows an almost absolute determination of the causes of delay; for the same principles that were applied to the progress of the complete cartridge through the factory can be and are applied to each of the separate items which go to make up the unit.

Furthermore, the material on hand is similarly plotted. The week-to-week history of the contract is set before the man responsible for the completion of that particular contract, and he is able to put his finger on the division of the work which is lagging and holding up delivery. An examination of the chart, based upon an understanding of the foregoing paragraphs, will show why deliveries of completed cartridgees were not begun at the time scheduled. In this case the trouble can be traced to the lack of sufficient powder. The chart shows that during the week of Feb. 2 the first delivery was made, while the schedule called for delivery during the week of Jan. 26. This first delivery was not enough to start work on, but taken with the deliveries during following weeks it was sufficient to bring the schedule up to the desired figure in a very short time.

These charts are made by the Government inspectors at the various plants, as a part of their routine duty. They are forwarded to Washington, finally getting to the hands of the Progress Section of the Control Bureau. Here they are reduced to the form in which they are to be used, plotted and analyzed. The section has no immediate control over the work at the factory, but keeps itself aloof and in the attitude of a student endeavoring to determining causes. In a sense, it is the "Intelligence Department," to use a phrase that is coming into wider use, in which the manifestations of disorder and misunderstanding are caught soon after their appearance, and studied with the purpose of determining wherein the difficulty lies.

Nor must it be thought that the object of such work is criticism. Rather, the work functions fully only when it can forestall criticism. Its real purpose, then, is found in its ability to forecast trouble in such a manner that

steps may be taken to prevent disastrous growth. The more complete the data on which such an organization works, and the more full its opportunity to digest the statistics which come before it, the greater service it can render. Where the limit of value of this modern service lies has not yet been determined. Today the further the analyses are pushed, the more definite and usable become the results.

It may readily be seen, since these charts are being kept up to date on every item which is required by the office of the Chief of Ordnance in its many activities, that master charts may be used to any extent that seems desirable or necessary. The statistics of the supplies for a complete unit, or even an expeditionary force, may be reduced to the same basis. In such form information in the hands of the general staff, for instance, can be made of incalculable value in determining the possible movement of troops, and in a manner to prevent the unfortunate situations that have been considered, in the past, inevitable accompaniments of large-scale military operations.

Workers for the Shipyards

Because ships are the primary factors in the winning of this war, and because the construction of these ships depends, and will always depend, upon labor, there has been created an organization of workmen known as the United States Shipyard Volunteers, enrolled under the Public Service Reserve. This organization is composed of workmen who are willing to give a good day's work for a good day's pay; workmen who are not asked to sacrifice present positions to rush madly off to shipyards which may not be able to accommodate them for the moment, but who stand ready when called upon to do a particular job for a particular wage in a particular place, and who have enrolled themselves in this organization so that when needed they may be readily reached.

The Need Is Great

The need of the nation is great. The Shipping Board has the money, the housing of men is being arranged for, the yards are being completed and the materials provided. All that now is lacking is the knowledge of the need that will inspire loyal and efficient mechanics to enroll for service in the yards, but not in a fashion to disrupt the business of the country through the robbing of present industries. On the other hand it is planned to make a careful selection of men whose places can be filled without hardship, and who when called upon to give up the jobs they now hold will have waiting for them definite positions at definite wages in definite yards.

Shipyard Men Out of Draft

Men actually working in the shipyards will be placed in the deferred class in the draft.

It is urged, therefore, that mechanics go at once to the nearest enrollment agent of the United States Public Service Reserve of the Labor Department, or to the local enrollment agent of his State Council of Defense, and register themselves as willing to work in the shipyards if needed; then to retain their present positions until called personally for service.

Through the Council of National Defense an appeal has been made to governors, mayors, and other prominent officials, to stimulate interest in their communities.

Edward N. Hurley, Chairman of the United States Shipping Board, and President of the Emergency Fleet Corporation, says:

Inspiring Words From Chairman Hurley

If the American people could be made to realize the necessity of building ships before this war can be won, they would subordinate local needs to national necessity. They would realize that not merely the safety of the nation depends upon the quick building of ships, but that industry itself must be disturbed and labor inconvenienced until such time as all the shipyards are working at their maximum capacity.

The man who lays down on the job in a shipyard, reducing his output, does not give employment to another man to make up his deficiency. Instead, he throws two or three men out of work, because everything that labor turns out for exportation must wait upon the completion of the ship which is designed to carry such supplies.

To manufacture thousands of tons of war munitions and other commodities for our army and then send them to the seaports, and not have ships to carry these supplies to France, will cause more congestion at our seaport terminals, and will ultimately result in the complete closing down of many of our industries.

The happiness of every man, woman and child in this country is involved in the shipbuilding program. Every rivet driven in the shipyards brings us nearer to the successful termination of the war. It is a question of manpower in shipbuilding, and within sixty days we will require 250,000 skilled mechanics to help the other loyal men now in the yards to build ships so fast that supplies can be furnished to our boys in the trenches who are making the supreme sacrifice for their country.

Charles Piez, Vice-President and general manager of the Emergency Fleet Corporation, says:

We have the task of getting the men, and we have the greater task of imbuing the entire community, the entire nation, with the supreme importance of this shipbuilding program. It does take precedence over every other single effort that we are making to win the war, and that message must be carried to every citizen.

A Duty of the Higheset Patriotism

We must have inspiration in every man who works in the shipyards, and every one connected with them. We must have the idea that a man who does work in the shipyard is carrying with him the same sacrificial service, performing the same duty as the man at the front.

It is not merely a job of eight hours, paying big wages. Conditions are not ideal in every community where ships are being built, although the Government is trying to make them so. The men must have that impressed upon them—they must not kick; they must not resist going. They have temporarily to bear that burden so that these ships may be gotten out, and the cause won in the earliest possible time.

In addition to the card which the volunteer fills out for the Public Service Reserve, he signs the following franked postcard, addressed to Chairman Hurley at Washington:

Appreciating the Nation's imperative need for skilled workmen to build merchant ships with which to overcome the submarine menace, I request to be enrolled as a member of the United States Shipyard Volunteers of the Public Service Reserve. I realize that the World War will be won or lost in the American shipyards. Every rivet driven is a blow at the Kaiser. Every ship turned out brings America nearer to victory.

It is understood that if I am asked to enter shipyard employment, my compensation shall be at the rate of wage prevailing in such yards.

The button which the workmen receive after enroll-

ing bears this inscription: "U. S. Shipyard Volunteers."

A Service Certificate to All Who Enroll

The text of the certificate which is given to him upon enrollment, or sent later, reads:

This is to certify (name of volunteer) of (city, state), has enrolled in the United States Shipyard Volunteers of the Public Service Reserve to aid the Nation in its imperative needs for merchant ships with which to overcome the submarine menace and maintain our forces at the front.

The World War will be won or lost in the American Shipyards. Every rivet driven is a blow at the Kaiser. Every ship turned out brings America nearer to victory.

Those who give their strength and their influence to the speedy construction of ships render service that is patriotic and highly essential to the successful termination of the war.

Edward N. Hurley,
Chairman, U. S. Shipping Board.

Workers Needed

The list below shows the kinds of trades most needed in shipbuilding, and a particular appeal is addressed to men in such occupations to enroll in the Reserve:

Acetylene and electrical welders; asbestos workers; blacksmiths, anglesmiths, drop-forge men, flange turners, furnace men; boilermakers, riveters, reamers; carpenters, ship carpenters, dock builders; chippers and calkers; electrical workers, electricians, wiremen, crane operators; foundry workers; laborers, all kinds; loftsmen, templet makers, machinists and machine hands, all sorts, helpers; painters, plumbers and pipefitters; sheet-metal workers and coppersmiths; ship-fitters; structural iron workers, riveters, erectors, bolters up; other trades, cementers and crane men.

Thomas Fawcus

Thomas Fawcus, President of the Fawcus Machine Co., Pittsburgh, Penn., died Jan. 22, at Mercy Hospital after an illness of about three weeks, leaving a widow and two daughters.

Mr. Fawcus was born in England in 1866. Coming to this country in 1888 he located at Birmingham, Ala. Later he became connected with enterprises in Chattanooga, Tenn. Afterward he came to Pittsburgh, being associated in turn with the Westinghouse Electric and Manufacturing Co., Anderson-Dupuy Co. and the R. D. Nuttall Co.

In 1900 he organized the Fawcus Machine Co., Pittsburgh, for the manufacture of gears and special machinery. The company started business in a one-story building at 2820 Smallman St. This was later increased by the addition of a second story. In 1906, the building at 2828 Smallman St. was added. Under the able management of Mr. Fawcus the growth of the business was so rapid that in 1910 the plant at Ford City, Penn., was purchased.

Mr. Fawcus was endowed with the rare combination of superior executive ability and a keen inventive brain. This is attested by the growth of the company and his many mechanical inventions, the most notable of which are the machines for cutting herringbone gears. In 1912 Mr. Fawcus started to design and develop the Fawcus herringbone gear cutting machines, which were later covered by patents both in the United States and foreign countries. The development of these machines has had the constant attention of Mr. Fawcus and has proven successful and satisfactory in every respect.

Mr. Fawcus was a member of the American Society of Mechanical Engineers, Society of Engineers of Western Pennsylvania, Calvary Episcopal Church, Duquesne Club, Oakmont Country Club and St. Andrews Brotherhood.

THOMAS FAWCUS

To Discourage the Enlistment of Technical Students

The recent action of the Secretary of War regarding the drafting of technical men is most encouraging from many points of view.

The new ruling is that if technical students wait until drafted, they can upon summons to the draft camp, take with them a letter from the president of a technical institution stating their special qualifications, such letter to be filed with the occupational census questionnaire of the War Department. The Secretary of War also authorizes the statement that effort will be made to use each student's special training in connection with specialized occupations in the army, so as to afford technical students of draft age, fully as great an opportuntiy through the draft as if they enlisted now.

This is a decided step in the right direction, and the Secretary of War is to be congratulated on taking this advanced stand. It will do much to hearten those who were discouraged over our apparent failure to benefit by the sad experience of England and France in the earlier days of the war.

Editorials

The Honor of the U. S. R.

THE reserve officers of the Ordnance Department have a great responsibility. They must give their best work and more to the Government at this time. Not only is their personal honor and reputation at stake but also that of the engineering and business branches which they represent. It is in their power to increase or to injure both.

Hundreds of these reserve officers are giving their best efforts, are working long hours, enduring discomforts and sacrificing substantial incomes in order to serve the country at this time. They are making an excellent record for efficiency and have made possible the sudden expansion of the work of the Ordnance Department.

But there is unfortunately another side which must be seriously considered. In some few instances at least, these officers are forgetting that service to the country is the first consideration—that all else is secondary. They are forgetting that orders must be placed absolutely without regard to previous business connections or personal considerations of any kind.

There is a natural tendency to place orders with those whom one knows, but the greatest care must be used to avoid causes for suspicion that self-interest in any way influences the decision. It is impossible to be too careful where orders go, and what terms are secured. It is much better to err on the safe side than to seem to show favoritism in any case.

THE policy of some concerns, in the machine business at least, is to quote Government orders the very best jobber's price on all products which are sold through the trade. In spite of this, however, orders are being placed through supply houses that must pay at least five per cent. more for the goods ordered than the Government would pay direct. What they charge the Government depends on the elasticity of the conscience of the dealer and the knowledge of the officer placing the order.

In some cases these orders are being placed by reserve officers who are or were connected with the supply firms which secure the order. In other instances, reserve officers refer all who wish to build machinery for the Government to dealers or builders of machinery who because of their size are important factors in supplying Government needs, and with whom they were formerly connected. It is even charged that dealers and manufacturers receive advance tips by phone and wire from reserve officers who have been in some way connected with them in the past.

There are doubtless many cases where preference has been given in certain quarters in the firm belief that the best interests of the country were thus being served. Unfortunately there are many instances where no such excuse exists but where the desire to favor old friends or to pave the way for a good position later has been the deciding factor. This is no time for personal considerations of either position or profit. The duty of everyone is to serve as best he may.

BUT few are given such opportunity to serve not only the country but their own profession as is now given the reserve officers of the War Department. The integrity of mechanical business and of professional men will be judged by the way in which the reserve officers justify the confidence placed in them. The honor and reputation of the industry will be marred unless the reserve officers drawn from their industry prove that they can forget self-interest and work solely for the common good.

Investigations usually follow such huge undertakings, and if questionable deals have been made they are sure to come to light; but whether investigation be made or not it should be the aim of all so to serve the country that there can be no question as to motives or the results.

We have faith that the reserve officers will guard their opportunity so jealously that any of them who forgets his obligations and his responsibility will be forced out of the service.

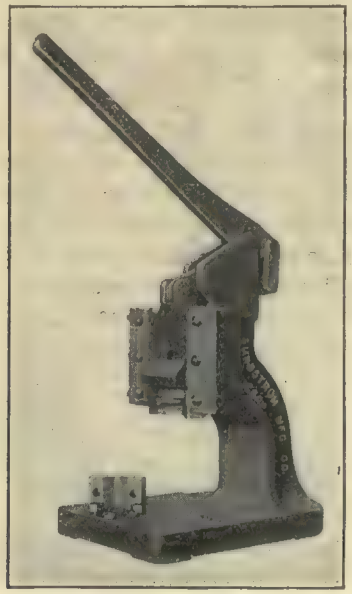
THE *American Machinist* is ready to do its share in helping to maintain the high standard which we know actuates the great majority of those in uniform. It is ready to uphold all who try to do the right; to condemn those who neglect or forget their duty, whether regular or reserve.

This is the time to show the world that we are not a nation of money-getters; instead, that the opportunity for service outweighs all other considerations. Let "U. S. R." become a synonym for honorable and unfaltering service.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

"Rex" Die-Testing Press

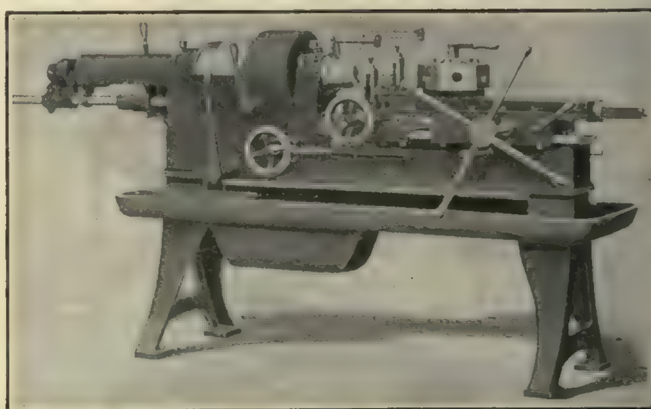
The Sundstrom Manufacturing Co., 3201 Shields Ave., Chicago, Ill., is now marketing the "Rex" die-testing press, shown in the illustration, which is for the purpose of spotting dies, finding blanks, shearing-in punches, locating dowel pins, etc. The device has a leverage of 20 to 1, making it sufficiently powerful to cut blanks up to 3 x 4½ in. from sheet stock up to $\frac{7}{32}$ in. thick. The slides are gibbed, allowing adjustment for wear, and the square shank holder takes shanks up to 2 in. in diameter. The depth of throat is 7 in., the stroke is 1¼ in., the die space with the head down is 6½ in. and the weight is about 260 lb.



"REX" DIE-TESTING PRESS

Defiance No. 4 Turret Screw Machine

The Defiance Machine Works, Defiance, Ohio, has recently placed on the market the No. 4 turret screw machine illustrated. The machine is equipped with geared friction head, automatic chuck, bar feed and hand longitudinal feed to cutoff. All gears are completely guarded. The head is of the cone-type drive with friction back gears, giving two spindle speeds for each cone step, or six speeds in all. The head and bed are cast integral to insure strength and rigidity. The automatic chuck and bar feed are operated by a lever within reach of the operator, and unless otherwise specified one collet for 1⅝-in. round stock is furnished with the machine. The collet is adjusted automatically for slight variations in the diameter of the stock by a stepped wedge. The hexagon turret is regularly furnished with tool holes bored 1½ in. in diameter and fitted with binder screws. Bolt holes are also provided to fasten tools to the turret faces. The turret is indexed automatically by reversing the slide, and turns on a steel stud. A hardened-steel lock bolt operates directly beneath the cutting tool and works in a tapered, hardened-steel bushing. The turret slide and saddle are adjustable both vertically and laterally by means of taper gibs, this feature allowing the turret to be kept in correct alignment with the spindle. The cutoff slide is controlled with a hand wheel and screw, adjustable stops controlling the forward and reverse movements. A swiveling toolpost is provided at the front of the slide and a cutting-off toolpost, which can also be swiveled, is provided at the rear. A handwheel and inclosed screw, operating a longitudinal feed which is essential for facing, necking, etc., is regularly supplied.



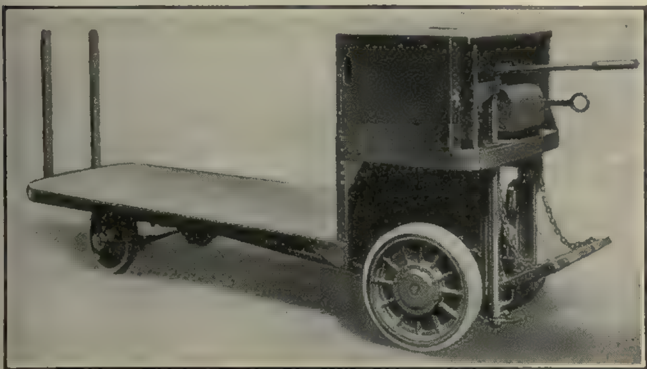
DEFIANCE NO. 4 TURRET SCREW MACHINE

Maximum collet capacity, 1⅝-in. rounds, 1$\frac{13}{32}$-in. hexagons, and 1$\frac{3}{16}$-in. squares; maximum capacity through spindle, 2-in. rounds, 1¾-in. hexagons, 1⅜-in. squares; diameter of spindle hole, 2$\frac{1}{16}$ in.; thread on spindle, 3⅜ in. in diameter, 6 pitch; spindle speeds, six, 37 to 412 r.p.m.; swing over bed, 16 in.; swing over cutoff slide, 6¾ in.; width of belt, 3 in.; tool holes in turret, 1½ x 3 in.; size of turret faces, 4¼ in. wide, 4 in. high; diameter across turret flats, 9¼ in.; size of tapped holes in turret faces, ⅜ in.; maximum distance face of collet to turret, 21 in.; center of tool holes to top of slide, 3⅜ in.; length of stock turned 8 in.; cross travel of cutoff slide, 5⅝ in.; longitudinal travel of cutoff slide, 8 in.; width of bed, 8½ in.; maximum longitudinal travel of turret, 10¾ in.; feeds of turret, four, 0.007 to 0.036 in. per spindle revolution; horsepower required, 2; floor space, 36 x 102 in.; floor space with bar feed, 36 x 144 in.; net weight, 2500 lb.

Automatic feed for the turret slide can be furnished to order. This is an all-geared device and provides four changes of feed which can be obtained by shifting a lever placed within reach of the operator. An automatic pump furnishes a continuous stream of lubricant regardless of the direction of motion of the machine.

Elwell-Parker Type WB Electric Truck

The Elwell-Parker Electric Co., Cleveland, Ohio, is now marketing the 4-wheel steer, 2-wheel drive electric truck illustrated, which is known as their Type WB. The truck is equipped with a single worm reduction drive, a differential with 4 bevel pinions and an axle of the full-floating type. Three speeds are possible in either direction, 400 to 650 ft. per min., and the capacity is 4000 lb. Malleable iron or steel castings are used throughout, and the solid, pressed-on rubbed tires measure $21\frac{1}{2}$ x $3\frac{1}{2}$ in. and 15 x $3\frac{1}{2}$ in. The turning radius of the outside edge is 9 ft. 3 in., the over-all dimensions 40 x 124 x 50 in., and the platform dimensions are 40 x 93 in. 17 in. from the floor. The batteries used are of the Edison, Ironclad or lead type, and of such capacity as to complete a day's work without recharging. The charging current is from 36 to 60 amperes at 40 volts. The weight ready to run is 2500 lb.

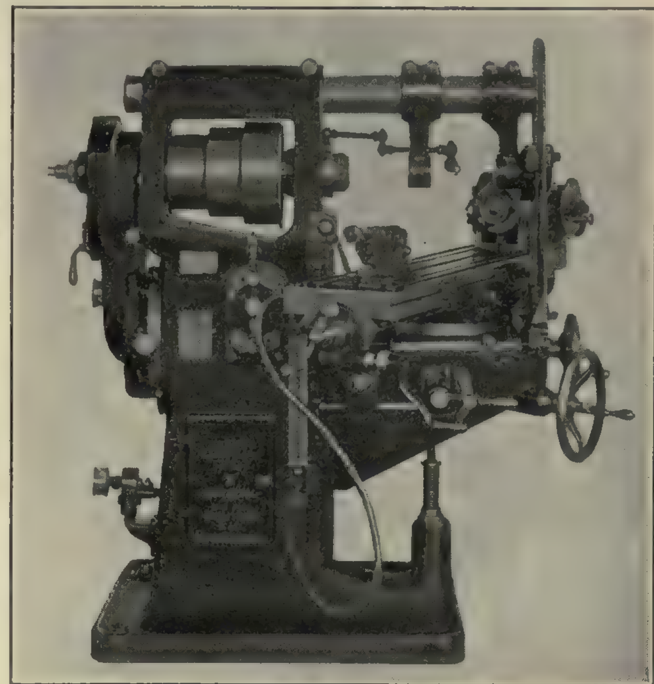


ELWELL-PARKER ELECTRIC TRUCK

Becker No. 3 Universal Milling Machine

The No. 3 universal milling machine illustrated, has recently been placed on the market by the Becker Milling Machine Co., Hyde Park, Boston, Mass. The machine is built with a special patented gibbing which, it is claimed, renders the knee very solid when locked. It has an overhanging arm of solid steel $4\frac{1}{2}$ in. in diameter, carrying a main arbor support with bushings of hard bronze and a center arbor support with a plain bushing of hard bronze. The machine is driven by a three-step cone pulley, the back gears being inclosed and located at the rear instead of on the side of the machine. They are operated by means of two levers. The spindle is of crucible steel with an adjustable main bearing of bronze and two rear ball bearings. The feeds are by means of a chain drive provided with an idler.

The dividing head has a front index plate 6 in. in diameter with a circle of 24 holes for direct indexing, and three side index plates, $7\frac{1}{2}$ in. in diameter, with holes in the following groups: 15, 16, 17, 18, 19, 20 — 21, 23, 27, 29, 31, 33 — 37, 39, 41, 43, 47, 49. In connection with the differential gearing, any division from 1 to 382 is obtainable. It can be set at any angle from 10 deg. below the horizontal, through an arc of 185 deg., and the swivel block is graduated and provided with a vernier reading to ten min. Thirteen change gears equip the head for differential indexing and spiral cutting, and spirals may be cut with a lead of from 0.670 to 149.0 in. When arranged for differential indexing or spiral cutting all the gearing forms a unit with the head. The dividing head spindle is arranged to be driven directly from the lead screw, a special arrangement enabling short leads to be cut. The tailstock is of the one-side type, and can be raised and lowered in a vertical plane, and swiveled to 10 deg. above or below the horizontal.



BECKER NO. 3 UNIVERSAL MILLING MACHINE

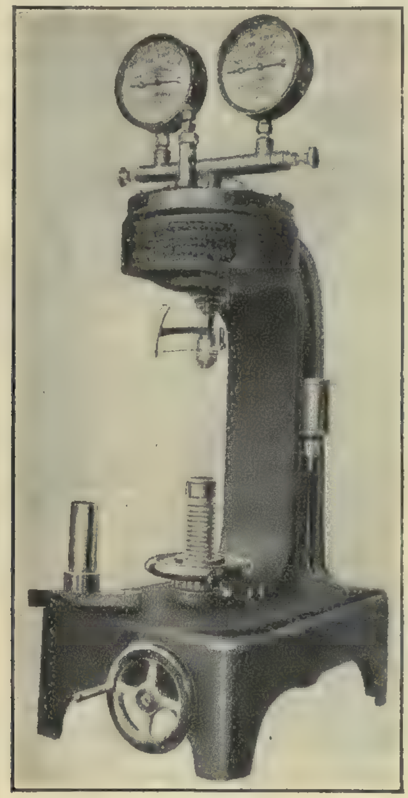
Longitudinal power feed, 30 in.; cross power feed, 10 in.; vertical power feed, 19 in.; maximum distance center of spindle to table, $19\frac{3}{4}$ in.; maximum distance between face of column and harness, $23\frac{1}{2}$ in.; center of spindle to underside of overhanging arm, $6\frac{5}{8}$ in.; working surface of table, 50 x 12 in.; overall table dimensions, 54 x 12 in.; T-slots, three, $\frac{5}{8}$ in. wide; swivel of table, 47 deg. to the right or left; main bearing, $2\frac{3}{4}$ x $5\frac{5}{8}$ in.; taper in spindle, No. 11 B & S.; back gear ratio, 6.92 to 1; spindle speeds, twelve, 12 to 412 r.p.m.; feeds, twenty-four, 0.002 to 0.528 in.; swing of dividing head, 10 in.; length of work accommodated on dividing head, 32 in.; swivel of dividing head, from 10 deg. below horizontal to 85 deg. beyond perpendicular; floor space $107\frac{1}{4}$ x 64 in.; height, $74\frac{3}{4}$ in.; weight, 3800 lb.

Regular equipment includes double-friction countershaft 6-in. rotary vise, 8-in. universal chuck, 10-in. dividing head complete with change gears, index plates and tables, center rest, raising block, No. 16 collet with No. 9 B. & S. inside taper, drawbar, oil pot and hook, and wrenches. The machine may be arranged for a 5-hp., variable-speed motor drive if desired.

Scientific Materials Co.'s Brinell Hardness-Testing Machine

The Brinell hardness-testing machine illustrated, has been placed on the market by the Scientific Materials Co., 711-719 Forbes St., Pittsburgh, Penn. With this machine, the depth instead of the area of the spherical indentation produced by the ball is measured. The machine is a hydraulic press, the upper neck of which

carries the hydraulic piston upon which is mounted a hardened steel ball 10 mm. in diameter. The stage on which the work to be tested is placed can be raised or lowered to accommodate work of various sizes. Two pressure gages are mounted at the top, one for regular use in measuring the pressure applied, the other to be reserved as a test gage to check the pressure readings. An automatic levelling stage mounted upon the spindle permits irregular shaped pieces to be tested. The hy-



BRINELL HARDNESS-TESTING MACHINE

draulic pressure is produced by a movement of the handwheel shown at the front of the base. The liquid employed is glycerine. After the indentation has been made, its depth is measured by means of the depth gage which is attached to the piston carrying the steel ball. The gage measures the depth, magnifying it 50 times. The gage is not affected by any spring in the casting, as it is entirely independent.

Defective Milling-Machine Design

By E. P. Armstrong

On page 10, Vol. 44, there was published a letter by the present writer entitled "Miller Designer and Shop Superintendents," calling the attention of manufacturers of milling machines to a serious defect in the design of such machines in respect to the length of the saddle upon which the table slides. In practically all such machines that have come under the writer's notice, this part is entirely too short, and when the table is run out to any extent in either direction, the center of gravity falling without the line of support will cause that end of the table to sag, and a hole bored in the work with the table in this position will not be in alignment with a hole bored when the table is in central position. If a third hole is bored in the same piece at the other end of table travel, the trouble will be still further aggravated; or as a further illustration: a long piece surface-milled from end to end will not be straight.

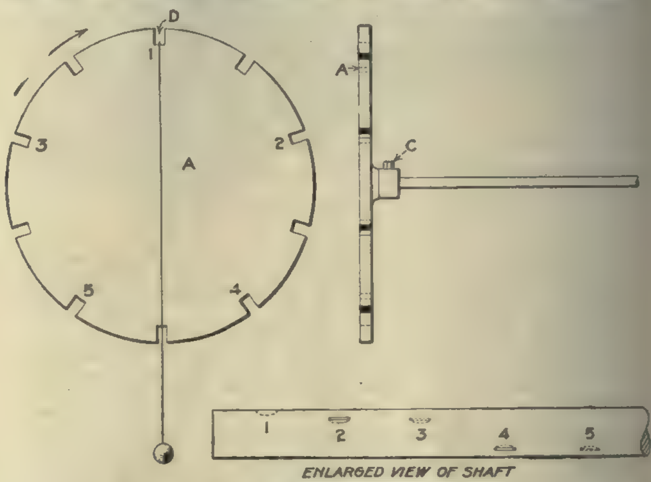
It is useless to say that the gibs should be tight enough to prevent this sag; they will not be; and any milling-machine operator can tell you so. Only when the builder makes the saddles long enough to keep the center of gravity of the table always well within this length, will the difficulty be obviated.

The writer had hoped the above-cited article would be given consideration by the manufacturers, but so far he has seen nothing to indicate that such was the case.

An Indexing Device

By Frank O. Martin

It was required to cut five keyways in each of several shafts for a government job, the keyways to come to the top in the following rotation: 1, 3, 5, 4, 2; spaced very accurately at 72 deg. apart. The shaft was longer than the milling-machine table, and too large to go through the indexing head. We cut 10 slots in an old printing press ink disk, *A*, which was at hand, bored the hub to



AN INDEXING DEVICE

fit the shaft and fastened it in place with a setscrew *C*, as shown in the accompanying illustration. The shaft was then placed in V blocks; we used a piece of soft brass wire about the diameter of the width of slot in disk, placed a button on one end and a plumb-bob on the other, hanging it on as at *D*. Revolving the disk till the wire cut off the light on bottom slot, the shaft was then clamped in V blocks, and keyway milled; the disk was then rotated to the next position and so on.

The disk being 27 in. in diameter and the shaft $1\frac{1}{4}$ in. in diameter it is seen that the error was very slight.

Exhibits at Lyon Fair

Merchandise intended for the Lyon Fair to be held in Lyon, France, Mar. 1 to 15, will be allowed temporary admission or entry under deposit of duty, without special authorization, according to notification from the foreign office to the American ambassador. The period allowed for reëxporting these goods will be one month from the time of the closing of the fair, and no special formalities will be required. The usual customs duties will be applied to certain articles if they remain in France. Assurances are given that samples from the United States will be granted priority of freightage.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Feb. 16, 1918—As an example of the way in which production methods have changed and as a reason why thoroughly up-to-date production men should be used to the fullest extent, the making of shells or projectiles with the latest special machinery affords an excellent example.

If an inspector of the old type, or a mechanic of the old school were to be given the problem of securing the greatest quantity of shells of large caliber, they would probably select the shop which had large engine lathes and similar equipment, together with a force of skilled men to handle the work. But judging from experience in the large shell game during the past two years, this method would be a mistake in almost every case. According to the best information to be secured, the proper formula for a shop should be something like this: a large shop with no machinery, or even no shop at all; an executive with a vision; a good organization; sufficient credit.

With these things as a basis, the shops which have turned out the most shells with the fewest rejections and incidentally made the most money, bought special machines, trained green men on single operations, paid them big wages and got away with it all.

To a great extent this procedure also applies to the small shellmakers, although some of them have done fairly well on standard machines. But when good mechanics got fooled as to the best shop for the work, we must excuse the army officer or his inspector who reports that such a shop is not well enough equipped or has not sufficient capacity, especially when he sees only empty floor space. The present method is a new development, and it keeps mechanics of the older type busy keeping up with it.

Growth of Industry

Some idea of the manner in which the rapid growth of war industry has affected some sections of the country may be had from a recent report by the Pennsylvania Railroad. The report covers the six industrial localities of Philadelphia and Hog Island; Baltimore and Sparrows Point; Baltimore and Aberdeen; Philadelphia and Eddystone; Westchester and Eddystone; and Bristol and Eddystone. Industrial transportation between these points—transportation solely for the workers at the plants at Hog Island, Sparrows Point, Aberdeen and Eddystone requires 215 passenger cars per day. In addition to this, the new shipbuilding plant at Bristol, Penn., will require 10 cars daily to bring men from Philadelphia, and 5 cars for those living in Trenton. Special passenger train service for war industries is also being maintained at Erie and Huntington, Penn.

The Government is enforcing the curtailment of production. That is the purpose of the Garfield holidays, and of the 25 per cent. fuel saving being asked of various industries. The degree of curtailment requested, however, has no scientific basis. No one knows whether the available shipping capacity requires a 10 per cent. or a 50 per cent. reduction. Worse still, no one seems to be trying to find out. Yet, on the careful determination of the relation of output to available cargo space depends the operation of industries, the distribution, supply and wages of labor, the housing program, prospective railroad expansion—in fact, every major problem of our war industry.

There are big problems pressing for solution in Washington, but none more important than this. Of what use to let new contracts, if they are shortly to be canceled or suspended. Of what avail to speed up industries, if later they are to be slowed down. To what purpose recruit labor forces at great expense, if the organizations are to be disrupted through layoffs.

Danger of Disturbances

Let us face the conditions frankly: we are in danger of severe disturbances. An unofficial inquiry recently made in Washington brought the investigators to the conclusion that we will produce in 1918 for oversea use three times as much as we can ship. Suppose the supply is only twice as much, or 50 per cent. more: the situation still is serious, even granting the storage possibilities—and storage needs cannot be intelligently estimated until there is a central intelligence in Washington charged with summarizing the tonnage in prospect and balancing it against shipping capacity.

It is a big job, an important job. It really involves knowing how much new tonnage will go into the water this year, knowing what the Emergency Fleet Corporation actually will do.

Until this job is done, we shall go forward with bungling efforts at curtailment, relying on patriotic appeals for support of the measures, rather than on facts. Meanwhile, we may embark on a housing program two or three times larger than needed, on labor recruitment which will result first in unnecessarily high wages and later in severe labor disturbances, on transportation and storage measures that might be unnecessary were the facts available.

Those who have given the matter careful consideration are being forced to the conclusion that much of the

congestion and lack of coördination about which we are hearing so much, is due to the fact that up to the present the majority of the work in Washington has been handled by financial men rather than by engineers. Millions of dollars' worth of various kinds of material have been ordered, and in many cases without much regard to the sequence in which they are required. Some of the errors have been brought out by the congressional investigation, which has shown that orders have been placed without the advice of expert engineers who are familiar with production on a large scale, and who know the various factors which affect it.

This is almost a repetition of what occurred in the early days of the munitions contracts with Great Britain and France, which business was played as a banker's game and without consulting the engineer until after the contracts had been taken. The results will long be remembered by many people who were properly "stung." From all appearances the engineer is beginning to come into his own, and is to be a guiding factor in matters where his particular training and knowledge are of most value. The real value of the designing and productive engineer is beginning to be appreciated, and there is every reason to believe that the effect of this will be widespread and extremely beneficial. The production engineer of a large plant, studies not only the methods of producing individual parts, but also the relation of the various parts to each other, that a continuous flow of parts may be coming through the factory, to secure an uninterrupted output. The sooner this is fully understood and the production engineer is used instead of the financier in places where the former properly belongs, we shall make a much better showing as to results.

Personals

Nelson Hall has been appointed production engineer of the Fisher Electrical Works, Detroit.

W. H. Vosmer has been made general manager of sales of the Donner Steel Co., Buffalo, N. Y.

Charles G. Lee, formerly die-sinker foreman with the Moore Drop Forge Co., is now with the Endicott Drop Forging Co., Endicott, N. Y.

H. F. Bardwell has been appointed New York district manager of the Vanadium-Alloys Steel Co., with offices at 30 Church St., New York City.

C. F. Kettering, vice president of the Dayton Electrical Laboratories Co., Dayton, Ohio, has been elected president of the Society of Automotive Engineers.

L. H. Thullen, formerly with the Hall Switch and Signal Co., New York, has been made general manager of the Grand Rapids Brass Co., Grand Rapids, Mich.

Alfred L. Aicher, recently chief draftsman of the F. J. Stokes Machine Co., Philadelphia, Penn., is now with the Southwark Foundry and Machine Co., Philadelphia, Penn.

Arthur T. Doud, formerly superintendent and later works manager of the Hero Manufacturing Co., Philadelphia, Penn., has been appointed general manager of this company.

A. W. Towse has been appointed general manager for William Jessop & Sons, Inc., 91 John St., New York City. Mr. Towse has had a wide engineering experience in Latin America.

E. C. Sickles, formerly works engineer of the Hyatt Roller Bearing Co., Newark, N. J., is now affiliated with the Lackawanna Bridge Co. in its shipbuilding activities at Port Newark, N. J.

Harry Krause, formerly with the Wire Wheel Corporation of America, has been made assistant general manager in charge of production of the Splitdorf Electrical Co., Newark, N. J.

George P. Huffmann has been appointed manager of the forge department of the Davis Sewing Machine Co., Dayton, Ohio. Mr. Huffman entered upon his duties as manager in February.

Horace E. Thomas, formerly chief engineer of the Reo Motor Car Co., Lansing, Mich., has been made chairman of the designing committee, perfecting the War Department's ¾- and 1-ton war trucks.

J. W. Jowett, formerly sales manager of the Ingersoll-Rand Co., 11 Broadway, New York City, has been elected vice president of that firm. **L. D. Albin** succeeds Mr. Jowett as general sales manager.

H. F. Harris has resigned his position as assistant branch manager of Willys-Overland, Inc., New York, and on Feb. 15 will become industrial engineer of the Republic Motor Truck Co., Alma, Mich.

M. J. Somers, formerly assistant superintendent of the foundry of the American Seeding Machine Co., Springfield, Ohio, has been made superintendent of the foundry at the new plant of the Fulflo Pump Co., Blanchester, Ohio.

William H. Alexander, assistant general manager of the Marvel Carbureter Co., Flint, Mich., who was in charge of experimental work in the engineering department, has been called to serve in the aviation section of the Signal Corps.

Major Frank R. Bacon, president Cutler-Hammer Mfg. Co., Milwaukee, has been transferred from New Haven, Conn., to Washington, D. C. Major Bacon was called into active service in the Ordnance Officers' Reserve Corps several months ago to take charge of gun-carriage work in the New Haven district.

G. B. Schneider, superintendent of the Bickett Machine and Manufacturing Co., Cincinnati, Ohio, has resigned and will establish a machinery sales office in Los Angeles, Calif. He will represent the Haynes Stellite Co., Ready Tool Co., Standard Electric Tool Co., Fulflo Pump Co. and other manufacturers in the Central West and East.

Dr. Arthur M. Hammerschlag, director of the Carnegie Institute of Technology, Pittsburgh, has been made head of the research department of the Quartermaster Corps of the United States Army. He has been granted a leave of absence for the period of the war by the trustees of the institute, and has assumed his new duties at Washington.

G. F. Evans, formerly connected with the W. C. Moore Co., Columbus, Ohio, has been appointed supervising engineer for the National X-Ray Reflector Co., Chicago, in the territory comprising the State of Ohio (except Toledo and Cincinnati), West Virginia and Western Pennsylvania. Mr. Evans is located at 825-826 Columbus Savings and Trust Building, Columbus, Ohio.

Elroy C. Robertson has resigned his position as factory manager of the Frantz Premier Co., Cleveland, Ohio, to become inspector of airplanes and airplane engineer at large for the Signal Corps. As aëronautical engineer he will have supervision of inspection of airplane engines being manufactured in New York, New Jersey and New England, with headquarters at the District Inspection Office of the Signal Corps, 15 Park Row, New York City.

Business Items

The Perfection Machine Works, Inc., Buffalo, N. Y., has moved into its new modern plant at 16-18 Norris Ave., Buffalo, N. Y.

The Herberts Machinery and Supply Co., manufacturing agents and dealers in used machine tools, Los Angeles, Calif., has moved into larger quarters at Third and San Pedro Streets.

The Driver-Harris Co., Harrison, N. J., wishes to correct the belief held in certain quarters that its plant was recently destroyed by fire. The actual fact is that only a small portion of the factory was burned.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

The sixth annual meeting of the Chamber of Commerce of the United States of America will be held in Chicago, Apr. 10, 11 and 12, 1918. Elliot H. Goodwin, Riggs Building, Washington, D. C., is general secretary.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

The National Society for the Promotion of Industrial Education will hold its eleventh annual convention in Philadelphia, Penn., Feb. 21, 22 and 23. The main topics for discussion will be Vocational Education in War Time. Administration of the Smith-Hughes Act, Twentieth Century Vocational Training and Reorganization of the National Society. The headquarters of the society are at 140 West 42nd Street, New York City.

New England Foundrymen's Association Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North. Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

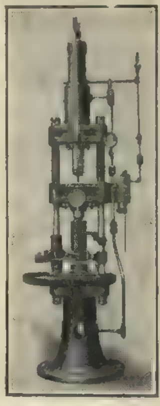
Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Press, Projectile Testing

Southwark Foundry and Machine Co., Philadelphia, Penn.



"American Machinist," February 7, 1918

A line of presses for testing projectiles built in sizes suitable for 75-mm. (3 in.), 4.7-in., 6-in., 8-in., 9.5-in. and larger shells. Are of the 3-station type: the first shell being placed in position and filled with water, the second being tested, and the third being inspected and removed simultaneously. The control is centered in a single operating valve. When the valve is operated the line pressure of 1500 lb. per sq.in. is admitted to the lower cylinder. This forces the open shell nose into a sealing device and when the full pressure has been reached the pressure is automatically admitted to the top cylinder. The intensifying ram of the top cylinder projects into the open nose of the shell which has been filled with water thus acting as the high-pressure intensifier cylinder

Lathe, Back Geared 14- and 16-Inch "Filsmith"

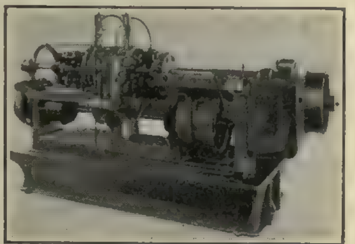
Philip Smith Manufacturing Co., Sidney, Ohio

"American Machinist," Feb. 14, 1918

Swing over bed, $14\frac{3}{8}$ in.; swing over carriage, 9 in.; distance between centers, 6 ft. bed, 36 in.; travel of tailstock, $5\frac{3}{4}$ in.; diameter of tailstock spindle, $1\frac{3}{8}$ in.; centers, Morse No. 3; front spindle bearing, $2\frac{3}{8}$ x 4 in.; rear spindle bearing, $1\frac{13}{16}$ x 3 in.; hole through spindle $1\frac{1}{16}$ in.; diameter of spindle nose, $2\frac{1}{16}$ in.; threads cut, 4 to 46; feeds, three times threads; back-gear ratios, 3 to 1 and 8 to 1; number of spindle speeds, twelve, 27 to 600 r.p.m.; bearing of carriage on ways, 18 in.; width of bridge, $7\frac{1}{4}$ in.; size of tools, $1\frac{1}{4}$ x $\frac{5}{8}$ in.; weight with 6 ft. bed, 1350 lb.; extra weight per additional ft. of bed, 90 lb.

Bar Machine, Automatic Sextuple

New Britain Machine Co., New Britain, Conn.



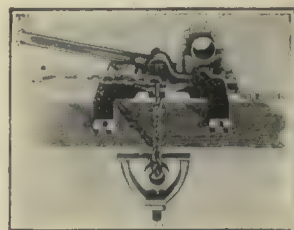
"American Machinist," February 7, 1918

An automatic bar machine in which the spindle cylinder does not index, the machine being designed to feed, drill, chamfer and cutoff in each position. The six spindles are of hammer-forged, chrome-nickel steel and run in bronze bearings. Six spindle speeds are provided by means of change gears. The tool slide operates at high speed when the tools have finished cutting

Vise, Pipe "Chaingrip"

Gerolo Manufacturing Co., Old Colony Bldg., Chicago, Ill.

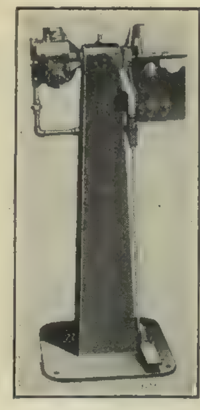
"American Machinist," Feb. 14, 1918



A quick acting vise made in two sizes: No. 1 accommodating $\frac{1}{8}$- to $2\frac{1}{2}$-in. pipe and No. 2 accommodating $\frac{1}{4}$- to $4\frac{1}{2}$-in. pipe, the respective weights being 17 and 22 lb. The bottom of the vise is made with two V-slots between the four feet so that it may be held by means of the chain-clamping device on any kind of a support whether it be round, square or flat. The pipe is held between a double set of steel jaws on one side and a close-linked steel chain on the other

Grinding Stand, No. 8 "Little David"

Ingersoll-Rand Co., 11 Broadway, New York City

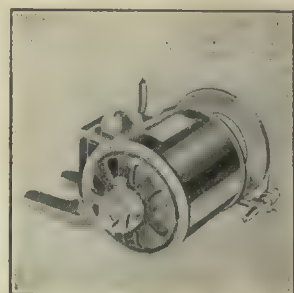


"American Machinist," February 7, 1918

The machine is designed for general use where a stationary machine is more convenient than one of the portable variety. The air motor is of the three-cylinder type with rotary valves integral with the crankshaft. Three sets of ball bearings are used on the spindle which is rated to operate at 3400 r.p.m., with air at a pressure of 80 lb. The control is effected by means of a foot lever, and the grinding wheel is 8 in. in diameter with a 1-in. face

Grinding Machine, Toolpost

Gilfillan Brothers Smelting and Refining Co., Los Angeles, Calif.

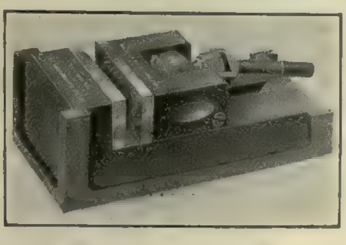


"American Machinist," Feb. 14, 1918

A motor-driven toolpost grinder with motor of $\frac{1}{4}$ hp. with a speed of 3400 r.p.m. The machine is provided with an angle plate designed to be clamped around the toolpost, any necessary vertical adjustment being secured by means of a device incorporated in the machine. The wheel used has a diameter of 6 in. and a width of face of $\frac{5}{8}$ in. The machine is furnished with an extension mandrel for internal grinding and a tooth rest for cutter grinding

Vise, Quick Acting Machine

Nestor Manufacturing Co., 40 West 13th St., New York

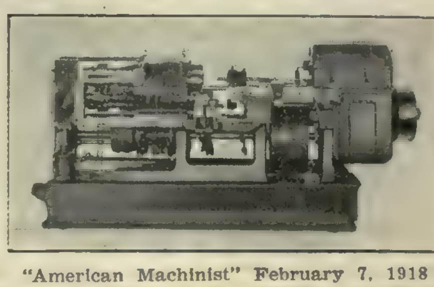


"American Machinist," February 14, 1918

A quick acting machine vise made in three sizes as follows: No. 0; $5\frac{3}{8}$ in. long, 3 in. wide, jaws $2\frac{1}{2}$ in. wide, maximum opening $2\frac{1}{2}$ in.; weight $4\frac{1}{2}$ lb. No. 1; $9\frac{1}{2}$ in. long, $4\frac{3}{4}$ in. wide, jaws 4 in. wide, maximum opening 4 in., weight 18 lb. No. 2; 14-in. long, 7 in. wide, jaws 6 in. wide, maximum opening 6 in. weight, 57 lb.

Chucking Machine Automatic Multiple Spindle Size 3

New Britain Machine Co., New Britain, Conn.



"American Machinist" February 7, 1918

An automatic, multiple-spindle chucking machine of the revolving-work type, the work being held and revolved by the spindle while the tools are fixed in the tool slide. Number of spindle speeds, 5; number of feed changes, 12; type of drive, either belt or motor; spindles, 6, of hammer-forged, chrome-nickel steel, heat treated hardened and ground

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Feb. 15, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$24.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia.................	38.75	33.75	30.50
*No. 2, Valley.......................	33.95	33.00	31.00
No. 2, Southern Cincinnati............	35.90	35.00	26.90
Basic, Eastern Pennsylvania..........	33.75	30.00	30.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Feb. 15, 1918	One Month Ago	One Year Ago	Feb. 15, 1918	One Year Ago	Feb. 15, 1918	One Year Ago
Structural shapes ...	$4.20	$4.20	$4.10	$4-4.04	$4.10	$4.20	$3.75
Soft steel bars......	4.10	4.10	4.00	4-4.04	4.00	4.10	3.85
Soft steel bar shapes.	4.10	4.10	4.00	4.14	4.00	4.10	3.75
Plates, ¼ to 1 in thick	4.45	4.45	5.15	4.39	4.75	4.45	4.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

Pittsburgh, mill	$3.50	$3.25
Warehouse, New York....................	4.70	3.75
Warehouse, Cleveland	3.98½	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Feb. 15, 1918	One Month Ago	One Year Ago	Feb. 15, 1918	One Year Ago	Feb. 15, 1918	One Year Ago
*No. 28 black......	5.00	6.45	5.00	5.75	6.45	5.50	6.45	5.15
*No. 26 black......	490	6.35	4.90	5.65	6.35	5.40	6.35	5.05
*Nos. 22 and 24 black	4.85	6.30	4.85	5.60	6.30	5.35	6.30	5.00
Nos. 18 and 26 black	4.80	6.25	4.80	5.55	6.25	5.30	6.25	4.95
No. 16 blue annealed.	4.45	5.65	4.45	5.10	5.65	4.95	5.65	5.00
No. 14 blue annealed.	4.35	5.55	4.35	5.00	5.55	4.85	5.55	4.90
No. 10 blue annealed.	4.25	5.45	4.25	4.95	5.45	4.75	5.45	4.85
*No. 28 galvanized..	6.25	7 70	6.25	7.50	7.70	7.00	7.70	7.25
*No. 26 galvanized..	5.95	7.40	5.95	7.20	7.40	6.70	7.40	6.95
No. 24 galvanized...	5.80	7.25	5.80	7.05	7.25	6.55	7.25	6.80

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c. all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Feb. 15, 1918	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	30%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Feb. 15, 1918	One Year Ago
New York	$15.00	$8.00
Cleveland	15.30	7.50
Chicago	15.00	6.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16, No. 8, 5/32 and No. 10, ⅛ ...., No. 12 ...., 3/32, No. 14 and 1/16.., No. 18 ...., No. 20	21.00@30.00

*Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

***Special Welding Wire**

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Feb. 15, 1918	Cleveland Feb. 15, 1918	Chicago Feb. 15, 1918
Tire	4.10	5.00	4.00
Toe calk	5.70	5.50	4.35
Openhearth spring steel...	7.50	8.25	8.00
Spring steel (crucible analysis)	11.00	11.25	11.50
Coppered bessemer rods...	9.00	....	7.50
Hoop steel	4.95	....	4.95
Cold-rolled strip steel.....	9.00	....	8.50
Floor plates	6.19½	....	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4.......	29%	17%
4½ to 6......	44%	32½%	4½ to 6.......	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Feb. 15, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	35.00
Tin, in 5-ton lots..................	85.00	86.00	50.00
Lead	7.00	6.50	8.75
Spelter	8.00	7.75	10.25

*Government price.

ST. LOUIS

Lead	6.85	6.37½	8.00
Spelter	7.87½	7.50	10.00

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Feb. 15, 1918	One Month Ago	One Year Ago	Feb. 15, 1918	One Year Ago	Feb. 15, 1918	One Year Ago
Copper sheets, base.	31.00-33.50	35.50	42.00	32.50	44.00	36.00	43.00
Copper wire (carload lots	32.00	32.00	36.00	28.50	44.00	34.50	37.00
Brass pipe base....	36.50	36.00	47.50	35.50	52.00	41.50	46.50
Brass sheets	30.75	30.75	45.50	29.00	43.00	35.50	44.00
Solder ½ and ½ (case lots)......	47.50	48.00	28.37½	47.00	27.50	48.75	28.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Feb. 15, 1918	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	34.00	42.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.. 19.00

	In Casks		Broken Lots	
	Feb. 15, 1918	One Year Ago	Feb. 15, 1918	One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.00	22.50	21.50	23.00

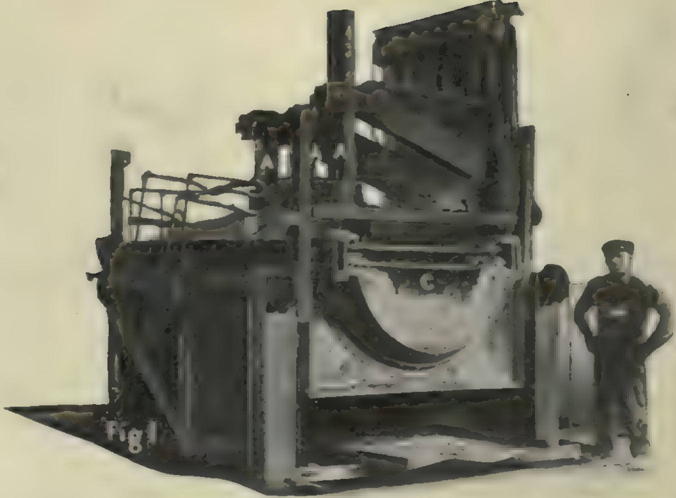
ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Feb. 15, 1918	One Year Ago
New York	14.25	18.00
Cleveland	17.00	26.00
Chicago	16.00	17.25

Manufacture of Electric Tool Steel

By

E. A. Suverkrop



The average machinist or toolmaker has but the faintest idea how steel is made and no knowledge of the infinite care and rigid inspection to which it is subjected at every stage of its manufacture. This article will probably prove of interest to users, as it gives in a general way methods of manufacturing electric tool steel.

THE large electric steel plant of the Ludlum Steel Co. started the manufacture of crucible tool steel in a small plant at Pompton, N. J., in the year of 1854, and in 1907 moved to Watervliet, N. Y. Until 1910 the concern devoted its entire attention to the production of crucible steels. There is a story that the writer was told by a disinterested party, which seems to be a fitting beginning to this. Some twenty years ago a steel maker sent one of his skilled men to get a job at the old Pompton plant with the instruction to "find out what they put in their steel and how they make it so much better than we do!" The story goes that after a few weeks he sent in a report to this effect: "Their mix is exactly the same as ours, but they turn out better steel because of the care exercised at all stages of manufacture." This critical care in the selection of material, in the manufacture of the product and in the elimination of defective material is impressed on the investigator at every step.

FIG. 2. TEEMING THE MELT

After several years of experiment with various types of electric furnaces, the Ludlum Steel Co. having devised a satisfactory electric furnace for melting steel, discontinued the manufacture of crucible steel in 1913. Their entire output is now the product of the electric furnaces shown in Figs. 1 and 2, (which not only produces a better steel but produces it at a lower cost,) in order that if possible even greater care can be devoted to the elimination of faulty material, without adding materially to the ultimate cost of the finished steel. High-grade tool steel is produced by two processes: (1) the crucible, (2) the electric furnace.

Crucible steel is made by remelting very high-grade, pure scrap. This is accomplished by the use of a plumbago or clay crucible which is filled with short pieces of Swedish, Walloon (Belgian), or Styrian charcoal iron. A lower grade of crucible steel is made from puddled iron, and a great many crucible steel manufacturers, in this country, because of the difficulties of shipment at the present time, are forced to make their crucible steel from puddled iron. Puddled iron is made from low phosphorus and low sulphur pig iron, melted in the presence of an extremely oxidizing flame, which

has the effect of oxidizing out most of the impurities. The remaining semi-plastic metal is then rolled into balls. These are full of slag, oxygen and nitrogen. They weigh about two or three hundred pounds each and are put through a mechanical squeezer which is a rotary mill with external and internal teeth. The internal drum rotates, and due to its eccentric arrangement with the shell, gradually turns the ball around and squeezes it out into an irregular shaped mass. This material is then squeezed further by being rolled in a rolling mill. The slag by this time having been almost entirely squeezed out of the bars, the bars 3 x ⅜-in. are cut into short lengths and used as the charge in the crucible to make crucible steel. The charge consists either of charcoal-refined iron or puddled iron—the additions of carbon, manganese, alloys, etc., being arranged with the charcoal iron in the crucible. The crucible is placed in a coke, oil or producer-fired furnace and heated until the charge melts. The melter, who must be a very highly skilled man, periodically examines the melt, observes its progress, and waits until it is quiet in the crucible; that is to say "killed," the melt then being known as "dead."

The metal is poured from the crucible into a ladle, or else direct from the crucible into ingot molds. Because the crucible process is purely one of remelting, a refining of the steel cannot take place. In other words the quality of the steel is dependent on the quality of the ingredients.

Electric Steel Manufacture

The electric crucible steel furnace is capable of completely refining the steel; that is to say of removing from it the undesirable metalloids such as phosphorus, sulphur, excess of silicon, manganese and carbon; also the gases: oxygen, hydrogen, nitrogen, etc.

The following report of the working of the electric furnace for the production of twist-drill steel will give the layman an idea of how closely the melt is watched. It is doubtful if any such detailed report has ever been printed.

Heat started 4:55 a. m. Part of the charge was loaded into the furnace and melted; the remainder was added after the metal had been made molten since the charge being of a bulky nature could not be entirely charged into the furnace at the start. A quantity of lime was added to the cold metal so as to keep the surface of the molten steel covered and protected from atmospheric influences; also to give the correct dephosphorizing slag. One hundred pounds of mill scale were added to the charge, to render the slag extremely oxidizing.

9:16 a. m.—The melt was observed to be boiling but the slag too thick. Two shovels of silica sand were added to thin the slag. The slag was well raked thoroughly to mix into the sand.

9:24 a. m.—A sample was taken for the laboratory. The metal was then fairly quiet, the slag was extremely oxidizing and black. It is necessary that the color of the slag be kept black as this is the indication of an oxidizing slag produced by iron oxide.

9:30 a. m.—Lime was added for the purpose of thickening up the slag so as to make the operation of raking off this slag comparatively easy.

9:35 a. m.—The current was turned off and the black dephosphorizing slag was raked off. The analysis of melt showed carbon 0.59 per cent., chromium 0.37 per cent., phosphorus 0.018 per cent., sulphur 0.025 per cent.

9:39 a. m.—Ten shovels of lime and fluor spar and sand were then added to the melt to form a second slag. The current consumption was 7500 amperes per electrode.

9:45 a. m.—Sample of the slag was taken showing the slag thin—which is the ideal consistency. The lime was not entirely fused.

9:53 a. m.—A further sample of the slag was taken, showing the same to be extremely desulphurizing and reducing. The color of the slag was gray, condition smooth and thin.

9:54 a. m.—A sample was taken of the metal for laboratory analysis. The current was then turned off.

10 a. m.—The temperature of the slag with the current off was 2573 deg. F.

10:02 a. m.—The current was turned on.

10:03 a. m.—Five shovels of the mixture in the boxes were then added to the slag to augment its desulphurizing nature.

10:08 a. m.—A further sample of the slag was taken, showing the color gray, and of good desulphurizing and deoxidizing condition.

10:10 a. m.—Lime was added to thicken the slag so as readily to remove same. Current turned off at 10:12 a. m.

10:14 a. m.—Slag was very thick and easily raked off. Temperature of the metal was then taken; 2570 deg. F.

10:20 a. m.—A predetermined amount of carbon was thrown into the melt to add to the carbon and further degasify the steel.

10:22 a. m.—The doors of the furnace were luted up with clay so as to prevent the atmosphere attacking the surface of the molten steel.

10:40 a. m.—The furnace was unsealed, the temperature of the steel was 2596 deg. A third slag was immediately added by throwing in seven shovelfulls of the mixture of lime, silica sand and fluorspar.

10:52 a. m.—A sample of the slag was then taken which showed the color gray and in excellent condition. Correct amount of alloys was then added to bring the steel up to the required analysis.

10:59 a. m.—A sample of the slag was taken which had a slight greenish color due to the chromium.

11:02 a. m.—Slag of metal was sent to the laboratory for analysis. The temperature of the slag was 2662 deg.

11:05 a. m.—The current was turned off. Sample was taken of the slag. The green color had almost disappeared showing the chromium present in the slag had returned to the metal.

11:08 a. m.—Temperature of the slag was 2652 deg. It is noted that the temperature has now fallen slightly. Current turned off waiting analysis. The ladles were now rapidly heated in preparation of the melt being teemed.

11:32 a. m.—While still waiting for the analysis, four shovels of lime were added to the slag, as it was noticed the slag was getting a little thin.

11:35 a. m.—A sample was taken of the slag; outside brown and inside gray, excellent condition.

11:42 a. m.—Laboratory analysis returned. A small quantity of alloys added to finally adjust the chemical analysis of the steel.

FIGS. 3 TO 5. THE POURING AND HAMMER SHOPS

Fig. 3—Pouring the ingots. Fig. 4—Pouring floor. Fig. 5—The hammer shop

11:52 a. m.—Test bar of the metal forged out, to find the mechanical working qualities.

11:53 a. m.—The metal agitated so as to insure complete mixing of the alloys.

11:55 a. m.—The melt held to insure saturation of the added alloys, sample again taken of the slag, small quantity of lime added, to keep the slag in a neutral condition, it now being neither oxidizing nor reducing. Temperature of the slag and the metal were then taken, 2650 deg. F.

11:58 a. m.—Small quantity of ferro-silicon was added to the melt to remove gases. It was noted that the metal did not boil at all, the surface of the metal being entirely still.

12:06 p. m.—A small quantity of fluorspar and silica sand were added to thin the slag and keep it neutral. Temperature of metal and slag was then taken, 2690 deg. F. Current was then turned off and the metal was ready to be teemed into the ladles. The metal was poured from the furnace into the ladle, temperature was then taken, 2641 deg. F. The ladle was put onto its car and placed over the first ingot, temperature at the first pouring of the ingot, 2600 deg. F. Time required to pour first ingot, 35 seconds. Seventeen ingots were cast from first ladle, temperature of the last ingot, 2550 deg. F. Second ladle was then used and the remainder of the melt in the furnace teemed into the ladle. Temperature of the metal pouring from the furnace into the ladle, 2618 deg. F. The ladle was then placed in position over the ingot molds; first ingot took 31 seconds to pour, temperature of the metal 2600 deg. F. Thirty-five ingots were cast from this ladle; the last ingot poured, the temperature of the metal was 2575 deg. F.

The correct analysis of this steel when in ingot form was carbon 0.95 per cent., chromium 0.45 per cent., silicon 0.15 per cent., manganese 0.20 per cent., phosphorus 0.015 per cent., and sulphur 0.012 per cent.

Selection of Materials

A careful analysis is made of all raw materials received at the plant. Raw material in which the sulphur and phosphorus contents are below 0.03 per cent. is used in the manufacture of tool steel. That in which the percentage of sulphur and phosphorus is above this figure, is used in the manufacture of low phosphorus pig iron, to which a department in the works is devoted. Owing to the possibility of refining the metal in the electric furnace, a raw-material charge of known analysis is melted down, with a slag covering the surface of the molten steel at all times. The first slag is of lime with a small amount of sand to keep it thin, and is known as an oxidizing slag since it oxidizes out the impurities: phosphorus, some sulphur, silicon, manganese, and carbon. The phosphorus comes up into the slag as phosphoric acid and changes to calcium phosphate. Great care must be exercised during this operation; the temperature must be definitely controlled; if too low the phosphorus is not taken out as speedily as desired; on the other hand, if the temperature is too high the phosphorus is reabsorbed in the melt, and if once reabsorbed is very difficult to eliminate. While the condition of low temperature which is favorable to the elimination of phosphorus prolongs the melting operation, it does not in any way injure the melt.

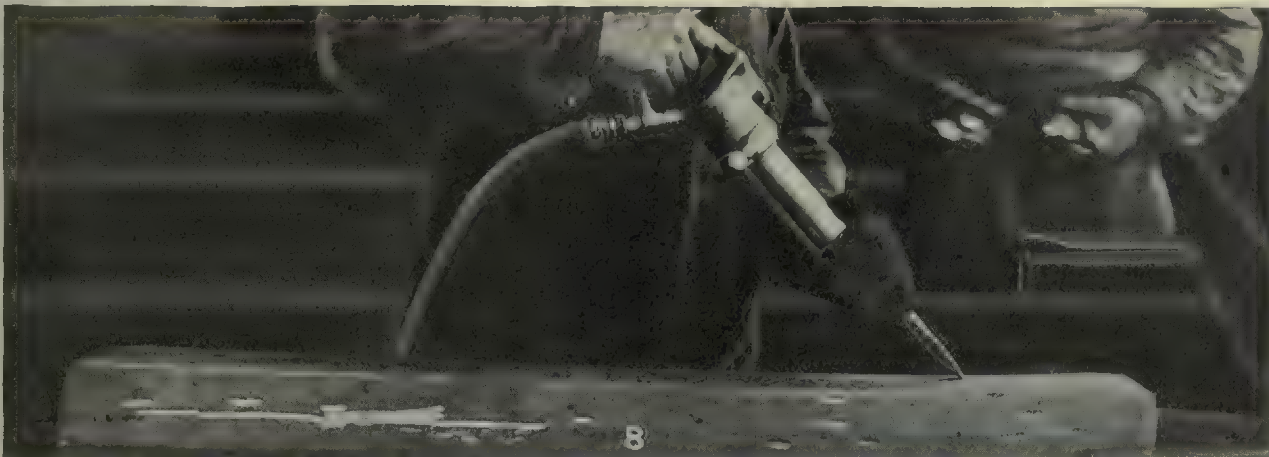
The period during which dephosphorization is most active is that preceding the actual melting of the charge.

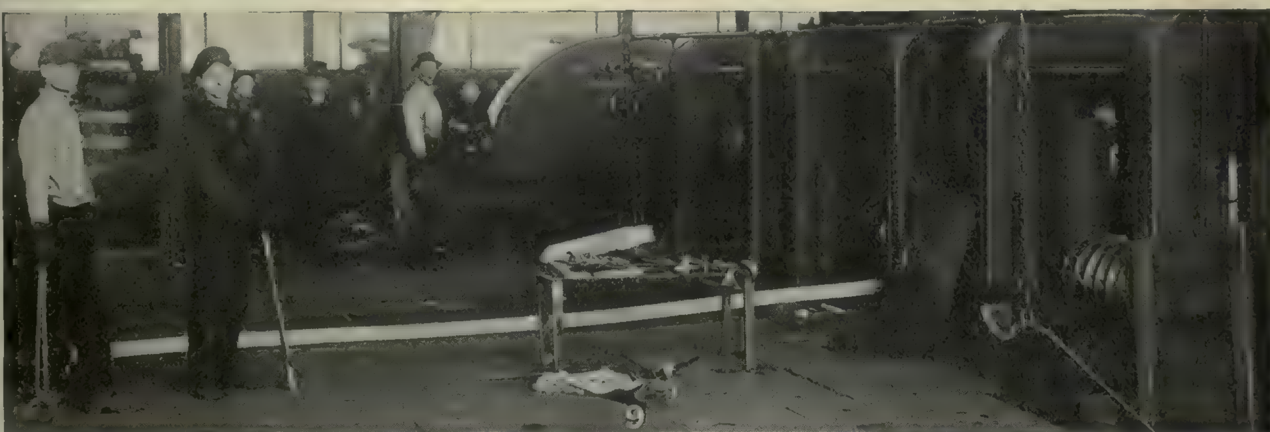
The electrodes *A* of the furnace shown in the headpiece are gradually lowered, melting their way through the charge. The metal as it becomes fluid, percolates to the bottom of the furnace where it forms a pool. The heat of the arc, direct, and that reflectetd by the roof *B* of the furnace, gradually melts the charge which augments the pool in the bottom of the furnace. The charging door is shown at *C*. When the charge is melted the first slag is raked off the steel, examined for color and texture, as these convey to the experienced furnaceman positive information, regarding the melt. A second lime slag is then added; this carries with it a definite quantity of fluorspar and silicious material, generally sand. This second slag should be very "thin" as known

FIG. 6. RESULTS OF FAULTY HAMMERING

in the terms of the melting shop. Fluorspar effectively helps to remove the sulphur, oxygen, hydrogen and nitrogen gases, and thins the slag. The silicon also thins the slag. If lime alone were used, the slag would be too thick and the chemical reactions taking place would be correspondingly slow. This second slag is known as a reducing slag, the oxygen rises to the surface and oxidizes the carbon or silicon. The sulphur rises and mixes with the slag and forms calcium sulphide, a comparatively stable compound. Great care must be exercised that the calcium sulphide is not thrown back into the steel by being oxidized and forming calcium sulphate. The action which takes place when the sulphur is eliminated from the metal is: iron sulphide + carbon + calcium oxide, which transforms into calcium sulphide. The iron passes back into the melt while the carbon passes out of the furnace in the form of carbon monoxide. The manganese sulphide + carbon + calcium oxide changes to calcium sulphide which enters the slag, while the liberated manganese returns to the melt and the carbon monoxide passes out of the furnace in the form of gas.

The slag is tested frequently during the process of refining, and the color of the slag is carefully noted. When the slag has done its work it becomes white, which however does not show that the action is completed but merely that that particular slag has done its work. The slag having become white, the melter without making any analysis knows that it has reached the desired state. The sulphur in the slag and in the melt is checked, while the process of slagging is repeated and the melter





FIGS 7 TO 10. SOME OF THE METHODS USED IN THE SHOP

Fig. 7—Grinding out defects in high-speed steel. Fig. 8—Chipping out defects in carbon steel. Fig. 9—Billet mill 2-high stand. Fig. 10—Bar mill 3-high stand.

is informed as to the chemical content of his melt. The test pieces are obtained by means of an iron bar which has a spoon-shaped end about 2½ in. in diameter.

During the process of refining, the temperatures of the molten steel in the furnace are very carefully taken. The melt after having been passed by the laboratory is ready to have the second slag removed by raking it off in a manner similar to the first. A third slag of lime and fluorspar is added, but without silicon or carbon. This slag acts as a blanket to keep the steel from oxidizing. The addition of alloys which are to bring the steel up to the desired chemical analysis is then made. Sufficient time is allowed for these alloys thoroughly to mix in the melt. The molten steel is then ready to be teemed; that is, poured out of the furnace into the ladle as shown in Fig. 2. When the ladle is about one-quarter full, some vanadium is thrown in further to deoxidize the metal. The third slag is not removed from the furnace, but is allowed to pour out with the steel into the ladle.

It is necessary that in pouring the molten steel from the ladle into the ingot molds, the slag shall not be carried down by the metal, therefore the ladle is bottom-poured as shown in Fig. 3. There is a hole in the bottom of the ladle which is called the nozzle, and the necessary refractory plug is fitted into the top of this hole or nozzle, this plug being called the stopper. The ladle nozzle is then placed over the center of each ingot mold in turn, and the metal allowed to run into it. The temperature at which the metal is poured is of prime importance and is carefully noted; also the temperature is noted when the last ingot is poured. By this means it is possible to determine the composition of the metal when it freezes—that is to say, becomes solid.

If the metal is poured at too high a temperature and a long time elapses between the period when the metal is poured into the ingot molds and the time when it freezes or becomes solid, the steel crystals which form will have a tendency to throw out their various alloys (all alloys with iron are impurities of iron, although some of these impurities are very desirable). Slow cooling sets up segregation, which is to say that the alloys have a tendency to segregate in the ingot more in one place than in another. This is particularly true of the low melting-point metaloids, under which heading come phosphorus and sulphur. Providing this segregation can be controlled, it forms another means of eliminating these undesirable alloys from the steel because they segregate at the top of the ingot, which part is subsequently cut off. Fig. 4 shows part of one of the pouring floors; *A* is the ladle carriage; *B* is half an ingot mold; *C* ingot mold clamped and wedged; *D* ingot mold in pouring position.

Hammer Shop

High-speed steel is stripped from the ingot molds while still hot and run to the preheating furnace in the hammer shop. The temperature of the preheat is 1600 deg. F., and the ingots remain here for a period of 5 to 6 hours. From here the ingots go to the high-heat furnace where they are heated to 1950 deg. F., thence direct to the hammers where they are forged to size, care being taken that the temperature of the work does not fall below 1750 deg. F.

The structure of the steel in the ingots as cast, is coarsely crystalline. Any steel in this state is quite unfit for tools and must therefore be mechanically worked to reduce the grain (that is to say the crystal sizes) to extreme smallness. The smaller the crystals or grains, the higher the refinement and better the steel.

Steel can be refined by heat treatment, but when heat treatment and mechanical work are carried on together, the refining is much more active and more thorough. Therefore all ingots before they can be used as tool steel, must be forged, and for convenience rolled into various shapes. The steel is heated very slowly and thoroughly soaked in specially designed furnaces, then carefully forged down (known as "cogged") under the hammer as shown at *A* in Fig. 5, to certain definite sizes which can be conveniently handled in the rolling mill. This forging must be done very carefully, otherwise the steel may be ruined. The pressure applied to the surface of the steel under the hammer must be applied at right angles to the face of the hammer. The contact under the head of the hammer and on the anvil must be on a line parallel to the axis of the hammer, otherwise a shearing is set up in the ingot, which if excessive, results in a burst center as shown in Fig. 6 at *A*. Too light hammering will also injure the steel, opening it up in the center as shown at *B*.

Forging from Ingots to Billets

In forging the ingots down to billets, which is the state after the first mechanical reduction, it is essential that the ingot should be worked in square form to very nearly the finished size, and then if the bar is to be still further reduced to hexagon, octagon, or round, the corners are reduced until the desired shape is obtained. If an ingot which is to be turned into a round billet or a round forging were forged at the start into a round shape, the bar would have a split center.

The billets after being forged in the hammer shop, pass to the inspectors. The inspectors examine them for surface defects, seams, blemishes, cracks, etc., which are outlined on the billet with a yellow wax crayon which shows quite clearly on the dark ingot. The high-speed billets (which of course are too hard to chip) go to the grinding shop, where the defects are ground out, as shown in Fig. 7.

Billets other than high speed are inspected and marked in the same way, but as the steel is soft enough to chip, the defects are removed with the pneumatic hammer as shown in Fig. 8. The chisels used for this work are rounded so that round-bottomed grooves are left where the defects are chipped out. The grooves must be round-bottomed so they will roll out in the subsequent rolling operation.

From the inspection and grinding the steel is either returned to the hammers or taken to the rolling mill, very carefully reheated in specially designed furnaces and passed through cogging rolls (that is, the billet mill) after which they are still further reduced in the bar mill. After each reduction the work is inspected and if necessary chipped or ground as described. If this were not done the imperfections would be rolled still further into the bar, thereby ruining the product.

The rolling mill is styled as so many "stands," each of which is composed of two uprights with the rollers horizontally arranged as shown in Fig. 9. The mill is

also styled as "two high" or "three high," which is to say that there are two rolls or three rolls in each stand. In a two-high stand rolling mill, Fig. 9, the bar is passed through shaped rollers along the same plane; in a three-high stand, Fig. 10, the bar is rolled alternately between the bottom roll and the middle roll and the top roll and the middle roll.

FIGS. 11 TO 16. VIEWS IN VARIOUS PARTS OF THE SHOP

Fig. 11—Eighteen-in. roll in lathe. Fig. 12—Nicking, breaking and inspecting small bars of high-speed steel. Fig. 13—Sawing ends of large bars. Fig. 14—Scrap ends of high-speed steel. Fig. 15—Inspection department. Fig. 16—Bar-straightening rolls.

The billets are cut in the shear to certain dimensions and are then inspected. The measuring stops on a bar-shearing machine are for the sake of economy, so set that the length of the bar will be a multiple of a certain length designated by the purchaser.

The bar mill shown in Fig. 10, also known as the merchant-bar mill because it is capable of rolling to the ordinary merchant-bar sizes, is used for reducing billets down to the finished size. The billets are carefully reheated (particular attention being given to the time which these billets remain in the furnace) to the temperature prior to rolling, the same care, of course, having previously been taken in the billet mill. The steel is then rolled in the bar mill, a certain definite reduction taking place at each pass. The reduction of cross-sectional area of the work amounts to from 15 to 20 per cent. per pass The large rolls of the billet mill are 18 in. in diameter, and have a surface speed of about 500 ft. per minute; one of them is shown in the roll lathe in Fig. 11. The small rolls of the bar mill are 10 in. in diameter, and have a surface speed of from 650 to 700 ft. per minute. The roughing rolls are made of alloy steel, heat treated, and the finishing rolls of chilled cast iron. The finishing temperature, that is to say the temperature at which the metal leaves the

last pass in the rolling mill, is very carefully controlled. This is important, as the grain size and the future effectiveness of the steel are very largely affected by the temperature at the last pass. The mill for rolling the smaller sizes of bar is called a wire mill, and work as small as $\frac{3}{16}$-in. diameter is rolled in it. The wire is coiled while hot, as it comes from the last pass.

Each analysis of tool steel must be mechanically worked at a certain temperature, therefore the furnaces are heated for each class of steel to a certain temperature and this temperature is controlled by pyrometers. The use of pyrometers is not at all common in the steel industry, and in many mills the temperature is gaged only by the eye and judgement of the furnace man.

The furnace man is instructed with each and every batch of steel to heat the furnace to a certain temperature which is recorded by a pyrometer over the furnace door. The finishing temperatures are also controlled by an inspector by the means of an optical pyrometer. Every bar that is not up to the standard temperature is marked so that it may be especially examined and passed upon. In most instances, these special bars are scrapped and remelted.

Final Inspection

After the steel has passed inspection in the rolling mills, it is sent to the warehouse to be finally viewed, a fracture taken of every bar, and each bar inspected for mechanical faults, seams, laps, cracks and general imperfections. The smaller bars are nicked with a cold chisel and broken, as shown in Fig. 12. When the photograph for this illustration was taken, high-speed steel bars were being inspected. Each end of each and every bar is nicked and broken, and if a defect shows in the fracture another piece is broken off. This accounts for the varying lengths of the pieces on the floor.

The wooden guard *A*, Fig. 12, prevents the broken pieces flying all over the shop. The larger bars are sawed part way through from each side and then broken as shown at *A* in Fig. 13. In Fig. 14 is shown a tote box with about two tons of these ends of high-speed steel bars. Many of them are 6 in. diameter by 4 to 5 in. long. These go back to the furnace to be remelted. In Fig. 15 are shown a few of the inspection stands at the side of the room. Each bar is inspected from end to end. Any suspicious looking mark on the bar is filed away to see whether it is a mere surface defect or a crack which penetrates the bar. A certain quantity of this material is then annealed, and the remainder which is known as normal steel is then stored in the warehouse ready for shipment to those customers who order the material unannealed.

After annealing, the steel bars, when required, are straightened in a mechanical straightener, one of which is shown in Fig. 16, and are carefully inspected, some being sawed and others fractured on the end so as to determine that the grain is of the desired fineness, all of which is described in connection with Figs. 12, 13 and 14. Of every 100 lb. of steel that goes into the furnace, only about 60 lb. passes the final inspection. All bars of steel that pass are then carefully stored in their respective bins so that no two qualities of steel can become mixed. The bars that are shipped direct from the warehouse are painted with various distinguishing symbols.

Work of Labor Divisions of War Administration Co-ordinated

Upon the recommendation of the Advisory Council, created to report on the handling of industrial relations growing out of the war, the Secretary of Labor has arranged for the coördination of the industrial service (labor) activities being developed in the various purchasing and supervisory offices of the war administration. Simultaneously a number of new bureaus have been established and will assume the coördinating functions.

A well-developed industrial service division is in operation in the Ordnance Department, and similar organizations are being worked up in the other purchasing and supervisory branches of the War Department as well as in the Navy Department and the Shipping Board. These bodies are all developing plans for accomplishing similar results in their own given departments. In some cases they might, if not coördinated, work to cross purposes, and in any of their activities, exchange of views on methods is desirable. The necessary machinery for getting together is now provided by the action of the Secretary of Labor.

The following new bureaus are established to effect the desired coördination: (1) Adjustment Bureau: to deal with disputes; (2) Condition of Labor Bureau: to administer conditions of labor within business plants, such as safety, sanitation, etc.; (3) Information and Education Bureau: to promote sound sentiment and to provide appropriate local machinery and policies in individual plants; (4) Women in Industry Bureau: to correlate the activities of various agencies dealing with this matter; (5) Training and Dilution Bureau; (6) Bureau of Housing and Transportation of Workers; (7) Bureau of Personnel (which may possibly be fused with the Information and Education Bureau).

The present United States Employment Service will act as the coördinating bureau on the procurement of labor.

Remedy for Breakage of Heavy Handwheel

By H. D. Martindale

We have a heavy punch of the type which carries a handwheel on the ram for the adjustment—up or down—of the punch. We experienced considerable difficulty from the breakage of the spokes in this wheel; the breakage evidently being caused by the sudden stopping and starting of the ram at the instant of shearing; the latter irregularity was in turn the result of backlash in the moving parts—a difficulty which it seems impossible to eliminate. We made these spokes straight and crooked; we used steel and every other material we could think of; still they would break until we hit upon the following plan which seems to have solved the problem.

We made a hub of cast iron, bored four 1¼-in. holes 90 deg. apart in the periphery, set in four wooden spokes capstanwise, and fastened them with setscrews. This arrangement has worked for several years without the necessity of repair.

Protective Screens for Furnaces

BY J. V. HUNTER

Workmen needlessly exposed to the flames, heat and glare from furnaces where high temperatures are maintained suffer in health as well as in bodily discomfort. This article deals with several types of shields designed for the maximum protection of the furnace worker.

ONLY a short time ago a visit to a drop-forging plant showed many of the workers around the big furnace exposed to glare and flame and sweltering in a heat, protection from which, no provision had been made.

Such conditions are not necessary; in almost every case means of relief can be found by one earnestly seeking them. The larger forge shops have adopted flame shields for the majority of their furnaces. Years ago the industrial furnaces (particularly of the oil-burning variety) were without shields, but the later models are all shield-equipped. These shields are adapted to all of the more modern, heat-treating furnaces, as well as to those furnaces in use for working forges; and attention should be paid to their use on the former type since the heat-treating furnaces are constantly becoming more numerous as manufacturers find need of them in the many phases of munitions making or similar work.

The heat that the worker about these furnaces must face may be divided in general into two classes: there is first that heat due to the flame and hot gases that the blast in the furnaces forces out onto a man's body and face. In the majority of furnaces this is by far the most discomforting, and care must be taken to fend it and turn it behind a suitable shield. The second class is the radiant heat, discharged as light from the glowing interior of the furnace. This is the lesser of the two evils so far as general forging furnaces are concerned, but it becomes the predominating feature in furnaces of large door area such as in the usual case-hardening furnaces. Here the amount of heat discharged is often almost unbearable even for a moment. This heat can be taken care of by interposing suitable, opaque shields that will temporarily absorb it without being destroyed by it, or becoming incandescent. Should such shields be so constructed as to close off all of the heat, it might be impossible to work around the furnace for the removal of its contents, but they can be made movable, and in such a manner as to shield the major portion of the worker's body.

First taking up the question of flame shields, the illustration, Fig. 1, is a typical installation that shows the main features for application to a forging machine or drop-hammer, oil-burning furnace, or for an arched-over, coal furnace where the flame blows out the front.

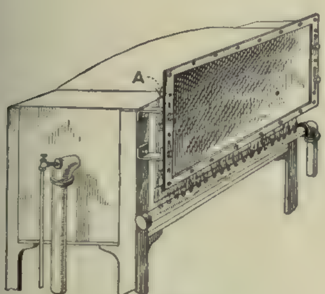


FIG. 1

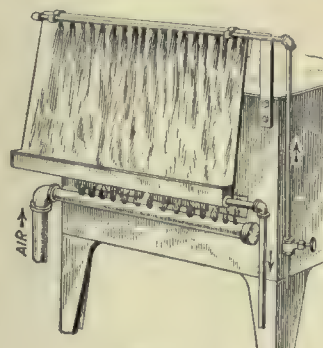


FIG. 2

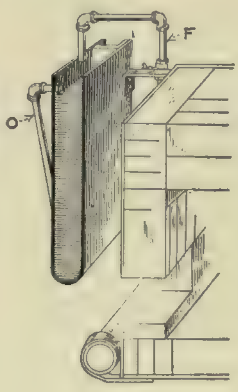


FIG. 4

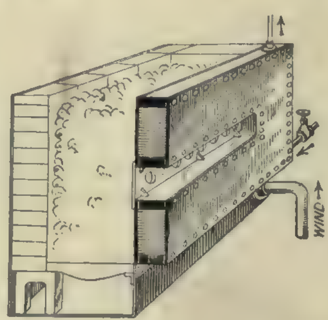


FIG. 5

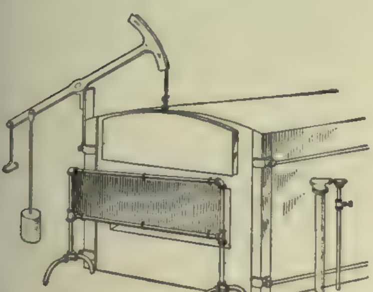


FIG. 6

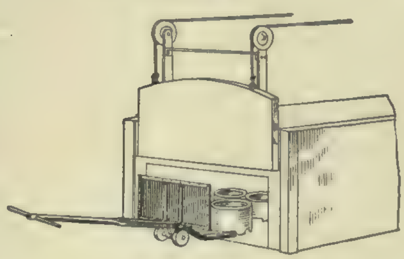


FIG. 7

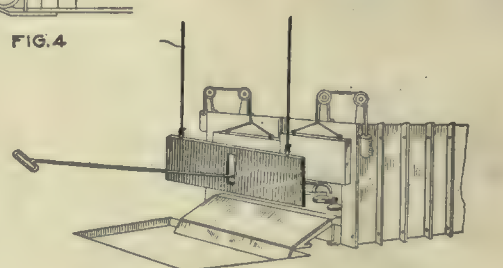


FIG. 8

FIGS. 1, 2, 4, 5, 6, 7 AND 8. VARIOUS PROTECTIVE DEVICES FOR FURNACES

Fig. 1—Double plate shield. Fig. 2—Water-cooled shield. Fig. 4—Section of improved water-cooled shield. Fig. 5—Abortive water-cooled front. Fig. 6—Portable flame shield. Fig. 7.—Truck shield. Fig. 8—Swinging shield

This shield consists of a frame covered with sheet metal and held by brackets about six inches in front of the furnace. It will be noted that slotted holes make this frame adjustable for height, and it should be lowered as far as possible when in use, so that the work may just pass under it and into the furnace openings.

Immediately below the furnace openings, and close to the furnace frame will be noted a blast pipe carrying air from the forge-shop fan. This has a row of small holes drilled in its upper side for the entire length, and these direct a curtain of cold air vertically across the

furnace openings, forcing all of the flame, or a greater portion of it, to rise behind the shield. Since the shield extends above the furnace top there is no escape for this flame until it has passed high enough to be of no further discomfort to the workman.

In this case fan-blast air is used for cooling, and this is cheaper and more satisfactory because a great volume may be used. However, where high-pressure air is used for atomizing the oil at the burner, and nothing else is available, this may be employed—though naturally a comparatively small pipe will be needed, in which minute holes are drilled, else the volume of air used will be too great for the compressor economically to supply. Steam may also be employed for like service.

The latest shields of this type are all made double, as illustrated, with an inner sheet of metal an inch or two inside of the front. In the illustration, *A*, Fig. 1, this inner sheet is smaller, but some are now built the same size as the front and bolted to it with pipe spacers between. The advantage of the double sheet is that the inner one bears the brunt of the flame, and, if needs be, burns up before the outer; while, if due to a heavy fire it should be heated red at any point, the outer sheet will still be much cooler and act as an additional shield to the furnace man.

Heavy Forging Practice

In heavy forging practice where the metal is being worked at a welding heat, the amount of flame that will issue from an open-front furnace is so great that a plain, sheet-steel front will neither afford sufficient protection nor stand up in service. For such a place a water-cooled front is often used. The general type of this front is illustrated in Fig. 2, and appears to have found considerable favor, for numbers of its kind are scattered throughout the country.

In this case the shield is placed at a slight angle from the vertical, and along the top edge is a water pipe with a row of small holes through which sprays of water are thrown against it. This water runs down in a thin sheet over the shield, cooling it, and is collected in a trough connected with a run-off pipe at the bottom. The lower blast-pipe arrangement is similar to the one first described.

There are several serious objections to this form of shield that should lead to its replacement by a better type; the first is that with a very hot fire, portions in the center may become so rapidly heated that the steam generated will part the sheet of water and cause it to flow from that point in an inverted V, and that section will then quickly become red hot. Another feature is that after the water and fire are shut down for the night the heat of the furnace can be great enough to cause serious warping of the surface of the shield so that the water will no longer cover it in a thin, uniform sheet.

After rigging up a big furnace with a shield of this type several years ago, its most serious objection was found in the increase of the water bill of the plant. This was already of large proportions, but it had suddenly jumped to the extent of several hundred dollars. Investigation soon disclosed the fact that this water shield was one of the main causes of the added cost of water. A little estimating of the amount of water that can flow through a ½-in. pipe under 30-lb. pressure, in the course of a day, will show that this amount at 10c. per 1000 gal., can count up rather rapidly.

The final step in water-cooled shield development was then adopted and the shield shown in the illustration of the furnace in Fig. 3 was constructed in the sheet-metal shop, and replaced the other type on those furnaces. This type really seems to be the logical solution of the water-cooled shield problem. Fig. 4 is a section through a portion of the furnace front and shield showing all of the principal parts. This shield consists essentially of a very thin tank, about 2½ in. between walls, and filled with water. Like other shields it is fitted with an adjustment, that it may be raised and lowered as the work demands. The tank having an open top, the water as it absorbs heat from the flame will simply boil away in steam; and only a small amount will have to be added to make up for that which has evaporated. The water-feed pipe shown at *F* ends a short distance above the top of the tank so that just how much water is running in may readily be seen.

An overflow pipe is provided at *O* which aids in maintaining the water at the proper height, as a sufficient quantity can always be permitted to run in, to avoid any

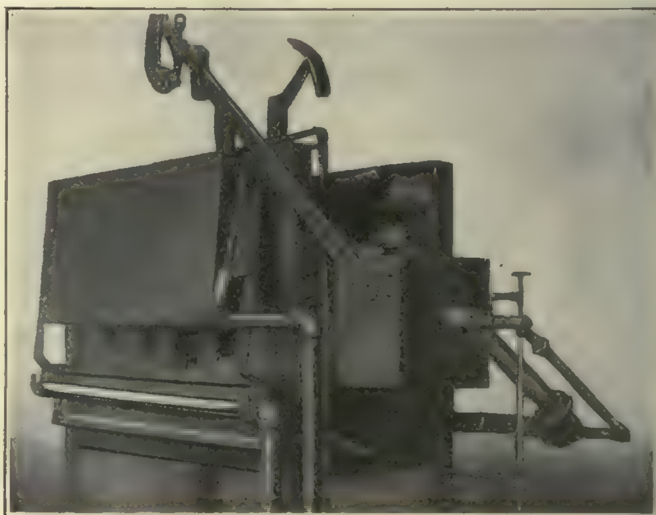


FIG. 3. IMPROVED WATER-COOLED SHIELD

possibility of the shield ever boiling dry; at the same time the small excess can run off without danger of an overflow. The shield illustrated in Fig. 4 has been in constant use for over two years, giving greater satisfaction than any other of which the writer has known. It might also be noted that this shield was made with riveted joints, the shop not having a gas-welding outfit. To flange over the edges and then weld them with an acetylene torch would be a far more economical procedure, and would also insure a tight and permanent joint.

The water-cooled front shown in Fig. 5 is an absurd effort to accomplish the design of a furnace that will provide cool working conditions; and yet the writer has observed several of these in a certain section of the country. This leads to the belief that the original designer was exceptionally gifted at convincing his neighboring friends in the blacksmith business that he had actually accomplished something of merit, or else that they were all blessed with a hard-coal supply which they were anxious to get rid of. This front was on a bolt-heating furnace using hard coal for fuel; and it

may be seen that it takes the place of all of the brickwork that should be on that side. Had this been nothing more than a very narrow water-cooled frame, with brickwork below and supporting bricks above, put in like the tuyeres in a foundry cupola, the case would have been somewhat different, for then it would have absorbed a smaller proportion of the heat.

A blacksmith who knows how a piece of cold iron laid in a small welding furnace momentarily lowers the temperature, will appreciate the enormous amount of extra heat that must be maintained in the central portion of this furnace to make up for the constant chilling effect of the cold wall. Moreover, since there would have been serious trouble had steam generated in this front, a steady stream of water had to be run through it constantly to insure against an approach to the boiling point. This is illustrated chiefly because of its absurdity, and as a warning of something to avoid.

Water-cooled, tuyere openings, as mentioned above, which support brick side-walls of the furnace, have proved successful for coal furnaces used for forging machine and drop-hammer heating, since they permit a great amount of work to be handled through their openings without wearing away as would a brick arch. Great care should be exercised properly to design them so that a minimum amount of the cold tuyere will be in contact with the interior of the furnace, and all interior portions possible should be covered by the bricks. However, a discussion of these points will hardly come in the flame-shield class, although they can be made to do a great deal toward relieving the excessive heat to be borne by the furnace worker.

Flange Shields for Furnaces

Such portable flame shields as the one illustrated in Fig. 6 may prove serviceable before furnaces required for plate work, where the doors are often only opened for a moment at a time. This shield can be placed far enough in front of the furnace, that it will be possible to work under it or around it, in removing bulky work from the furnace, and yet it will afford the furnace tender some relief from the excessive glare that will come out the wide-opened door. To have this shield of light weight so that it may be readily pushed aside when not wanted, the frame may be made up of pipe and fittings, and a piece of thin sheet steel fastened in the panel by rings about the frame.

About the most disagreeable task in a heat-treating shop is the removal of the pots from the casehardening furnaces; these must be handled at a bright red heat in order that their contents may be dumped into the quenching tank with a minimum-time contact with the air, and before they have cooled sufficiently to require reheating. Facing the heat before the large open doors of the majority of these furnaces, is a man-killing task even when the weather is moderately cool. The boxes soon become more or less distorted, and then even the best of lifting devices will not remove a hot pot without several minutes labor in front of the doors.

In Fig. 7 is shown a method of arranging a shield on one type of charging and removing truck. This shield cannot afford more than a partial protection to the body of the furnace tender, because he must be able to see around it, and in some cases even push it partly through the door of the furnace, but even small as it is it may still afford some welcome protection. The great advantage in this case of having the shield on the truck instead of stationary in front of the furnace, is that it still affords protection as long as the hot pot is being handled through the shop on its way to the quenching tank.

It might be interesting to many engaged in the heat-treating or casehardening of steel parts, to make a special note of the design of the truck that is illustrated in connection with the shield; the general form is shown although the actual details for the construction of such a truck are lacking; these being simple, may be readily worked out by anyone wishing to build one. This is considered to be one of the quickest and easiest operated devices for the removal of this class of work from the furnace. To be sure it may only be used where the floor of the furnace has been built level with the floor of the room, but many of the modern furnaces of this class are so designed.

The pack-hardening pots are cast with legs, from two to three inches high, to permit the circulation of the hot gases, and so heat more quickly. Between these legs and under the body of the pot, the two forward prongs of the truck are pushed, tilting the outer handle to make these prongs as low as possible. The handle is then lowered and, as it has a good leverage, the pot is easily raised from the floor, and the truck and its load rolled out.

Heating of Manganese Steel

Another form of heat-treating furnace is that which is used for the heating of manganese and other alloy steels, which after having been brought to the proper heat are drawn from the furnace into an immediate quenching tank. With manganese steel in particular, the parts are so fragile and easily damaged while hot that it is frequent practice to have a sloping platform immediately in front of the furnace door down which the castings may slide into a tank situated below the floor level. Such a furnace with a quenching tank in front of its door is shown in Fig. 8.

These tanks are covered with plates while charging the furnace, and the cold castings are placed in a moderately cool furnace. Since some of these steels must not be charged into a furnace where the heat is extreme but should be brought up to their final heat gradually, there is little discomfort during the charging process. When quenching, however, from a temperature of 1800 to 1900 deg., it is extremely unpleasant in front of the doors. The swinging shield is here adapted to give protecton for this work.. As will be noted it is hung a sufficient distance in front of the doors, that it may not interfere with the castings as they come from the furnace, and slide down into the tank.

To facilitate the work, and avoid the necessity of working with the bars outside the edges of the shield, the slot-like hole is cut in the center of the shield, and through this the bars or rakes for dragging out the castings are easily inserted and manipulated. The advantage of such a swinging shield is that it may be readily moved from side to side, or forward and back as occasion requires.

There are doubtless many other types of furnaces to which shields would prove a most welcome addition, but no attempt has been made here to include all of the ideas

on the subject. It appears, however, that the millwright in charge of such arrangments in a wide variety of industries can improve conditions by giving some thought to the matter. For instance such furnaces as those air furnaces of the malleable foundry that require slag skimming from the molten metal, could have the doors protected in some way so as to shelter the furnace man without interferring with the free removal of the slag. A light, temporary or portable shield might be applied to the old hand-fired boilers as a protection during those trying 5 or 10 minutes twice or more each day, that are devoted to the task of cleaning the fires, which is mostly a cringing attempt to drag out all of the white-hot clinkers in the least possible time.

Another type of screen that was lately illustrated consisted of a number of short lengths of steel chain suspended from a bar; this made a curtain that protected the worker from flying sparks, yet could easily be parted at any point. It was used before a stand of hot rolls, for reworking steel bars to smaller sizes. A swinging shield should be placed before the spout of a blast furnace, or of a cupola that is to run continuously, to protect the men who must pass in front of it from the ever-flying sparks. Shields that are placed in the sides of hand ladles, merely a sheet of iron standing up 6 in. beyond the top of the ladle bowl, and held in place by the shank, cost a foundry practically nothing and yet afford great protection to the arm and hand on the shank toward the bowl.

Labor and Material Waste

By A. J. Chamberlain
Assistant Superintendent, Geo. Cutter Co., South Bend, Ind.

I have recently read the article on page 1081, Vol. 47, by W. Thomas, entitled "Muscles and Brains," in which Mr. Thomas criticizes methods he has observed in visits to manufacturing plants, and suggests some improvements.

I believe that if articles of this kind could be published continuously, they would be very beneficial to many of us. I dare say there is hardly a plant in operation in which labor or material is not wasted to some extent. The difficult problem is to detect this condition, and I agree with Mr. Thomas that it sometimes takes high-speed brain work to accomplish satisfactory results in this direction.

It is quite strange but nevertheless true, that men who are constantly improving their own method of manufacture are most apt to overlook some of these leaks. Very often we centralize our interest on some particular part of the work to too great an extent, and neglect other departments under our direction, almost entirely.

A visitor unacquainted with the plant, but who happens to be observant or especially interested in some part of the work that we have neglected, can often point out wasteful methods which we have overlooked for years. Recently I visited a plant where the only product was a wrought iron plate about 6 or 7 in. square and ⅜ in. thick, cross-ribbed on one side and containing a few holes. My visit began in the material-storage yards where I was greatly impressed by the efficient methods of handling the raw materials and conveying them to their furnaces; also the melting of the iron and rolling it to the desired shape seemed to be done quite efficiently. I shall always remember how the fiery masses of iron were rushed through the different rolls at great speed and came out of the finishing rolls in 20-ft. bars all ribbed and ready to cut off, all of these rolling operations having been performed with the one original melting heat. I began to think that this plant was efficient and well equipped to manufacture their product.

I then visited the next room where the bars were cut off and the holes punched in the square pieces. A number of men were sprinkling the hot bars to cool them; one man was running a large cut-off punching machine, others were picking up the square pieces that he had cut off and piling them in rows on trucks.

Brushing Plates With Oil

Further on were men brushing the plates with oil and handing them to the operator of another press, who punched the holes in them while two other men were piling the finished plates on trucks again, whereupon they were ready to be delivered to the warehouse. I stopped to consider things awhile and decided to look over these operations again. I could see no reason why the hot bars could not be cooled by mechanical means at a moderate expense. The cutting-off and punching operations could have been combined into one operation by the use of a simple, progressive, piercing- and cutting-off die; and either one of the presses in use had capacity enough to do this work. This would have eliminated the rehandling of the plates. I also considered the feasibility of a conveying belt at the rear of the press, which would have eliminated any handling of plates in that room. The result of my visit to this plant was, that I regard the layout of the rolling-mill equipment and furnaces has been well engineered by some expert on rolling-mill methods, but the layout of the press shop has probably been considered of but little importance and perhaps left to an inexperienced handy man about the plant. There appeared to be enough waste labor in that press shop to operate another row of rolling mills.

Improvements Carefully Analyzed

Another explanation is that the management of this plant which seemed to be an old-established concern, might have carried on an efficiency campaign at some time, which terminated at the press-shop door. Quite often and particularly in medium-size plants, when an efficiency campaign is started, there is a tendency to improve methods in the order in which incorrect methods are found, rather than in the order of their importance.

Those corrections which would effect the greatest saving in production cost, are sometimes left undisturbed, while less important things are changed simply because they happen to be detected first. All contemplated improvements should be most carefully analyzed and scheduled in such a manner that those which will effect the greatest amount of saving in production-cost in one year, per dollar of expenditure made, will be taken care of first. Such precaution is quite necessary when there is a possibility of efficiency work being terminated before all contemplated improvements have been made—a thing which often happens because of the expense involved, or because of unforeseen business depressions.

A Fair Royalty Contract

By ROBERT G. PILKINGTON

THE writer's thanks are due first to the editor for his correction of the wording of the contract as given in the original article. The writer's legal knowledge is entirely borrowed, and an oversight like the one in question may slip in very easily. In justice to the attorney who wrote the contract, however, it is only fair to say that he is at present a very successful corporation lawyer of the City of Chicago, and the oversight in the wording, which is important, should be blamed on the writer.

Readers are congratulated on having available a discussion like that which Mr. Harris gives on page 143, of the *American Machinist.* The original article is dissected and clarified in a way that leaves nothing to be desired, and if the writer had been gifted with the facile pen of Mr. Harris, much of the latter's argument would not have been necessary. However, in justice to the young men who might be tempted to use the contract as a model, it is only fair to say that, with the noticeable exception before mentioned, the contract as written is in use and actually works, and works well. If the matter were not of some actual importance, the editor could not justly be asked for additional space, and the writer will not use more than is necessary in making reply to Mr. Harris, for the reassurance of those who might want to use this form of contract.

Mechanical Problems in Business

All of the writer's experience has been in working out mechanical problems that arose in the daily business of the larger corporations of the country, with especial reference to the motor car and allied or contributing industries. This will explain the repeated reference to such work. Exception is taken in a mild way to the statement that, "As a rule, an invention is an inspiration." It has been the writer's duty much of the time to review each issue of the "Patent Office Gazette," to see what was being done or thought in kindred lines. If care is used not to take the statement too literally, it is easy to see by perusal of that periodical just what inventions are the result of an inspiration. A considerable experience with engineering work inclines the writer to think that most of the desirable inventions now in use have resulted from an actual need in some line of business, and this need came to the knowledge of some one employed in that line or a related line.

It is suggested that any recent number of the better-known trade and technical journals be chosen, and the advertising columns be considered with this in mind. Some of the cases with which the writer is familiar and many others, easily may be guessed at. On page after page may be seen things that represent a stage in the evolution of some crude device that an employee originated in his daily work, and after having its possibilities tested out, it was put on the market, either by the employee or the employer. Some of the best devices have originated in shops where the contract system is used. Mr. Harris says, "It is a peculiar circumstance that the efforts of inventors are not appreciated" etc. The cause of this lack of appreciation is not far to seek, as Mr. Harris undoubtedly knows; generally, it is due to one of two things, both inherent in the mind that produces the invention. Lack of appreciation is the due of that class of invention which Mr. Harris characterizes as "inspirational"—and the spirit of his statement is intentionally misquoted—or else to the fact that, no matter how good the invention may be, the inventor has not the kind of mind that can take its time under any stress, and after getting all the protection possible, find for himself a business manager to whom he may assign a share of all future income due from the invention. His choice of this business manager is about as important as the invention, so far as the inventor is concerned.

Condition Rapidly Changing

It is also a fact, as Mr. Harris says, that an employer is not as keenly alive to the possibilities of an invention produced by one of his own men as would he be to those of one submitted by an outsider, but this is a condition that is rapidly changing and correcting itself. The writer's personal knowledge comprises enough notable exceptions to make for great encouragement. The employer is a business man first, and he is almost sure to belittle the approach of his employee. The man was urged in the original article to take his witnessed sketch to his employer; but if the employer shows no interest, the employee should not have the slightest compunction in similarly approaching the employer's most energetic competitor, transferring his services also if he thinks wise. This is good business from the employee's standpoint, and exactly similar methods would be used by the employer.

Mr. Harris also says, "Until the actual issuance of a patent, an alleged inventor has no more actual rights," etc. This is true in a strictly legal interpretation of an accomplished fact, but in business it does not always work out that way. It depends largely on how good the invention is, and how badly some one wants to use it. If a sketch is witnessed by two parties, and due diligence is used in reducing it to practice and applying for a patent, the actual protection, which is what constitutes the inventor's rights, is as good as though the patent were already granted. True, this condition does not assume that it may not be attacked and even discredited in future; but again, a reference to the advertising columns of any technical journal will show numerous cases in which very successful companies have been started on a patent that was simply applied for. It is difficult to imagine how the motor-car business could have got along, if business men generally had assumed that because the inventor had no actual rights until the patent had been granted, they would not go into a thing; and there is nothing especially unstable in the motor-car business on this account, either. The fact of the matter is, that in most cases, the evolution in methods is so rapid that very few patents are worth fighting over. A patent is a good thing, but there are others about as good. A secret can be kept, like the composition of the best-known talking machine disk record; or the possession of capital enough to work around a patented idea, without fighting it, can produce some-

thing just as good. It is a well-known fact that if an inventor wants more than his invention is worth, or is cranky, the big corporation begins to study.

As Mr. Harris intimates: some corporations do not like an employee to be a stockholder, and this contingency was provided for in the original writing, but many of the largest corporations welcome them, as is well realized in the experience of the writer who has been intimately connected as an employee, with the world's largest and next-to-largest motor car corporation, the largest rubber producing interest, the largest adding machine company, and others. In any of these several corporations especially easy terms are arranged for the purchase of stock by employees, and it makes no difference whether the stock is paid for by royalties or not. As said before: the inventor must expect to be bluffed by a man who is paid a very large salary for bluffing; but much of this is camouflage, and the inventor can take as much or as little as his mental attitude permits.

Mr. Harris says that he would not sign a contract containing the provision that the inventor might examine the books at any time, with the inventor of the best device that ever bore patent protection. Again attention is called to the fact that the attorney who wrote the agreement makes an excellent daily success from just such work; and that to the writer's certain knowledge, the president of one of the country's largest corporations did sign, gladly, an agreement containing that provision exactly as worded there. It is only fair to agree with Mr. Harris that such a wording might be made extremely burdensome if there were an intention to make it so. Even when a corporation is known to be the soul of honor, it may be of advantage to an inventor to examine the books several times between the regular and recognized occasions, and not for any reason reflecting on the integrity or methods of the corporation. Even before the breaking out of the war, many firms did a big business in the cost-plus way. Were their books and operations never examined "between times?" It is safe to say that they were.

Question of Interpretation

Mr. Harris suggests a valuable addition to the contract, but it has the same liability to trouble as have other points discussed, if it is taken in a strictly literal way. Its intention is excellent. It is one that would concern me, as an employer, much more than the other. It is the one which says, "make provision that the party of the second part shall not become interested in any manner in a competing invention," etc. Since a difference of opinion is indicated, an example may be quoted. Let A, an inventor of a carburetor that may be the actual best for a high-speed motor, sign an agreement with B, who is a very large manufacturer of a varied line of gasoline-driven power apparatus, including cars, to use A's carburetor exclusively. B also makes a tractor, which requires an air cleaner on the inlet. C comes along with a carburetor that is designed exclusively for tractors, has the air-cleaning provision simply and cheaply provided for, and it does good work in every way as a tractor carburetor. A's carburetor, if it could be attached, would actually furnish a workable mixture for the tractor, but its starting characteristics would not be right any more than would its running ones; it would promptly choke solid with dust, and no way of washing the inlet air could be attached without a complete redesign.

Should B refrain from signing a contract with C, because he has an "exclusive" contract with A? He uses it with satisfaction on his cars, but will his contract with A prevent him from using C's, which he can use with satisfaction on his tractors? Much of the value of such an agreement would rest upon a common-sense interpretation of the word "competing," which should prevent such a situation as has been suggested in the preceding paragraph; but for everyday work, the friend has been well enough provided for.

A "Safety-First" Idea of Twenty Years Ago

By Walter H. Webster

Not long ago I read an article in which reference was made to an accident caused by a loose pulley seizing on the countershaft and starting the machine while the operator was setting it. I do not remember the details and I am unable to locate the article in question, but it calls to mind another on loose-pulley trouble which appeared in the *American Machinist* about twenty years ago. At that time "Safety First" was not given the consideration that it receives at the present day, and the trouble which the idea expressed in the article was intended to overcome, was the rattle due to the faulty bearing and caused by excessive wear.

The article described the usual result of wear in such cases and called attention to the fact that if the shaft could always be stopped in the same position, the worn place on the shaft would always conform to the bore; and as the pull of the belt would hold the pulley to the shaft, there would be no rattle.

Since it was out of the question to have the shaft stop always in a certain position, the same result was accomplished by first reboring the pulley, after which a bushing was made a running fit, both on the new shaft and in the pulley. This bushing had a flange on the outside of the pulley big enough to fasten on an arm, and the arm was to be fastened to any convenient place that would prevent it turning.

A hole was drilled from end to end of the bushing and the ends plugged; a connecting hole was drilled in the flange and the arm so located as to keep this hole on top. Oil holes were also drilled through the bushing, passing through the blind hole, and these were always at the top, that the pulley might be oiled at any time regardless of the belt position.

We have a pulley fixed in this manner, in use on the countershaft of a small grinding machine for more than six years, and it used to give a great deal of trouble, since the emery wheel is used at very irregular intervals and is idle most of the time. Constant oiling in the former circumstances, was required to keep it quiet. Oiling once a week is now sufficient.

The "Safety-First" feature of this idea should commend it to your readers of today. It can always be depended upon to stop and to stay stopped when the belt is on the loose pulley. In fact the belt pull on the loose pulley helps stop the countershaft by making the bushing act as a brake.

Drafted

BY BERTON BRALEY

WELL, here I am in the army, packing a Springfield gun,
And learning the trick of drilling the way that it should be done;
I'm gaining in flesh and muscle, my hands and my face are brown;
But somehow I can't help thinking I ought to be back in town.
Don't dope me out as a slacker who's scared at the thought of fight,
I guess I can take my chances along with the bunch, all right,
I like the army fellows, and the way that the game is played,
But I figure I'd help the country more, if she'd let me stick to my trade.

FOR out in the field of action I'd be one man—no more!
While back in the old machine shop, I'd count for half a score;
Machinery does the business in most of the fights today,
And I am a crack machinist—or that's what my bosses say!
And if I should be conscripted back to the shop again
I could turn out shells and rifles for maybe a dozen men;
So it just seems sort of *wasteful* to put me into a trench,
When I can do better service right at the workman's bench.

REMEMBER, I'm not kicking, I'll fight with a darn good will;
But there's lots of men for soldiers who haven't my kind of skill
In making the tools to fight with; so it sort of seems to me
It's wiser to keep them fighting and send me where I'd be
A kind of a Shop-Reservist; a soldier in overalls,
Whose job is to work like thunder whenever the country calls
For motors and rails and engines and aeroes and trucks and guns,
To help in the nation's business of smashing our foes, the Huns!

NOW it isn't a case of wages, and it isn't a case of funk,
For I like the army rations, and I'm warm in an army bunk,
I'm glad to give my service wherever I'm told to go,
And I'm keen for the Great Adventure in the great war's monster show;
But the nation's need should govern, and in the crucial test
A man should serve his country the way he can serve her best,
And the wisest way to use a man—at least I've found it true—
Is to let him serve at the kind of work that he is trained to do!

Making TYPEWRITER PARTS

by
M. E. Hoag

In the preceding articles of this series we have described parts that are comparatively easy to make. The parts described in this article are much more complicated and require the use of some very clever dies.

IV.—Bending, Swaging, and Forming Dies

THE type-bar guide in Fig. 26, requires very accurate work in the final bending operation, as well as some clever forming dies. The piece is first pierced and blanked as shown at *A*, by the progressive piercing and blanking dies shown in Figs. 27A and 27B. The ends *B*, Fig. 26, are then milled off on a taper so that they are thinner at the tips than near the body of the blank.

This taper could be made in swaging dies but would harden the metal to such an extent that the piece would require annealing before the bending operations could be perfomed.

After milling, the ends *B* are bent up at right angles to the base as shown at *C*. The dies for this operation are shown in Figs. 28A and 28B. The pins *B* locate the blank, and as the punch descends it is carried down into the recess in the block *D*. Block *A* being backed up with a strong spring, acts as an ejector for the finished piece. A slight depression cut at *E* in the block *A* also offers a means of prying the piece loose in case it should stick to the pins.

The second bending operation curls the ends over into V-form as shown at *D*, Fig 26. The dies for this operation are seen in Figs. 29A and 29B, and are rather unusual in construction. The block *A*, Fig. 29A, carries two locating pins, and two support blocks *B*, between which the ends of the blank are held and prevented from buckling outwardly as the punch operates.

The tongue *C* just clears the work when it is in place on the block *A*, and is connected to the piece *D*. This tongue *C* also supports the work on the inside and prevents buckling in that direction.

As the punch comes down on the work, the ends of the piece enter the openings *E*, Fig. 29B, and are forced up and around the forms. As the punch nears the end of the stroke, the wedge *F* entering the slot *G*, Fig. 29A, engages the piece *D* and withdraws the tongue *C* from the work which is now held on the punch and rises with it, until it is pushed out by the stripper *H*, Fig. 29B, which is operated by the hand lever *I*. This operation leaves the piece in good shape but not sufficiently accurate to meet the requirements of service. It is therefore given a final swaging in the dies shown in Figs. 30A and 30B. The die base *A*, Fig. 30A, carries the usual locating pins and the auxiliary block *B* which contains the sliding member *C*. The member *C* is attached to the lever *D* by a link and pin, and on its inner end carries two hardened swaging anvils *E*, which enter the loops in the formed piece and support them while the die operates to swage them to form.

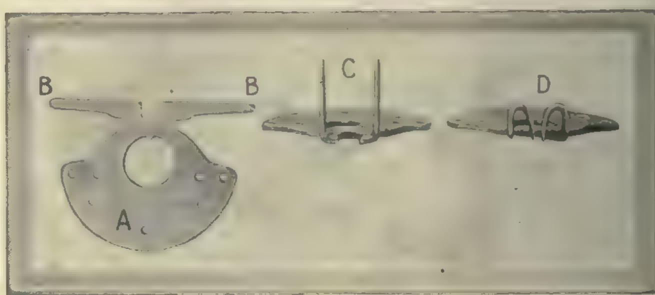
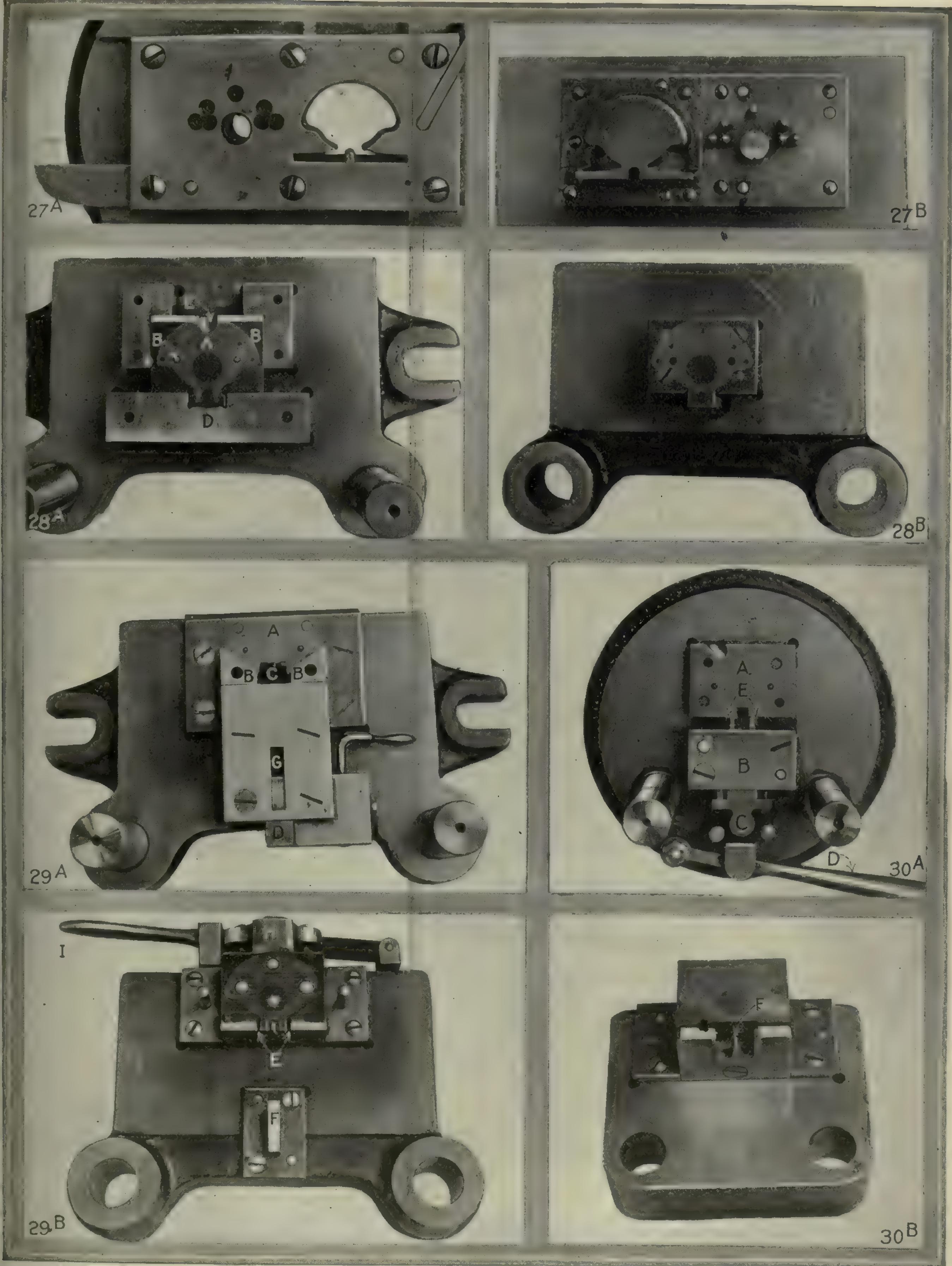


FIG. 26. TYPE-BAR GUIDE

The central tongue *F*, Fig. 30B, in the punch controls the size and shape of the ends on the finished piece. The anvils *E*, Fig. 30A, are withdrawn from the finished piece by the lever *D*.

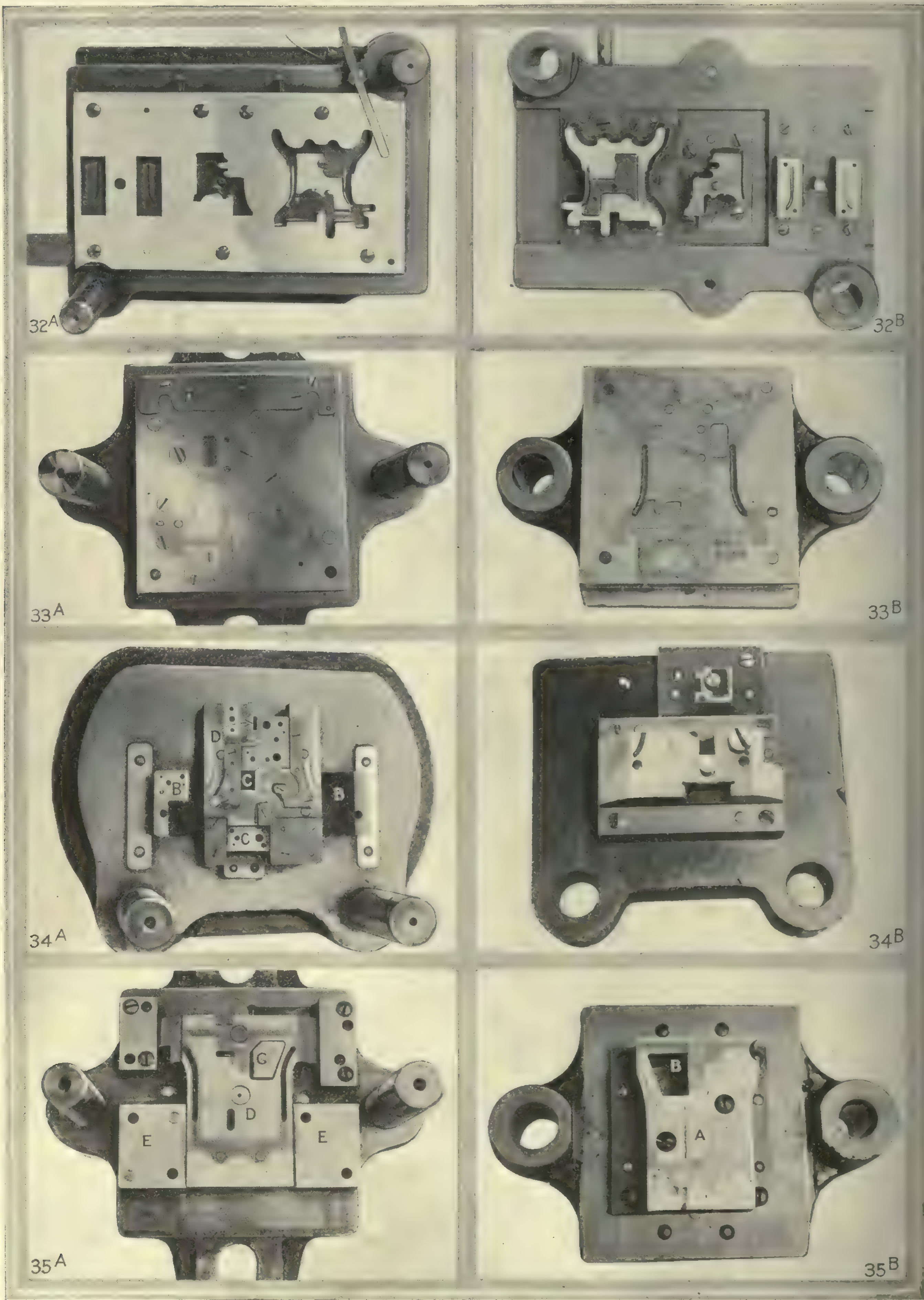
The universal bar frame shown in Fig. 31 is swaged, pierced and blanked in the progressive dies shown in Figs. 32A and 32B. The reason for doing the swaging previous to piercing and blanking, is because the large amount of metal in the blank stock tends to prevent distortion of the piece.

A subsequent piercing operation removes the remainder of the stock from *F*; Fig. 31, punches the four round holes and the two oblong openings *G* and *H*. The dies for this operation are shown in Figs. 33A and 33B, and do not require description.



FIGS 27 TO 30. DIES USED IN PRODUCING THE TYPE-BAR GUIDE

Fig. 27—Progressive piercing and blanking dies for type-bar guide. Fig. 28—First forming die for type-bar guide. Fig. 29—Second forming die for type-bar guide. Fig. 30—Final swaging die for type-bar guide.



FIGS. 32 TO 35. A NUMBER OF THE DIES USED

The first forming die shown in Figs. 34A and 34B is rather complex in construction. The base carries a number of both free and moving members, which on entering or receding from the punches, bend the work in several directions.

The parts *B*, *C* and *D* of the die, Fig. 34A, bend up the parts *H*, *I* and *J* respectively, of Fig. 31. The second forming operation is done in the dies shown in Figs. 35A and 35B, which bend down the two arms *K*, Fig. 31, and the curved part leaving the piece formed as shown at the right.

These dies are rather less complicated than those for the first forming operation. The punch *A*, Fig. 35B, is solid except for the opening *B*, which receives the punch *C*, Fig. 35A, that bends up the part *L*, Fig. 31. The body *D* of the die, Fig. 35A, recedes between the two blocks *E* which catch the two arms *K*, Fig. 31, and bring them to shape.

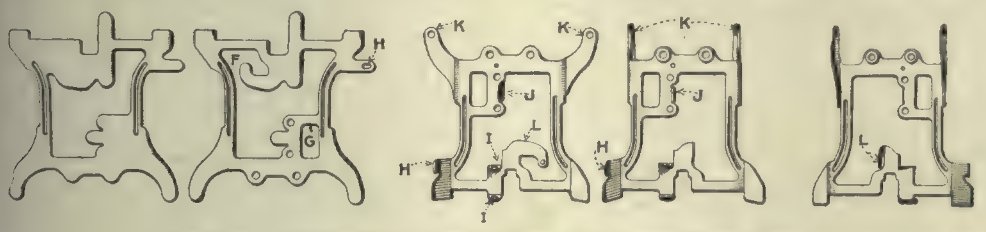


FIG. 31. UNIVERSAL BAR FRAME IN VARIOUS STAGES

The dies and tools described in these articles are only a very few of the hundreds used by the Woodstock Typewriter Company, Woodstock, Ill., but they are fair examples of the many ingenious devices employed.

An Accurate Air Meter

By Glenn B. Harris

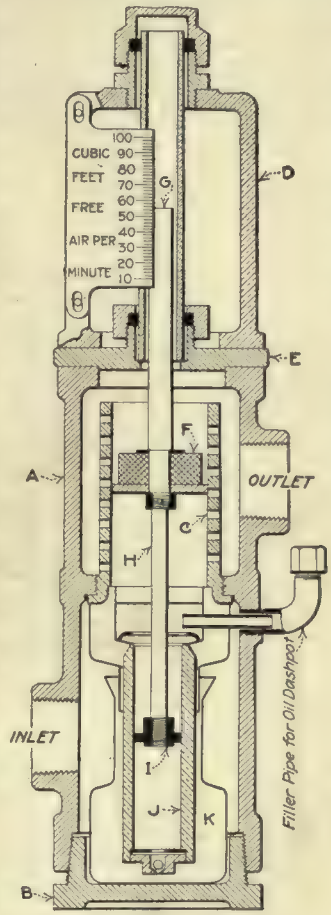
On page 985, Vol. 47, the writer discussed the Economy of Tight Air Hose Connections, and made the statement that 5 ft. of free air compressed to 80-lb. pressure, would require 1 hp. These figures are in the main correct, excepting that the horsepower required is somewhat in excess of these figures when friction is taken into consideration. As stated in this article: 5 ft. of air compressed to 80-lb. pressure will escape through a $\frac{1}{16}$-in. orifice, while 21 ft. will flow through a $\frac{1}{8}$-in. opening in one minute, requiring approximately 6 hp. for production.

It will be evident from what has been written, coupled with the figures here given, that the necessity of conserving the air supply, hence the coal pile, through tight connections, sound hose, and tools which are in perfect working condition, cannot be too strongly urged. Heretofore there has been no definite manner of ascertaining a leak except in "gunning" for it, and in a shop or yard where there is a considerable amount of piping and connections this is no easy job. The necessity of being able readily to locate a leak, has long been apparent to the user of compressed-air tools and appliances; also the desirability of knowing the efficiency of the latter, not only from the standpoint of air saving, but in relation to the amount of work turned out. In shipyards, bridge shops, large machine shops, and other considerable plants where installation of a great number of pneumatic tools or appliances was contemplated, crude methods of determining the air consumption have been resorted to; such for instance as pumping the receiver to a pressure of perhaps 80 lb. and then cutting off the compressor; after which the tool was run for a predetermined length of time, and the drop in gage pressure noted. This gave only a relative understanding of air consumption, as the tool was not operating under a constant pressure, as when at work.

The writer recently noted a device which is simple in its construction, absolutely accurate in its operation, and shows at a glance the exact number of cubic feet of free air per minute which is flowing through a tool, appliance, hose or in fact any part of a compressed-air system. The device will appeal to users of pneumatic tools, as one filling a long-felt want, and a description of its construction and operation may prove interesting. The meter—for so it may be properly termed—depends on the principle that the volume of a definite compressed fluid or gas flowing under small, constant head through multiple orifices of the same shape and size, is directly proportional to the number of orifices exposed. In the accompanying illustration is shown a main casing *A*, which is threaded on a supporting base *B;* the casing being provided with an inlet opening near the lower end, and an outlet near the upper. These openings are threaded for the connection of the air hose to the meter, and from the latter to the hose of the tool, the air consumption of which is to be recorded. About midway the length of the casing *A*, and on its interior, there is a threaded flange, into which is screwed the lower end of the meter cylinder *C*. In the walls of this cylinder are numerous accurately spaced, drilled and reamed holes. On the upper end of the casing is mounted the indicating cylinder *D*, an air tight joint between the cylinders being maintained by means of the plate *E*, fitted with a stuffing box. A sight glass extends into the stuffing box, and from that point out through the upper end of the indicating cylinder, where it is secured. A vertical opening is provided in the indicating cylinder which exposes the glass, and adjoining this opening a scale plate is secured. The scale plate is divided into feet from 10 to 100. Within the metering cylinder is located a piston *F* to which is attached a rod *G*. This rod projects into the sight glass, and is designed to move freely. On the under side of the piston *F*, is attached a rod *H*, having a small piston *I* secured to its lower end. This piston moves in a dashpot *J* located in an oil reservoir *K* which is supported by the base of the meter. Convenient means are provided for filling and emtying the oil reservoir.

The operation is substantially as follows: air enters through the inlet pipe into the space surrounding the dashpot cylinder and oil reservoir; it then passes through ported openings into the interior of the metering cylinder. In passing to the outlet chamber, the air lifts the piston and exposes some of the holes to the flow. A small head or difference in pressure is established between the interior of the metering cylinder, and the outlet chamber surrounding it. This pressure difference is only a few ounces per square inch, and is fixed by

the exact weight of the moving elements and the area of the piston on which the difference of pressure acts. The moving elements rise until the weight is exactly supported by the difference in pressure. The pistons and rods are then floating in static balance in a position corresponding exactly to the volume of air flowing through the holes exposed; and the number of cubic feet of air consumed is accurately shown on the scale plate by the measuring rod. The divisions of the scale plate are calibrated by comparison with a standardized instrument and absolute accuracy is obtained. The loss of pressure is so slight that it cannot be detected with a gage, and the device cannot be injured by a flow in excess of its metering capacity. There are no parts employed which can develop defects to change the accuracy; the use of bronze parts prevents corrosion or rusting.



AIR-FLOW METER

The meter can be used to the greatest advantage not only in accurately determining the air consumption of different makes of tools when installed, but also the amount of air used after they have been at work for any considerable length of time. It also enables the user to determine the relative efficiency of a tool before and after repairing, and thus determines whether to use spare parts or consign the tool to the scrap pile.

Heretofore a practical man could judge the work performed, but there has been no means of determining whether or not the air consumption of an individual machine was excessive. Rated consumption may be exceeded by as high as 100%, and the device worked fairly well, but the coal pile is being unnecessarily drawn upon; and if tools and air lines are not maintained at their maximum efficiency, the compressor is unduly overworked. It frequently happens that the latter machine is condemned as not coming up to its rated capacity when the trouble lies in air leakage. Where the compressor capacity rates close to that of the calls upon it, it would seem that accurate means of determining just where its product is going are most essential. The instrument here described is readily portable, and has a length overall of about 1 ft.

It will of course be readily understood that 1 cu.ft. on the scale is represented by the same distance, whether working at high or low pressure; excepting that at high pressure the indicating rod will be raised to a higher point, due to the greater flow of air through the orifices or holes which are machined in the walls of metering cylinder.

Criticism of Thread-Lead Gage

By Walter J. Woodworth

In the thread-lead gage described by Leonard M Thorn on page 1092, Vol. 47, there is a detail of construction that is more likely to show apparent inaccuracy than if the gage were properly made. In the illustration Mr. Thorn shows the disks *D* extending beyond the spacing collar *E*, plug *C* and hub *A*, a distance of at least four or five times more than is necessary. This is wrong: if the disks *D* extend two or three times the thread depth, it will be more than sufficient.

As the accuracy of a lead gage of this discription depends somewhat on the accuracy of the faces of the spacing collar, it can be readily seen that if the faces of collar *E* are out of parallel say 0.000025 the variations of lead shown with a gage equipped with proper sized disks would not amount to 0.00005 on any part of the circumference. Whereas, with the same amount of inaccuracy in collar *E* and the disks *D*, of the size shown by Mr. Thorn, the variation in lead shown would would approach 0.0001.

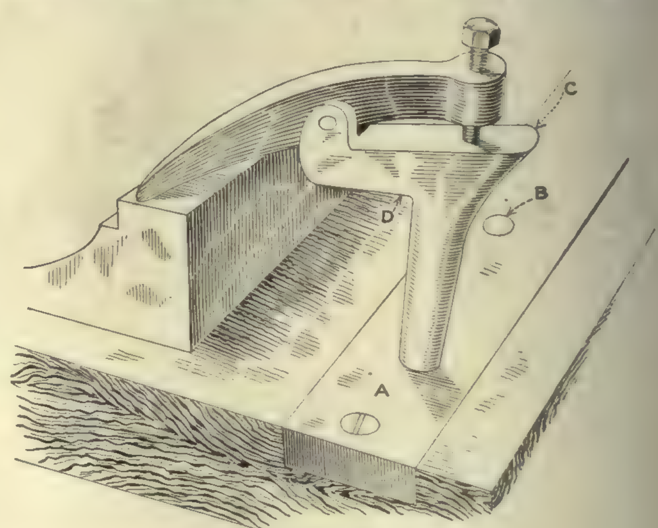
Furthermore, while this gage is of simple design, it is far from simple to produce, because some very nice measurements are involved in order to produce two duplicate disks and space them an exact, predetermined distance from center to center, as any toolmaker that has handled a job like this can testify.

A Bench Clamp

By C. H. Willey

A very useful and simple form of bench clamp or holdfast came to my notice during a recent visit to a small shop. It is shown in the illustration.

A piece of ½ x 2-in. steel stock *A* was set into the center of the bench, and ran its full length. A series



A BENCH CLAMP

of holes *B* were drilled to permit the clamp being used at the most convenient places. A few taps with a hand hammer at *C* made the device secure in the hole where needed, and when it was desirable to change it, a few taps under *D* released it.

There is a wide variety of work that cannot be satisfactorily held in a bench vise. This class of work is easily secured to the bench with this device.

Musket Manufacture in Past Centuries

By H. H. MANCHESTER

THE hand gun was first experimented with as early as the fourteenth century and probably not much later than the first cannon; at least some are shown in a much damaged fresco painting by St. Leonardo in the Lacetto at Sienna, the date of which is presumably about 1340. There is also a record that some were used at the siege of Hunter Combe Manor in 1375.

In the beginning, according to the pictures, the hand gun was merely a metal tube which was fastened like a rocket to the end of a stick. About 1400, there was added to the gun a rod which was rested on the earth in order to hold the gun steadier. At first the gun was scarcely more effective than the bow. In 1427 out of 80,000 men in the Hussite War only 200 had guns. Corned powder, which was invented in Germany about 1429, was first used exclusively in hand guns, it being too strong for the cannon as then constructed. In 1466 the pictures prove that the hand gun was still merely an iron or bronze tube, which was slipped over the end of a stick and fired through a touch-hole by hand. A butt end approximating the stock seems to have come into use about 1475.

FIG. 1. GUNSMITH'S SHOP IN 1568

At the end of the reign of Edward IV the match lock came in, and in 1517 the wheel lock was invented; but it was not until after the development of the musket by the Spaniards in 1540 that the use of firearms by infantry became decidedly effective, and in consequence far more general. In 1540 pistols also seem first to have been made at Pistoiá, Italy, and to have taken their name from the city of their origin. A woodcut of a gunmaker's shop was produced by Jost Ammon in 1568. Although the drawing is comparatively small, it is one of a series in which Ammon took particular pains to show the actual conditions in different trades, and is therefore quite exact. It is reproduced in Fig. 1 and illustrates not only guns but pistols, which had recently come into use. In the verses which were appended to the cut, the gunmaker states that he can fasten the iron barrel perfectly into the wooden stock, decorate it with ivory, and produce a gun with which a brave man, either mounted or on foot, could easily hold off robbers. The fact that he mentions fitting the barrel to the stock, and not making the barrel, seems to indicate that many gunmakers were accustomed to buy their barrels ready made. This thought is corroborated by the fact that Ammon published another and somewhat different picture which he labeled "The Gunsmith." In the verses to this, he speaks of the making of gun barrels, but the picture shows none of the operations.

The first step toward rifling seems to have been to draw a steel disk through the hollow barrel in order to make it smoother. In 1520 Kotter of Nuremberg modified the disk so as to produce small grooves in the barrel. At Woolwich in 1547 muzzle-loading guns were rifled with six small straight grooves; the rifling, however, was applied only to small arms used for sporting purposes, and neither to hand guns for war nor to cannon. A design of a machine for the boring of musket barrels was published by Jacob de Strada in 1629, and practically repeated by Boeckler in 1661. This is reproduced in Fig. 2 and depicts the boring of two barrels at once by means of hand power. Each drill

FIG. 2. A MACHINE FOR BORING MUSKET BARRELS IN 1629

is fastened into the center of the wheel and the two wheels are turned at the same time by the cogs of another wheel which rests upon them. The barrels are pulled against the drills by a rope which runs over a pulley and is drawn taut by a weight.

The material used for hand-gun barrels was very often wrought iron, although cast iron and brass were

FIG. 3. RIFLING AND BORING GUN BARRELS IN 1699

also employed. For this reason, as the use of the musket spread, it became very important to produce wrought-iron bars for gun barrels as rapidly and as economically as possible. This was one great influence which led to the development of the trip hammer.

A hammer, which was presumably run by water power, was pictured by Agricola in 1556. Another one to be worked by hand was designed by Besson in 1572. The invention of the flint lock in 1635 marked another great advance in the musket, widely extended its use, and made the manufacture of wrought-iron blanks for gun barrels of the utmost importance. Another trip hammer for this purpose, in which water power was used both to lift the hammer and to run the bellows of the furnace, was shown in an engraving by Boeckler in 1661. Boeckler also illustrates an arrangement by which iron bars for barrels could be heated so as to be better wrought, by means of a furnace, the bellows of which were worked by a waterwheel.

The most complete seventeenth century picture of hand-gun manufacture was published by Weigel in 1699. In the foreground of this picture, reproduced in Fig. 3, two men are boring a musket barrel. One man is

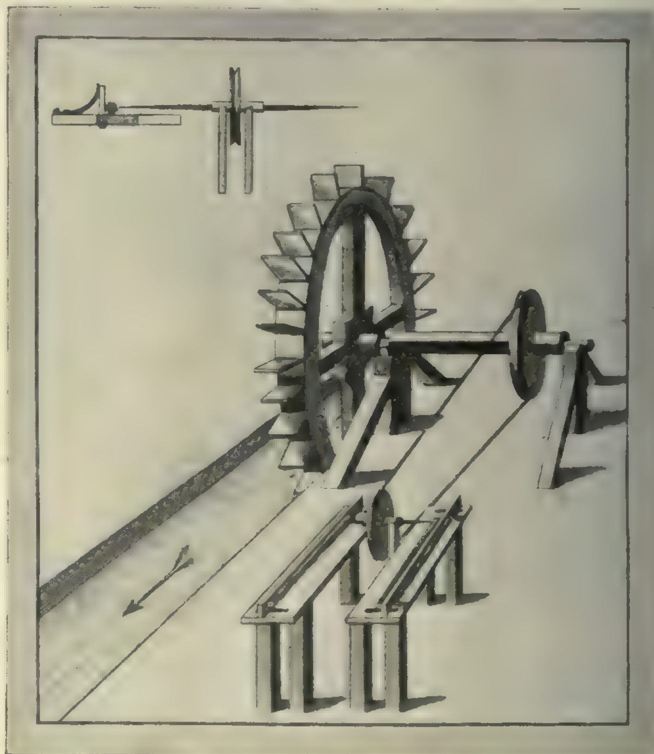


FIG. 4. MACHINE FOR DRILLING TOUCH-HOLES, DATE 1716

apparently pressing the barrel against the drill, while the power seems to be furnished by a workman who turns a large wheel with which the drill is connected. Behind these workmen, another man is probably rifling

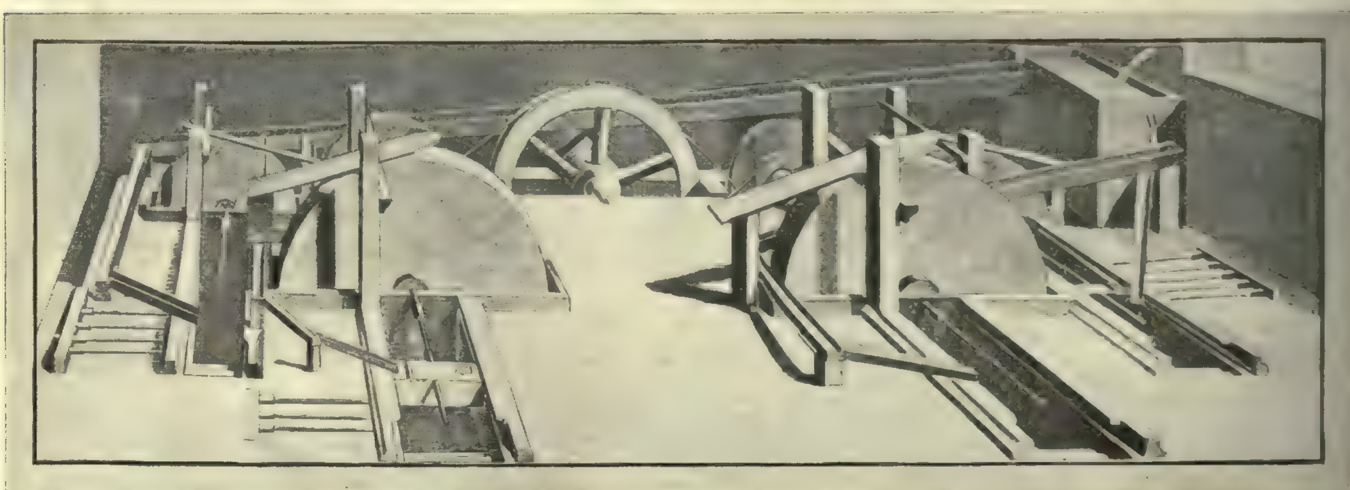


FIG. 5. MACHINE FOR BORING GUN BARRELS, 1763

a barrel by drawing a cutter through it. Rifling, however, seems at that time to have been used chiefly in sporting guns.

Lying on the benches or hung up on the wall are the parts of muskets and pistols. The locks are of several sorts, and are evidently intended to represent the types prevalent at the time. Fastened to the bench is a vise, while several tools hang upon the wall. Probably the bow which is visible in the picture was used as a bow drill: a supposition which is rendered the more likely, from the fact that a bow drill is illustrated as being used in boring the touch-hole of a cannon as late as 1783. An attempt to improve upon the bow drill was made by M. Villons in 1716 in an arrangement for boring touch-holes, which was approved by the French Academy. In this, reproduced at Fig. 4, two musket barrels were bored at the same time by drills which were fixed to the center of wheels, the power for which was furnished by a waterwheel. A more elaborate machine for boring gun barrels was illustrated in the French *Encyclopédie* in 1763. The machine shown here in Fig. 5, was run by water power and turned a number of wheels, to the center of each of which a drill was fastened. The barrel was fixed in a small box, and was kept cool during the boring by a small stream of water which ran over the box in which it was clamped.

By this time the gun had so developed in importance that the outside of the barrel was considered worthy of attention. An engraving showing the operation of finishing the barrel, was also published in 1763 in the French *Encyclopédie*. The gun barrel was fastened by pivots to a carriage and could be raised or lowered, or turned partly around in such a way as to adjust it exactly to a grinding wheel in the bed of the machine. The carriage was run back and forth by one workman, while another furnished the power by turning a drive wheel which was connected with the grindstone by a belt and pulley, as shown in Fig. 6.

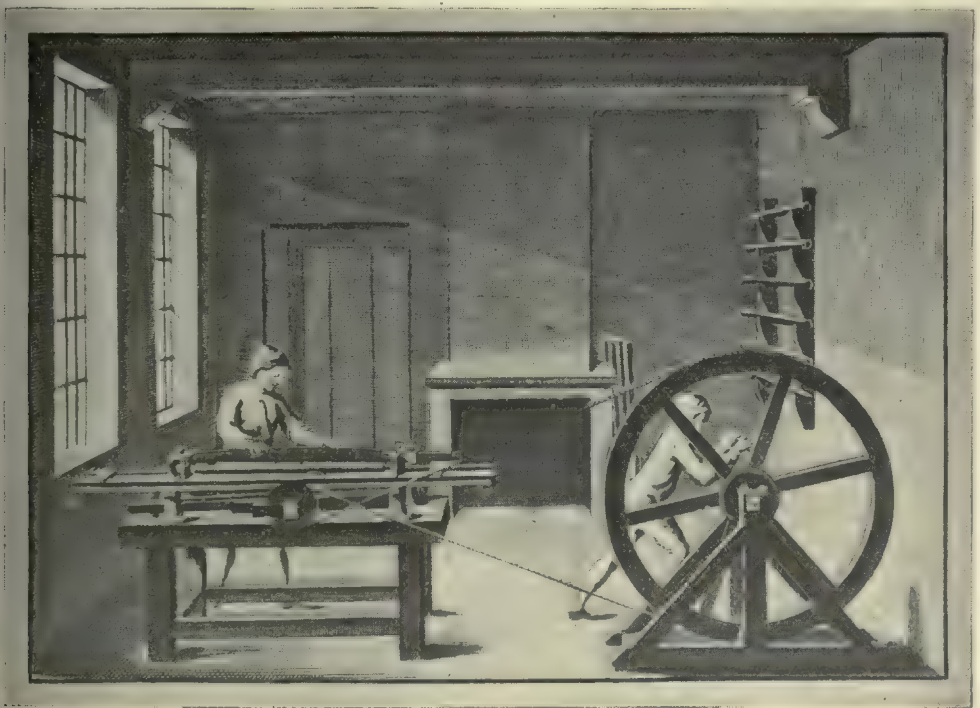


FIG. 6. GUN-BARREL FINISHING MACHINE, 1763

Why Force Us To Speak a Foreign Language?

By Luther D. Burlingame
Industrial Superintendent of Brown & Sharpe Mfg. Co., Providence, R. I.

I note in the *American Machinist*, page 29, that S. Lambercier, Geneva, Switzerland, picks up the gauntlet in favor of the metric system which Mr. Brophy has thrown down in his forceful argument against a change to that system, published in an earlier issue.

It would seem that Mr. Lambercier, in attempting to show why America should adopt the metric system, brings to our attention and opens up for discussion, some of the important reasons why we should not adopt it in this country.

In urging the advantages of a decimal system he points out that we are using thousandths of an inch and other decimal subdivisions at the present time. In other words: he admits that we now have in our machine shops all the advantages which the metric system could give so far as decimal divisions and decimal calculations are concerned, which leads to the conclusion, according to his own admission, that there would be no gain in our mechanical industries in making the change, at least so far as this particular feature is concerned.

In emphasizing the point that for a long time America has been using a decimal system in its machine shops, Mr. Lambercier writes that the Brown & Sharpe Manufacturing Co. made a sheet-metal gage in 1867, the divisions of which were in thousandths. It can be pointed out that long before that time, in fact in 1850, when Joseph R. Brown of the above concern first brought out the vernier caliper, decimal divisions were made use of in American shops, and that refinements of measurement based on decimal divisions have been the bases of that interchangeable manufacture which in turn has been the backbone of American mechanical progress. By taking as units the inch and its divisions—hundredths, thousandths, and ten-thousandths—our present system has proved especially adapted to use in such manufacturing operations. In addition, we have had all the convenience of binary divisions when desired.

Changing Drawings

Mr. Lambercier says that among the worst difficulties created for American manufacturers by the introduction of the metric system would be that of having to translate all their drawings into millimeter measures, and he states that even the leading men in manufacturing con-

cerns, would, in supervising this change, be "greatly puzzled." It is interesting to note that while many advocates of the metric system in this country are ready to assert that the change can be made with little or no trouble and expense, Mr. Lambercier, who has apparently more direct knowledge of the real conditions, appreciates that there would be great difficulty and cost. It might be pointed out that instead of the changing of dimensions being the greatest difficulty—even though that might be an extremely serious one—it would be but the beginning of endless difficulties and an incalculable number of serious mistakes and misunderstandings.

Danger of Mistakes

In recently looking over some testimony relating to the metric system presented before a Congressional committee, it was noticed that while the reports of this testimony were accurate in the main, yet in reference to metric dimensions most extraordinary mistakes had crept in. For instance, in the testimony of Dr. Alexander Graham Bell, he is made to say that if a tank holds 123,456,789 c.c. of water, that amount would be equivalent to 123,456,789 liters weighing 123,456,789 kg.; these latter amounts being just 1000 times too great. It is assumed that a man of the great attainments of Dr. Bell knew better than to make such a statement, but although his testimony was reviewed and put into print, there was so little knowledge of the real meaning of these amounts it was possible for such a glaring mistake to occur. Later in the testimony, and after Dr. Bell had made the statement that a centimeter is 0.01 m., the chairman of the committee, a man well informed on and enthusiastic for the metric system, replied: "And that is equal to one liter which, filled with water, is 1 kg., the unit of weight," again making the same type of mistake!

This matter of errors through the wrong use of units or the wrong location of the decimal point is a weakness often found in drawings or in calculations made under the metric system.

Mr. Lambercier ends with the argument that even though there is a vast cost in translating drawings and in eventually rebuilding jigs, gages, tooling equipment, etc., yet because a large proportion of American manufactures are sold abroad, "the foreign customer would finally bear the cost involved, which would be added to the selling prices."

One Fact Lost Sight Of

It would seem that a fact is lost sight of, in making this statement: the fact that a large proportion of American manufactures are used in countries where the inch is the basis of measurement! In short, the change would not only make confusion at home but also with all countries using the inch as the unit of measure; therefore could not bring about the uniformity desired. Hence, Mr. Lambercier's argument pleads as strongly for retaining the present unit and for preserving uniformity for the vast majority of our manufactures, as for making a change by which we would lose such uniformity.

We have heard much in recent times regarding the need of making a change to the metric system in order to help our foreign commerce and for the benefit of our foreign customers. Now we have presented to us by Mr. Lambercier the thought that the vast increase in the cost of our manufacturers, due to a change to the metric system, should be added to what we charge these foreign customers, thus putting the burden on them—very probably to the extent of losing their trade and reducing our foreign commerce rather than increasing it. It seems to be a fact that many of the generalizations which are current regarding the advantages and theoretical beauty of the metric system, do not stand the test of common sense when applied to the actual conditions, any more than would the suggestion that we give up our English language in favor of some other, when, after many centuries, it has become a part of the warp and woof of our national life—as has our present system and measures.

[We had definitely decided against printing any more metric discussion, but the foregoing article is so excellent that we have made it an exception. This, however, is positively the last of the kind we shall use during the period of the war.—Editor.]

The New Labor Program

THE new labor program is more far-reaching than many seem to realize. It is an ambitious undertaking and will prove far more than a war measure, for it will have a direct bearing on conditions after the war as well. The President is deeply interested in the new program and is giving it his hearty support. Briefly its purpose is to provide:

1. A means of furnishing an adequate and stable supply of labor to war industries. This will include: (a) A satisfactory system of labor exchanges. (b) A satisfactory method and administration of training workers. (c) An agency for determining priorities of labor demand. (d) Agencies for dilution of skilled labor as and when needed.
2. Machinery which will provide for the immediate and equitable adjustment of disputes in accordance with principles to be agreed upon between labor and capital and without stoppage of work. Such machinery would deal with demands concerning wages, hours, shop conditions, etc.
3. Machinery for safeguarding conditions of labor in the production of war essentials: this provision to include industrial hygiene, safety, women and child labor, etc.
4. Machinery for safeguarding conditions of living, including housing, transportation, etc.
5. Fact-gathering body to assemble and present data, collected through various existing Governmental agencies or by independent research, which shall furnish the information necessary for effective executive action.
6. Information and Education Division which has the functions of developing sound public sentiment; securing an exchange of information between departments of labor administration; and the promotion in industrial plants, of local machinery helpful in carrynig out the national labor program.

This will utilize such agencies as already exist—as the labor exchanges, the mediation boards, the statistic, etc.; but these agencies, particularly the labor exchanges, must be vastly enlarged and coördinated by men who thoroughly understand this work. Men of high standing are being called into this service, and it is gratifying to note that the importance of this work is being recognized on all sides.

The work of this department will include the shipping board and other war activities, with a view to establishing uniform labor policies, toward securing better distribution and conditions of labor and a betterment of its relations with the employer.

Wage Payment Slide Rule

By J. B. Carroll

In establishing standard times for wage payment systems operating on the plan of adopting the average time as a basis, plus a fair allowance embracing fatigue, machine and tool trouble, etc., a considerable amount of detail calculation is encountered before arriving at the result sought.

The slide rule, or rather the addition of a special group of gage points, shown in Figs. 1 and 2, is designed to eliminate a great amount of calculation and to arrive at a quick result.

Under the plan mentioned above, the usual operation is as follows: Let the average time of studies taken be 3.2 min. The working day we will assume to be 10 hours, or 600 min. To the average time will be added, say 15 min. tool allowance; 30 min. for miscellaneous trouble and 30 per cent. of the average time. The total allowance then for a 10-hour, 600-min. day will be 15 + 30 = 45 + 30 per cent. of average time.

The amount in minutes deducted from 600, = 555 for the actual working period. The number of pieces to be expected per day will equal $\frac{555}{3.2} = 173+$ pieces. The time per piece will equal $\frac{600}{173} = 3.47$ min. Then $3.47 \times 0.30+ = 4.5+$ or 3.47×130 per cent. $= 4.5+$ or 4.50 min., will represent the standard or allotted time per piece.

The computation in condensed form would appear thus: 600 — 45 = 555 actual working day. 555 ÷ 3.2 = 173 pieces per day. 600 ÷ 173 pieces = 3.47 min. per piece. 3.47 × 0.30 + 0.30 = 4.50 standard or allotted time, or 3.73 × 130 per cent. = 4.50 standard or allotted time.

Referring to the slide rule, Fig. 2, we find that by setting the time allowance in minutes, shown on scale B (which in this case is 45) under the per cent. allowance (30 per cent.) on scale *A*, then running the indicator *C* to 3.2 average time on scale *B* and reading above 3.2, on scale *A*, we find 4.5, which is the standard or allotted time required. The pieces per day can be readily ascertained by dividing 600, or the minutes in working day by the standard time, the calculation being the ordinary one of division on a standard slide rule.

To add the necessary scale to a standard slide rule the procedure is as follows: With *B* scale on slide set for the division $\frac{590}{600}$, which appears inverted on the rule, thus $\frac{600}{590}$, mark a dot on *B* scale under the index 7 on *A* scale, so that the index and dot coincide. Then proceed to divide $\frac{580}{600}$, $\frac{570}{600}$, $\frac{560}{600}$ and so on as far as desired. The divisions shown, herewith, are carried to only $\frac{430}{600}$, which result gives 170 on scale *B* and is the maximum allowance in time usually met with in practice, except in rare cases, on work of an exceptional nature.

For readily finding the time allowance scribe a line as shown from dots representing 45, 70, 100 and 170, or any combination which might better suit the local conditions. On scale *A* and beginning with the first division or second main graduation, indicate this line as 10 per cent.; the next 20 per cent. and so on until the division line 2 will represent 100 per cent. This scale then is the per cent. allowance scale, and the one on *B* scale the time allowance in minutes.

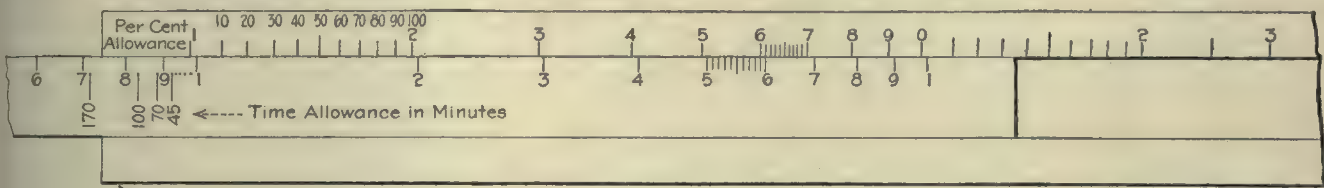


FIG 1

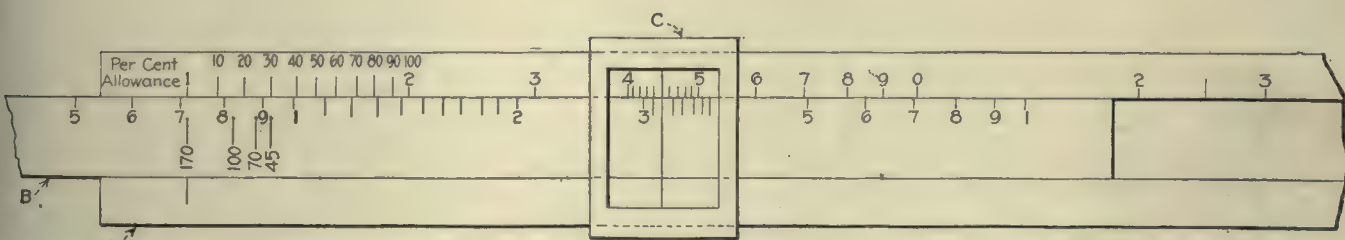


FIG. 2

FIGS. 1 AND 2. THE WAY THE SLIDE IS MARKED AND SLIDE ADJUSTED FOR COMPUTATION

This reduces the computation mentioned before to the proportion:

When the slide *B* is moved to cause the time allowance (45 min.) to register with the per cent. allowance (30 per cent), the average time (3 min. 2 sec.) on said scale is shown through the slide *C*, as in Fig. 2, and the reading on scale *A*, is then 4 min. 5 sec., or the standard time of producing each piece.

At first glance, the reader may condemn the above proportion inasmuch as it represents the ratio of per cent. to time in min. On closer inspection we find that this is a term in name only. Referring to Fig. 1, we find that 590 divided by 600 is the ratio of 600 to 10 or as 98.34 is to 1. In other words, $\frac{590}{600}$ is equivalent to $\frac{600-10}{600}$, which result is 98.34 per cent. Therefore, 98.34 per cent. is the equivalent of 10 and (proceeding

with the other calculation in like manner) we find that by assigning the term "minutes" to the equivalent ratio that our calculations are not effected in any manner and that the term "time allowance in minutes" is virtually the ratio of the time allowance to the standard working minutes in the day.

If it is borne in mind that in dealing with logarithms, upon which the slide rule is based, division is accomplished by subtraction of logarithms of the two factors, the above explanation will perhaps be made easier of comprehension.

The writer has successfuly employed the above scale in conjunction with the 10-in. slide rule in establishing standard times, and can recommend its adoption to anyone having standard times to compute on the basis mentioned.

The Railroad Situation

By Glenn B. Harris

One of the serious business problems of today with most of the large business corporations, is so to adjust their affairs as to satisfy the modern demand for government control of corporations without sacrificing the object for which the corporation was formed.

Whether the assumption of control by the Government of the different railroad systems is to be permanent, and continue after the termination of the war, can be only one of conjecture and surmise.

That the move is a wise one is frankly admitted by the financial interests of the country, by the executive heads of the railroads and by the press, irrespective of any political tendencies. That the order should please the two former interests is readily to be seen, as the railroads are guaranteed by the Government, earnings equal to their net for the past three years. As freight haulage has been immense in its proportions, the earnings should have been proportionately large, and as earnings are absolutely a known quantity as to minimum, there is now no uncertainty as to the standing of a stock or the credit of a road. Further than this, equipment, terminals, etc., are to be kept in the highest state of repair.

As a war expedient the move is most excellent, for it will permit the setting of rates and the adjustment of the wage question in an entirely satisfactory manner to all concerned, and without resorting to long-drawn-out hearings or court proceedings. Further, the authority of the Government will be exercised only in the financial administration of the railroads, and in those matters of general public welfare which are affected in time of war. The physical operation of the roads will not be interfered with, and the present executive officers will be left in control, under the direction of the Railroads' War Board, which is composed of leading railroad officials.

As the roads are now one family it should be a happy and contented one. There will be an interchange of locomotives and rolling stock, terminals and yards; and possibly an interchange of employees, as all are now virtually working for Uncle Sam.

The financing of the railroads by the Government will undoubtedly place them in a position to secure machine tools of which for a long time past they have been so badly in need, and the demand for which will now be greatly stimulated. The funds with which to meet payment of bills will be at hand; moreover, as our railroads are so essential to the moving of foodstuffs, munitions and other warfare necessities, they will undoubtedly be maintained at the highest standard of efficiency. Where necessary, the railroads will undoubtedly be given preference in deliveries of machine tools and everything else pertaining not only to speedy production of motive and rolling stock, but also to its prompt repair. The roads for a long time past have suffered severely for lack of adequate machine-tool facilities in the motive branch of their service.

The question naturally arises whether or not this is but the entering wedge to Government control of all public utilities and the great manufacturing businesses of the country. Those who have been advocating a measure of this character for years will be loath to relinquish the ground they have gained, and are likely to use the vantage as a lever to further progress in Government ownership.

New shipyards have been built throughout the country at Government expense, and in one instance the immense sum of $21,000,000 was advanced. The needs after the war will necessitate building very considerable amounts of tonnage; and it is fair to presume that the yards now enjoying Government bounty or subsidies will so continue, and that it will be altogether a question of Government ownership and operation.

If the railroads are to be Government-controlled, why should it not follow in natural sequence that the concerns which manufacture locomotives, rolling stock and all supplies needed in their operation shall be also subjected to Government control or ownership?

The war will undoubtedly prove the means of supplying a fund of information concerning the feasibility and desirability of extended Government ownership.

Chemists and the War

Adequate chemical control of manufacturing plants engaged in the supply of war material is now receiving the careful consideration of the War Department. The experience of both Great Britain and France teaches the necessity of conserving the supply of trained chemists, at no time large, in order that the supplies upon which the winning of the war so largely depends may not be curtailed.

Provision has now been made through an order of the Adjutant General of the Army by which manufacturers of material necessary to the prosecution of the war, who have lost the services of chemists through the first draft, may again obtain the services of these men for war work.

It is announced also, that provision has been made by which manufacturers threatened with the loss of their trained chemists in the present draft, may retain these men. Only those chemists whose services are necessary to war work will be considered, and the evidence submitted by the manufacturer must be conclusive.

Manufacturers thus affected should apply to the Chemical Service Section, N. A., New Interior Building, Washington, D. C., for the regulations governing the transfer of men already drafted, or the possible reclassification of men not yet called. This request must come from the manufacturers; applications from the men will not be considered.

Practical Economies in Pattern Building

By W. Rockwood Conover

As one of the essential elements in the present urgent trend toward improvement in industrial processes, the pattern shop offers opportunity for the practice of more efficient and economic methods of procedure.

IN GENERAL, economic methods of procedure in pattern construction are not studied with the same intense interest as are the various processes of machining and assembling in the machine shop. In reality, the pattern department is one of the first places in which to begin the work of economy and efficiency. A factor of prime importance in patternmaking is the adoption of the green sand sweep process of molding in the foundry. By the adoption of this process the greater percentage of initial cost in the making of patterns is saved, and the necessity and expense of providing storage space for patterns which may be used but once, or but few times at most, are avoided. This is particularly true and in a marked degree, in the making of large castings where the cost of complete patterns and core boxes exceeds that of the green sand sweep process, or green sand sweep process with dry sand cores, or what is commonly known as a skeleton pattern. Even where the allowances for variation are comparatively close, these methods of molding prove fully successful, since it is possible to work within necessary limits of required dimensions.

Patterns in Constant Use

Patterns which are in constant use should be made from the better grades of pattern lumber, also, the quality of workmanship should be high; while such patterns as are to be put into the sand only occasionally, or from which but few castings are to be made at most, can be produced from medium or second grade lumber and with less labor in their construction. A third class should include patterns which are to be used but once, or where close limits of dimensions are not required, and on which the amount of labor expended can be greatly reduced.

White pine of the lower grades is most economical to use for the construction of cheap patterns. Pine of better quality, such as Michigan and Wisconsin uppers and selects, is best adapted to the building of high-grade white pine patterns. It is the practice in many patternshops to use a grade of mahogany known as Mexican wormy shorts, to face the working parts of medium and large size first-class patterns. Also, this grade of mahogany is used for making entire small and medium size standard patterns, the life of the mahogany pattern being equal to two and one-half or three times that of a pattern constructed of white pine.

Too much care cannot be given to the question of proper allowances for finish, and this subject is one which not infrequently receives less attention than it deserves. The character of the casting and the purpose for which it is to be used, and the special requirements in relation to the various surfaces to be machined, should always receive consideration, otherwise the labor of the machine shop may be greatly multiplied, and the cost unnecessarily increased. The expense of changing patterns to reduce excess stock and avoid additional cuts in the lathe, or in the planing machine and boring mill, is one with which every manufacturer is familiar. These cases, more often than otherwise, come to his attention after the casting has reached the machine floor, and a certain percentage of the work of that department is found to be unnecessary, and the labor costs prohibitively high. Much of this expense can be avoided by the adoption of systematic methods of inspection in the drafting room and pattern shop. A drawing may be perfect as a piece of workmanship, and yet be imperfect as the working basis of an economical design. Even the skilled draftsman does not, as a rule know all the conditions of the pattern shop, foundry and machine floor. It is in this initial stage of the work that large economies can be gained with the minimum of outlay to the manufacturer.

The Pattern Inspector

The pattern inspector should possess a broad and intimate knowledge of pattern construction, molding, and machining. Also, he should be familiar in some degree, with the mechanical requirements of the various parts of the apparatus being designed. The salary paid in such a position is of minor importance, as with this knowledge, he is able to effect many changes which result in a large saving of time and labor in the succeeding stages of the work.

Theory and practice with the manufacturer, as in all other lines of business, frequently require harmonizing by the skilled hand of the individual, trained in the school of practical experience. The man possessed of broad shop experience will often suggest the cutting out of unnecessary stock and a reduction of weight in one portion of a casting, and the increase of weight where there is insufficient stock, that so far as possible a proper uniformity may be secured in the process of cooling. The cracking of large castings may be the evident result of improper balance, possible (in some cases at least) to prevent in the initial stage of the work. Not only is the loss of such large castings usually considerable, but the delay of production frequently causes a serious handicap to delivering shipments within the period of contract. Most of these troubles can be avoided by properly directed effort in the pattern shop.

Checking Patterns

The importance of this feature of the work of the pattern department must be emphasized. All patterns should be carefully checked before they are delivered to the foundry, to ascertain if they are correctly made, also, to insure that proper allowance has been made for shrinkage, strain and finish in the machine shop. This operation of checking up is relatively as important as the inspection of drawings before sending to the pattern department. It not infrequently occurs that castings are lost in the foundry because of faulty construction in the design. By following a system of care-

ful and rigid inspection of all patterns before they leave the pattern shop, any points of weakness may be brought to light before the first casting is made, thereby saving subsequent loss in the foundry itself. It gives the designing engineer opportunity to reconsider and reconstruct his design, and make such modifications as will enable the foundry not only to produce more perfect castings but to produce them at a lower cost.

Not infrequently small lugs, bosses or projections are called for on drawings which increase the cost of molding as well as affect the percentage of perfect castings obtained. In some instances these can be removed and not only reduce the labor in the foundry and machine shop but insure better results in the process of molding itself.

Effect of Number of Orders

The number of castings required or the prospect of future orders will necessarily govern the pattern foreman in deciding what class of pattern is most practical and economical to make. In some instances the first order is sufficiently large to pay the cost of a full pattern. If the prospect of further orders is remote or doubtful it is usually the most economical practice to make a skeleton or partial skeleton. It not infrequently happens that the castings from a given pattern turn out bad and it is found desirable to cancel any further casts and redesign the part; and for this reason the outlay should be limited as much as possible until it is definitely determined that the castings produced are satisfactory and that they can be made economically. It is evident that a high degree of knowledge and skill is required in no small percentage of cases to judge from a drawing just what is the best procedure.

Repetition Molding

In repetition molding of pieces of standard apparatus, it is often advisable and economical to make as many parts of the pattern as possible, interchangeable. As an illustration of this it may be stated that many manufacturers of pulleys use the interchangeable system. Core prints, hubs, rims, and arms are made interchangeable. The diameter of shaft and amount of power to be transmitted will necessarily govern the size of the hub to be selected; but different sizes of pulleys, up to certain limitations, will take the same size of hub, provided they call for same diameter of shaft. The arms and rims are made light or heavy according to the amount of power to be transmitted. Under this system it is very easy to thicken the rim, enlarge the hub, and change the bore or otherwise alter the dimensions of a pulley casting without entailing more than a limited additional expense for pattern labor or material to fill an individual order. Each bin or shelf where such interchangeable patterns are kept in stock, should have its proper card index showing type, detail, and all measurements of dimension, etc., so that the proper sections or parts required for any given class or size of work can be located immediately without expense or delay.

The advantage gained by making gang core boxes, hardly requires discussion. A saving from 30 to 50 per cent. in cost of molding, is possible by this method as compared with the much slower process and decreased output of the molder when single core boxes are used.

Improved machinery has its value in pattern making as in other lines of manufacture. One of the best illustrations is found in the universal milling machine: a valuable labor saver in the work of cutting grooves or recesses in pattern surfaces. Another tool which the patternmaker cannot afford to be without, is the automatic grinding or finishing machine. This machine is designed to finish pattern surfaces; also, to finish the inside of core boxes. It is a practical necessity in the large shop and saves a vast amount of labor hand finishing. It will pay for itself within a very limited period in reduced labor costs. In addition to these machines which are of special value, the equipment of tools should include a sufficient number of wood-turning lathes and planing machines of proper dimension, band and rip saws, universal sander, bench trimmers, drilling machines, and other devices found in the up-to-date patternshop.

It is important that the men who operate the machines should be thoroughly familiar with them, as the facility with which these machine hands do their work has a relatively important bearing in reducing the various costs.

A considerable portion of ordinary pattern work can be done by bright, intelligent boys. They soon become quite competent in some of the better grades of work as well.

As indicated in a previous paragraph, the foreman and inspector of the pattern shop should keep in close touch with the machine shops and foundry, in order to know that proper allowances for machining and for shrinkage in the foundry, are being made. The pattern foreman cannot ignore this rule and still be a successful patternmaker. He needs to see the results of his work, and to know intimately the kind of castings produced, and the relation his work bears to the final cost of the apparatus.

The pattern department should be kept carefully swept and cleaned, both for the sake of appearance and to reduce fire hazard. All waste lumber and nails should be sorted and kept for further use as far as possible. This work is usually done by the floor sweeper or laborer.

Pattern Storage

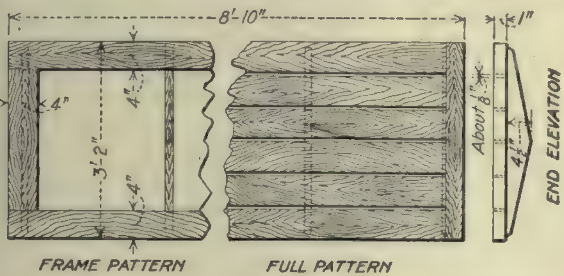
The arrangement of patterns in storage should provide for the grouping of similar details in order to avoid the making of new patterns as far as possible. Cutting off of a lug, putting one or more pieces in a core box, or other slight change, will in many cases obviate the necessity of building a new pattern. Without systematic grouping in the storehouse and proper records of reference, the benefit of such economies will, to a large extent, be limited.

The cost of the first set of patterns—labor and material—is usually charged against the shop order or specific piece of apparatus for which they are built. If, however, they are ordered on a requisition calling for a large number of castings, or for a definite line of apparatus involving repetition orders, the cost may be spread over an extended quantity or period. Subsequent replacements of patterns are properly chargeable to investment account, provided such replacements constitute new work and do not involve alterations or work in the nature of repairs.

The Construction of Plate Patterns

By M. E. Duggan

We are told there are "thirteen wrong to one right way" for doing a great many jobs. During the last twenty-five years the writer has made numerous patterns for cast plates. All, or nearly all of these, were constructed according to some one of the "thirteen ways." Some were made by the frame-and-sweep method; some, a solid plate having the boards jointed



TWO METHODS OF PLATE-PATTERN CONSTRUCTION

and securely glued together; others were made as a solid plate from narrow strips, leaving the joints open. The construction of these patterns gave little trouble, but the predetermining of the operations of the molder was all guess work. Any man who is handy with tools can make a pattern for a plate, but to make the right kind of pattern for that special job, requires a mechanic who has had molding experience or who understands foundry requirements. Should you ask if any of the patterns made by the above methods were practical and satisfactory to the molder, your question would not be readily answered.

During the past year the writer has constructed patterns for floor plates, both plain and ornamental; also for muffles, reheating furnaces and soaking pits. Considerable thought and study has been given to this particular branch of pattern making.

The following are a few expressions from different sources: one book on "Foundry Practices" (by Tate & Stone) states "the frame-and-sweep pattern for plates and the like, is the one most desired by molders. This is also true concerning the patternmaker because a frame is easily and quickly made, requires very little lumber in its construction, a minimum amount of labor and is inexpensive." Is it the right way? The foreman molder says "No, give me the solid-made plate pattern: with it I can make two better molds, in the same time that it takes to make one with the frame and sweep, and the casting will be sound and true to pattern."

"They are both wrong," says the old timer. "A good mold can be made and a practically perfect casting produced by either method provided, however, in the making of a mold with the frame and sweep, the molder is experienced in this branch of foundry practice. But how is the patternmaker to know? A solid-plate pattern requires material, labor and time in its construction, and is expensive."

How would you make a pattern for a plate to dimensions given in the sketch? For one casting only, for present use? A standard pattern for present and future use?

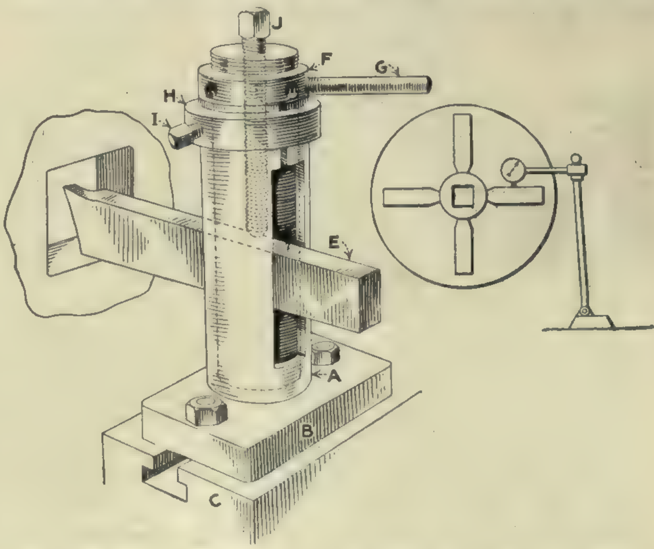
Plate patterns are being made every day. This should interest both the patternmaker and the molder.

Broaching Holes on the Lathe

By W. Burr Bennett

The special toolpost for broaching on a lathe shown in the illustration is intended only for toolroom work, and is designed to provide a method of accurately cutting square or other shaped holes in work not requiring duplication.

The external shell *A* is turned out of a solid block of steel of the shape of the base *B*, and drilled to receive



TOOLPOST FOR BROACHING HOLES ON THE LATHE

bolts for attachment to the cross-slide *C*. This shell is bored out and threaded to receive the toolholding post. The shell *A* and post are slotted as shown, to receive the tool *E*, the slot in the shell being elongated to permit the vertical movement of post and the tool which it carries.

On the projecting upper end of the post, is a nut F, having a series of openings, in any one of which may be inserted a short rod or pin G, by means of which it may be turned to raise or lower the toolpost. The nut F, rests on a ring or collar H, which is clamped to the shell A, by means of the setscrew I. The vertical movement of the toolpost is obtained by turning the feed nut F.

The tool E is secured in position by a long setscrew J, which is located in a threaded opening in the toolpost.

In operation, the work is clamped in the chuck of a lathe and indicated by means of the chuck jaws. The lathe spindle is also clamped in position as needed. The hole to be broached is first bored round, then by feeding the lathe carriage lengthwise on the bed, and also feeding the cross-slide in the right direction on its ways, a cut is started. In obtaining the vertical feed, the special toolpost described is brought into operation.

Packing for Export

By J. W. Hart

During the last three years, because of the enormous volume of export tonnage moving through our ports, the handling of freight from cars to lighters and to steamers has been a severe tax on the packing which is employed by American manufacturers. The writer has always advocated the use of the best materials and methods in constructing of export packages, and has never believed that the additional cost was an item to merit serious consideration.

The foreign competition which all American manufacturers and exporters have had to meet, heretofore, will be more keen after the war, and packing will be as much an item of competition as price; for packing represents a condition of delivery, and its insufficiency and quality in use prior to the war, is still a hinderance to the American exporter's foreign trade. The object of manufacturers of export goods, should be to fortify themselves in the markets they are now serving, and which will be sought again by the countries at present out of the competition.

The company with which the writer is connected has always been willing to pay for packing that would deliver its manufactures and purchases at their destinations in first-class condition; and it still adheres to that policy. This subject is a vital one, and all exporters should undoubtedly coöperate in this matter. The writer submits sketches of boxes used in shipping goods by the company with which he is connected, and whose packing system has proved satisfactory; and he trusts that others will coöperate in a movement for improving both packing material and methods of construction, and give him the benefit of criticism.

Too much has been said and too little done by manufacturers in this vital matter, and there are many who stand ready to join in a movement that will make for improvement.

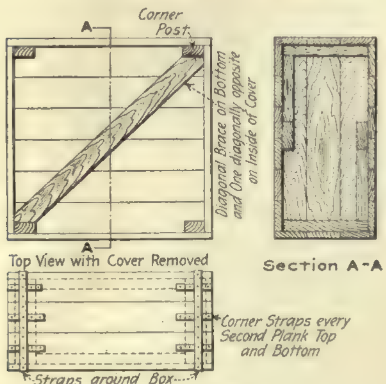


FIG. 1

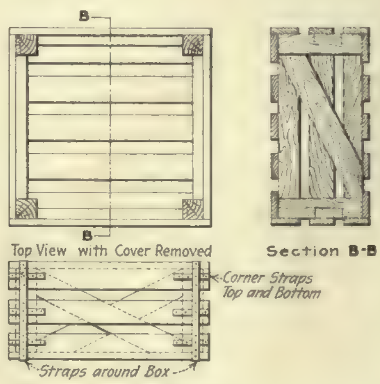


FIG. 2

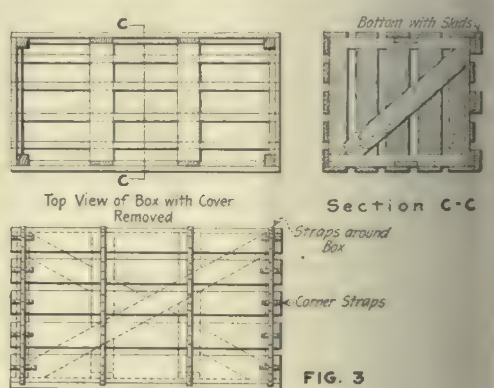


FIG. 3

FIG. 1. PACKAGE FOR LIGHT MACHINERY

FIG. 2. PACKAGE FOR MEDIUM MACHINERY

FIG. 3. PACKAGE FOR HEAVY MACHINERY

Lapping Micrometers

By V. E. Snow

In the production of munitions and small tools, a great many micrometers are used, especially in the manufacture of twist drills.

The grinding room seems to be the hardest place on them, the work coming from the grinding machines being charged more or less with grit from the wheels, and constant measuring shortens the life of the micrometer by wearing grooves or pits in the spindle. Being engaged with a concern in this line of work, I was given a hundred or more micrometers to repair.

First, I measured the spindles of those which I found to be all of the same size; I then took a block of cold-rolled steel cut from a shaft of 3½ or 4 in. in diameter, and 1½ in. thick; this I chucked in a lathe and bored a hole in the center, that the spindle of the micrometers might slide in without any shake. I then faced the block with the hole at right angles to the face.

Taking the block and laying it with the face side down on the lap and putting the spindle in the hole, the face of the spindle was lapped square on the end.

To lap the anvil I took a small V-block and put it on a bench lathe, lining it so it was parallel with the center of the lathe as at A in Fig. 1. I placed the anvil and spindle in the V, and ran a rotary lap in the spindle of the lathe, with a slot cut in the V-block to allow the lap to pass over the anvil, thus I could get them within 0.0002 in. of square.

To work the cross-feed of the lathe, I made a jack, as at B consisting of a pulley, a shaft and a crank: the crank being just long enough to let the lap pass over the work, which is not only a saving of labor and time, but also a saving of wear on the nut and screw—the screw being removed.

The travel of the cross-feed was about 16 complete trips per minute: this I got by running a belt from the countershaft as at *C*, to the large pulley that drives the grinding head of the lathe, and putting a small pulley on beside this, with a belt to the jack.

After they were lapped on the bench lathe, they had to be finished by another method; I accomplished the

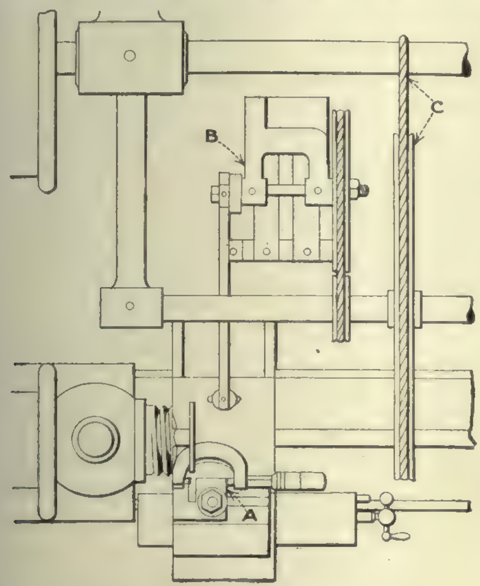


FIG. 1. THE V-BLOCK IN THE BENCH LATHE

finishing by taking a cylinder with no taper, about $\frac{3}{4}$ in. diameter and charging one side of it with abrasive, after which I put it in the jaws of a vise, endwise, as at *D*, Fig. 2. I seated the micrometer on the cylinder as

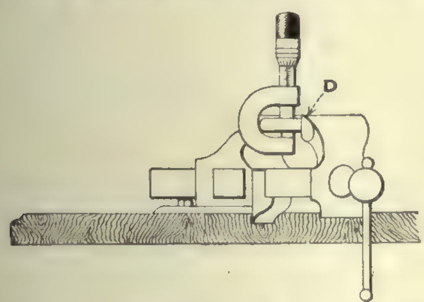


FIG. 2. CYLINDER LAP IN THE BENCH VISE

if I were going to measure it, with the anvil on the charged side and tightened down on the screw, so it pulled a little hard.

The spindle—being square on the end and rotary on one side of the cylinder—lapped the high spots off the anvil when pushed over the charged side, making both faces parallel.

The spindle should not be allowed to move or slide off the cylinder much, but this can be avoided by a rocking motion. The micrometers were all 1 in., and to prove their faces to be exactly parallel I used a steel ball.

Cams Made From Tubing

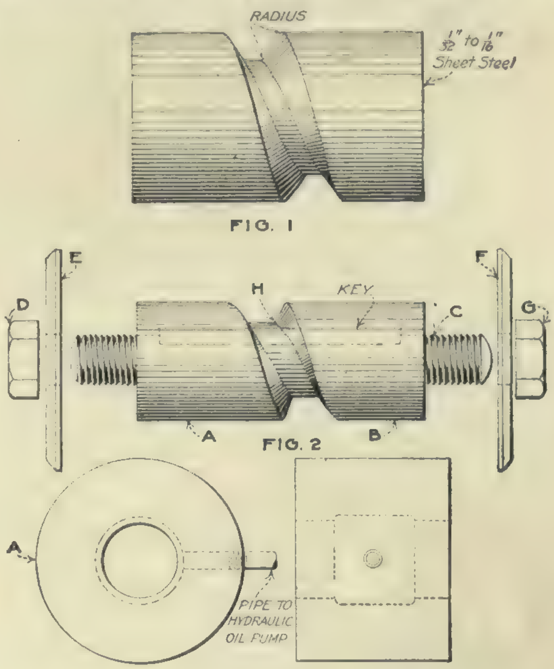
By Donald A. Baker

One of the cleverest pieces of work the writer has had the pleasure of seeing for some time, was the making of a drum cam, one of which is shown in Fig. 1, from seamless steel tubing.

These cams, one hundred of which go into the making of a single machine, which is used by the textile industry for winding thread on bobbins, were at one time made of solid cast iron, the cam path being finished on milling machines. The saving in cost by adopting the sheet metal construction, as well as the reduction in weight will be readily apparent from the following description of the methods used for producing the cam.

An attempt was at first made to design tools whereby the job could be produced with punches and dies in the punch press, but this was soon abandoned as being impractical and the following method devised, put into practice and found successful:

First, a sectional mandrel was made as shown by Fig. 2. *A* and *B* being a sliding fit, and keyed to the inner mandrel *C*. A master cam path was cut as shown



FIGS. 1 TO 3. MAKING CAMS FROM TUBING

partly on the end of *A* and partly on the end of *B*; *A* and *B* being divided on the line *H* so they could be readily taken apart. With this combination mandrel went the two washers *E* and *F* and the two nuts *D* and *G*.

Next, in a hydraulic press was set up a large cast-iron ring, as shown by *A*, Fig. 3. The hole in this ring was the same size as the diameter of *A* and *B*, Fig. 2, plus twice the thickness of the metal in the tubes which were used for the cam blanks. In other words the inside diameter of this ring was such that the cam blank tubes after being placed on the mandrel *A* and *B*, would just slide into it.

Inside this ring *A*, Fig. 3, was turned out a groove which was just wide enough to cover the cam path which it was intended to draw. From this groove a hole led to the outside of the ring, the outer end of which was tapped, and into which was screwed a pipe which led to the high-pressure oil pump of the hydraulic press.

This completed the mechanical equipment necessary for the job, and the work was performed in the following manner:

A and *B*, Fig. 2, were placed on the mandrel *C*; the tubing, cut to proper length was then placed over *A* and

B. Nut *D* and washer *E* put in place on the mandrel *C*, and then the complete mandrel carrying the tube was shoved endways into the hole in the ring *A*, Fig. 3; the nut and washer placed on the other end of the mandrel *C*, Fig. 2, and then the nuts screwed up tight. As when *A* and *B* were tight together they were of the same length as the width of the ring into which they were put, when the nuts were screwed up the washers formed an oil-tight joint, and also held *A* and *B* tight together.

After the nuts were tightened, oil was pumped into the groove in ring *A*, Fig. 3, under sufficient pressure to force the metal of the tube down into the cam path which was cut in *A* and *B*, Fig. 2, and thus formed the cam groove in the tubing. It must be noted that the cam path varies somewhat from standard practice in that the sides are made tapering and that there are radii both at the top and at the bottom of this cam path. This is, of course, made necessary from the fact that it would have been impossible to have drawn the metal over a sharp corner without its fracturing. This, however, was easily enough adjusted. since it was only necessary to make the cam rolls to the same taper as the cam path.

After the groove had been formed, the mandrel was taken out of the ring and the work removed by simply taking apart *A* and *B*, which as shown, were split apart for this purpose.

To complete these cams, sheet-metal hubs or spiders were drawn up in a punch press, one hub forced into each end of the cam and then with an acetylene torch they were welded into place; afterward all roughness was removed by grinding.

Efficient Herringbone Grate Patterns

By R. W. Derby

Supervisor of Manual Training, University School, Cleveland, O.

On page 636, Vol. 47, of the *American Machinist*, M. E. Duggan describes his method of making single or double herringbone grate-bar patterns.

If the same method were to be employed in the making of the double herringbone bars as he describes for the single, there would be without question a great loss of time. As I have made many grate-bar patterns, and as they were nearly all of the double type, my method may be of interest.

After having planed the stock for both the cross-pieces and the frame, the block *A*, Fig. 1, was made to the exact size of the inside of the bar, the ends being tapered to fit the frame and the angled faces to fit the cross-pieces.

The pieces *C* were then made to the same length and taper as *A*, but about ½ in. higher. These pieces are merely for additional guides for the back-saw. After mounting pieces *A* and *C* on the block *B*, I sawed the slot in the center and the sawing jig was ready. I then took *D*, one of the strips which was made for the cross-pieces, and in the manner shown, cut as many right-hand pieces as there were crosspieces in the bar; I then cut the same number of left-hand pieces.

These pieces were then taken to a surface plate *G* and all glued in pairs as shown at *E*, Fig. 2. While the glue was setting the frame *F*, Fig. 3, was made.

After the crosspieces had set, they were nailed both ways at the point (a scrap of the crosspiece strip being used to hold them in the vise) glue-cleaned and well shellaced. They were then put on the jig again and cut to the exact length of the block *A*, Fig. 1.

I have found that the back-saw, if carefully used, will make truer, cleaner cuts than the band-saw, and when the pieces *C* are located on the jig, the sawing of the ends is comparatively easy.

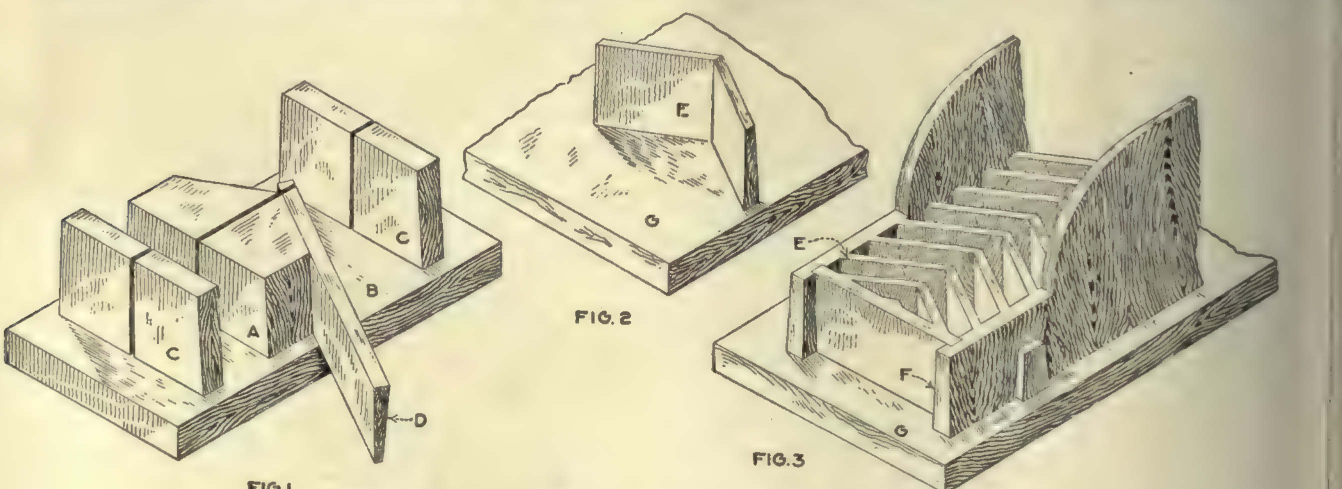
When the crosspieces have all been cut to length, the frame *F* is turned upside down on the surface plate, as shown in Fig. 3, and the crosspieces glued in as shown at *E*.

Care must be taken to see that the first piece is set square, the others can then be set in like so many dominoes, proper spacing being accomplished by using little squares of wood the size of the required opening.

After approximately five crosspieces have been set in, the little squares that were used to space the first two can be picked out with a scriber and used again. Then the pieces that were used in the second space can be taken out, thus proceeding down the bar.

After the glue has properly set, the clamps are removed and each crosspiece is first drilled, then nailed in the frame. The frame is then filleted with ⅛-in. fillet, finished and shellaced.

In this manner I have made bars from 18 in. to 6 ft. in length, and have cut from $5 to $15 per bar from the former cost of making.



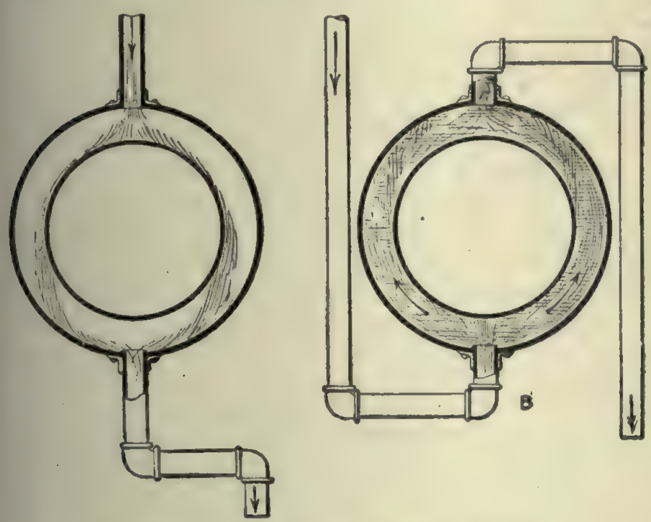
FIGS. 1 TO 3. A METHOD OF MAKING GRATE PATTERNS

Cooling a Small Air Compressor

BY W. A. LAILER

In a small machine shop with which the writer was connected, considerable difficulty was encountered in maintaining a sufficient supply of air because the compressor persisted in heating up. We had decided that the compressor was too small, and were about to order a larger unit when the writer decided to make a more complete investigation. While going over the water-cooling connections an air-compressor erector stopped in, and after a brief inspection explained the cause of our trouble.

The original water connection was made as per sketch *A*. With this system of piping, a body of cooling water could not be maintained around the cylinder, but instead merely ran over the cylinder in a thin film, and out to waste. The compressor erector advised revising the



ORIGINAL AND REARRANGED PIPING

water-cooling connection as per sketch *B*, from which it will be observed that the water jacket would be completely filled with water at all times. These simple piping changes were made, and as a result we had an abundance of air.

Navy Standard Capscrews

SPECIAL CORRESPONDENCE

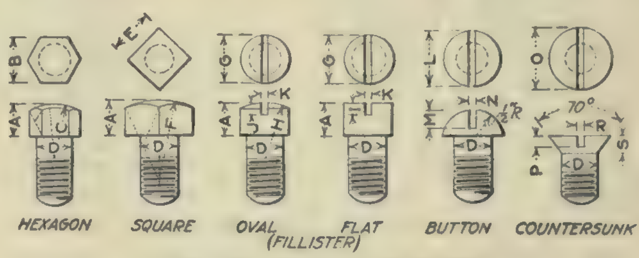
Among the standards adopted by the U. S. Navy Department is one for capscrews, and as these are being used to a considerable extent by the other divisions of the United States forces, it is well to know exactly what is meant by a Navy Department standard capscrew.

NAVY STANDARD CAPSCREWS

D	A	B	C	E	z F	G	H	I	J	K	L	M	N	O	P	II	S	X*
9/16	9/16	13/16	1 5/32	11/16	1 3/8	11/16	1 1/32	9/64	11/64	0.1114	13/16	3/16	0.114	1	5/64	0.133	1/16	12
5/8	5/8	7/8	1 5/16	3/4	1 1/2	7/8	1 5/32	5/32	13/64	0.128	1	3/16	0.133	1 1/8	1/4	0.133	11/64	11
3/4	3/4	1	1 1/2	7/8	1 3/4	1	1 1/4	3/16	7/32	0.133	1 1/8	1/4	0.133	1 3/8	5/32	0.133	1/16	10
7/8	7/8	1 1/8	1 11/16	1 1/8	2 1/4	1 1/8	1 15/32	7/32	15/64	0.133	...	..	.....	..	..	.....	..	9
1	1	1 1/4	1 7/8	1 1/4	2 1/2	1 1/4	1 9/16	1/4	1/4	0.165	...	..	.....	..	..	.....	..	8
1 1/8	1 1/8	1 3/8	2 1/16	1 3/8	2 3/4	...	...	..	..	.....	...	..	.....	..	..	.....	..	7
1 1/4	1 1/4	1 1/2	2 1/4	1 1/2	3	...	...	..	..	.....	...	..	.....	..	..	.....	..	...
1 3/8	1 3/8	1 5/8	2 7/16	1 5/8	3 1/2	...	...	..	..	.....	...	..	.....	..	..	.....	..	...

*X Threads per in

The accompanying illustrations and table give the various dimensions, and among the specifications we find they are to be made from a high grade of steel suitable for the purpose and to be of good manufacture and free from any blemishes or defects which may affect the appearance or strength of the screw. The heads of these screws are either hexagon, square, oval or flat fillister; button, oval or flat countersunk, as specified The heads are to be ground. The head can be either black, extra-finish or hardened, as per specifications.



NAVY STANDARD CAPSCREWS

All screws are to be provided with the U. S. S. thread. Hexagon and square-head capscrews 1 in. and less in diameter, and less than 4 in. long, shall be threaded three-fourths of their length. Screws of this type, 4 in. and over in length, shall have threads cut one-half their length. Button-head and fillister-head screws shall be threaded in a manner similar to hexagon and square-head screws; and except when so specified, they shall be threaded to the full length of the screw under the head. Flat and oval countersunk screws are also to be threaded to their full length.

These screws are to be packed in substantial wooden boxes, each box containing 100 screws. The boxes are to be plainly marked with the name of the material, size, quantity and name of manufacturer.

Screws which are below $\frac{9}{16}$ in. in diameter are purchased in accordance with the latest Navy Department specifications for machine screws, which call for the A.S.M.E. standard screws.

Theoretical vs. Practical Accuracy

BY S. MUNDAY

Problems involving extreme accuracy of measurement are often the subjects of articles appearing in the pages of *American Machinist*, and while I concede the facility with which theoretical dimensions may be laid down even to the *n*th decimal degree, the physical limitations and restrictions in the way of applying these measurements are such as to lead me to doubt their practicability. Prof. Perry in a course of lectures to London working men pointed this out when he said: "What is the use of expressing the results of our calculations to the sixth or seventh decimal place, when for all practical purposes the last three or four are useless!" In an article on page 749, Vol. 47, on "Uses of the Sine Bar," the author says: "so we set the stud *B*, Fig. 1, 0.20795 higher than the stud *A*." Referring to the illustration we observe that the tool used for determining this measurement is a gage.

Now, is there a vernier upon which it is possible to measure—not estimate—accurately, to less than 0.001 in.? In one of his "Letters to Bill" Jack remarks anent his "speechlist coarse of learnin" that the "marks on the inspecktur's vernyur callyper ain't near so far apart as they air on mikes." It is evident that Jack had an inkling as to the manner of obtaining extremely accurate measurements.

I do not believe there are many toolmakers who would agree to set a vernier even to 0.0005 and gamble next week's pay envelope on the accuracy of the result.

Assuming that we have a gage capable of being set, and a man capable of reading it to 0.00001 in., there are many other things that must be taken into consideration. In the measurement of angles by the use of the sine bar and plate we must be sure of the accuracy of the sine-bar studs, their relative positions on the bar, the absolute truth of the plates, etc., and must take into account the constant minute changes due to local temperature changes in handling, all of which tend to remove such a job from the scope of a toolroom and place it within that of a laboratory if we are to depend upon the accuracy of the results.

It was stated in a recent issue of the *American Machinist* that an American firm of some size refused an order for gages on the ground that they could not guarantee them to be correct to the fourth place of decimals. This is apt to cause one to wonder if a good deal of the so-called accuracy is not of a doubtful quality; at the same time, in the writer's opinion it points to a high degree of moral courage on the part of that firm, that might be followed by others to their advantage.

Personal Contact

By H. L. Morey

"Now take the foreman of our transformer department: I'm frank to state, his actions are beyond me. I've tried again and again in a nice way to pull him round to my way of thinking; to the attitude I'd assume in tackling those can't-be-done jobs; but it's a case of 'no-go' with him; he does not respond. Personally, he is a splendid chap, well educated, and way up on the technical end of the business; but down, way down, on the 'push'; no initiative at all. I'd hate to discharge him, but there seems to be no other course for me to follow. His department, one of the most important in our organization, is running behind and I do not propose to stand by and let things go to smash entirely. I've given him plenty of rope, to no avail, and thought it best, therefore, to place the matter before your for your consideration."

Thus spoke the superintendent of a large electrical plant in airing his troubles to the general manager. It seems this particular foreman was what you would term a "joy killer." He was forever throwing cold water on suggestions intended to speed up his department, and this was especially true of matters which came within the scope of his technical knowledge. He had the happy or unhappy faculty of passing snap judgment: "it can't be done" and "its impractical" were bywords with him. Still, for all that, he was a good man in many ways, and having this in mind the superintendent endeavored to win him around. He had met with no success, and now had to go on record with the general manager.

"On the other hand"—the superintendent continued—"there is Anderson, in our pressroom: it's a pleasure to have that man around. Hand him a hard nut to crack and he goes to it with a determination to be successful or know the reason why. No questioning, no bantering, and after the matter is given a trial I get a report—and I can rely on his word. That man has the spirit that moves mountains. Now if"—the general manager interrupted him.

The general manager was a broad-minded man, an able executive and one who had a distinctive leaning toward the men in the ranks. He knew the employees fully as well as did the superintendent, and possibly he understood them better.

In this instance his system of personal contact served him well, for as the superintendent spoke he had in mind before him a picture of the offending foreman, and as he weighed the testimony he decided to take a hand in the matter himself. To him it appeared to be a case of "fit, not fire." He had interrupted the superintendent and instructed him to place the man on probation for one month; and though he did not unfold his thought, he had arranged a plan of action.

A few days later he met the foreman on the street, and as both were going in the same direction they walked along together. The conversation finally drifted into shop talk, with the general manager doing most of the talking—seemingly reviewing his own experiences, while in reality, doing nothing more than to place himself in the shoes of the man he was addressing; thus, he worked in the points gleaned from the superintendent's report. He explained how he had lost a very good opportunity in his younger days, due to his apparent inability to coöperate successfully with his superior. "I always maintained," said the general manager, "that my superior never rightly understood my actions, when as a matter of fact I never really understood him nor tried to for that matter; and I can appreciate, now, as I look back, that I must have caused him no end of trouble. It was a rude awakening for me to find I hadn't made good, but you may be sure I made the most of my lesson. It taught me how to take an inventory of myself, and to this very day I take stock, and weed out the weak points."

Thus he continued to drive home matters, which to the listener, appeared to be suggestive of nothing more than good advice. The superintendent was extremely pleased some time later, to note a change for the better in the actions of his foreman, and he was elated with the progress the department had been making of late. He concluded he had won his man over at last, and he took pleasure in reporting to the general manager at the end of the probation period, that the foreman had "seen the error of his way" and reformed.

The general manager, smiling to himself, warmly complimented the superintendent for his good work. The results obtained were more gratifying to him, than was personal glory: a happy solution, with both superintendent and foreman all unaware of the part played by the third party! And the foreman, now secure in the good graces of the superintendent, often thought as he looked back, how closely related his experiences were to those of the general manager.

THE SOLDIERS OF THE SHOP

OUR BOYS are in France.

Their khaki-clad ranks are thousands strong and growing with each passing day. Theirs to hold the trenches, to sail the air, to man the guns, to meet the enemy face to face, to die maybe, that we in America may never know the pangs of ravaged Belgium and of devastated Serbia!

They are the vanguard, the skirmish line! The main army is here in the United States of America, and you men of the machine-building industry, you soldiers of the shops, are a most important unit—one of the most important.

Never before in all history have you played such a vital part in the welfare of the world. Never before has the safety of democracy, both political and industrial, been so dependent on you. Without your loyalty and skill and industry, the boys in France will make their sacrifice in vain.

No matter what your work may be, no matter whether you are in the shops of Maine, of Michigan or California, you are just as much a part of winning the war as though you were under Pershing in France with the boys. Your energy, your faithfulness and loyalty are just as important as theirs, and often more difficult to exercise; because you are far away from the firing line, and its thrill, and its excitement.

WHETHER you are making shells or guns, or only the machines with which uniforms or shoes are made, do not forget that all these things are needed in increasing quantities. Do not forget that a single day's output may decide a battle. Let every day count in the grand total which is credited to your efforts.

Whether you are running a lathe, a drilling machine or doing any other necessary work; whether you are in the drafting room, the stock room or the office, you are a necessary part of the great army of shops which stand behind the men in France.

You may think the shop monotonous, but so is much of the life in the trenches. You may think it noisy and distracting, but it is nothing to the noise of shell in barrage and curtain firing. You may envy the thrill and action of the firing line; if so, you deserve the more credit for staying where you may perhaps do the more good. But wherever you are, and whatever your work, remember that this is *your* war; that it safeguards *your* future against definitely threatened invasion; that it is protecting *your* loved ones from future dangers.

None of us wanted war, nor was it of our making. Reluctantly and with no adequate preparation were we drawn into it against our wills. But now that we are in, there can be no turning back. We must face the future calmly, seriously and with the utmost determination, each to do his part as best he may.

As soldiers of the shops, responsible for so much of the equipment of war, let us daily do our best to stand behind the army and to keep it well supplied. With full and unswerving loyalty let us realize our responsibility and keep the faith.

The eyes of the world are upon us, and our army of the shop must be as steadfast as our army of the field!

Editorials

What Is Labor Unrest?

THE human mind is the most complex piece of mechanism in the world. It is the master mechanism. How it works nobody knows. What it will do individually and collectively under any given conditions, nobody knows—not even its owner.

The man who digs your ditches has depths you cannot plumb. You see him come and go every day and his coming and going become a part of your daily habit of thought, like the coming of your morning newspaper. Some day he doesn't blend with the scenery as you are accustomed to viewing it. Unknown to you there has been some crisis in his life; his mental depths are in turmoil; age-old questions come to the surface. Placidity becomes turbulence and you are annoyed—unless you have become similarly turbulent yourself, in which event you are not annoyed. You understand.

Your ditch digger has thousands of years of his ancestors' life and thoughts and yearnings slumbering in his soul and speaking when he roused. He has not always been a ditch digger. Some centuries past in Asia Minor, in Greece, in Italy, along the whole line of civilization's push upward, he has been oppressor and oppressed, just as you have been—mostly oppressed, for the oppressed have always been in the majority.

One life begins and ends; but the blood-flow is continuous from generation to generation. The thousands of years behind us speak in us and to us and through us every day. The greatest thinkers, ancient and modern, affirm this.

There has been more stirring of the human depths since August, 1914, than there had been in the whole period since our Civil War. All of our accustomed grooves have been upset. In our social bearings we lack a sureness of direction. The guide posts have become weathervanes. Our placid gray matter has been set seething. The former smooth surface of our minds which reflected the current weather, the passing clouds and the orderly seasons, is turbulent; the sediment of the centuries is bubbling to the surface from the depths.

We get into channels. Channels are comfortable. They fix direction. Where you are going doesn't worry you. It suffices that you are comfortably on your way. Then something happens and destroys the channel. You and your ditch digger face each other with the eternal question of your mutual relationship in your eyes. The thousands of years back of each of you is compacted in the look. *And you couldn't phrase the question in words if you tried.* You don't try, either of you. Instinctively you know it, but to save your souls neither of you could say it.

If you tried to say it, you would both use the words you used in the channel—wages, open shop, cost of living. Especially the ditch digger would. He couldn't phrase the concentrated protest of ten thousand years in a moment of crisis any more than he could think it logically in a year in the channel. It is too big, too overwhelming, too much a rising of his whole being.

So when you ask him what he is turbulent about, don't quibble about the lack of a clear-cut answer. It can't be made; you couldn't make it yourself. But if you want his answer, get it in his reactions. Hear him give approval to war against the Kaiser; note the set of his features when the war profiteer is mentioned; watch him as he listens by the hour to the man you would call an agitator; catch his constant sanction to the opportunities open alike to everybody and his equally constant suspicion of opportunities not possible for *his* children. The public schools are never afraid to go to the people for money; the universities are.

Business based on the idea of maximum cash returns to the owner, at any cost to competitors, to labor, to the social order, to the Government, was bound to be a boomerang.

The labor unrest is the instinctive protest of ten thousand years against all this.

Airplanes Not Built to Metric Measurement

THE organ of the American Metric Association, *Metric News*, for Sept. 10, contains this statement: "The United States Government is using the metric system almost exclusively in the manufacture of airplanes."

The facts are these: In our columns for Aug. 23 last, we published a page of new airplane standard parts in which there is not a single metric dimension. It is no secret that the Liberty Motor from carburetor to exhaust pipe, inclusive, is being made to English measures. The Standards Committee of the Society of Automotive Engineers has published the following:

"In view of the fact that the Army and Navy Departments are not both in favor of adopting the system, and further, in view of the necessity of arriving at standards that will mean the least possible delay in the production of airplane parts, this Division (the Division of Standards Committee) recommends definitely to use the English system of measurements except in isolated cases such as spark-plug threads, where the metric system is desirable in order to effect interchangeability with some well-established standard."

The National Council of Defense referred this matter to the American Society of Mechanical Engineers, who, in turn, referred it to their Weights and Measures Committee. In its report, this committee considered the facts as they now exist, to settle the question definitely in favor of a continuance of the English system for the manufacture of both motors and other parts of airplanes. The committee felt that a change at the present time would involve so serious a delay as to border on disaster, and recommended the continued use of the English system for all airplane work.

We have here a fresh illustration of the old policy of the metric party in accepting as true any statement favorable to their case and then publishing it as a fact without the slightest investigation or inquiry regarding its truth. Meanwhile, this misstatement of facts has begun making the rounds of the press, and the public will soon come to believe it to be true; for no possible correction can catch up with such a statement once it has begun its travels.

It is to be regretted that the advocates of any cause, allow themselves, intentionally or otherwise, to use incorrect statements in place of facts. The American Institute of Weights and Measures, which is engaged in fighting and exposing these false statements, seems to be the only means available of counteracting them.

Motor Trucks Can Relieve Railways

THE machine builders are finding themselves seriously hampered by lack of shipping facilities over the railroads, and comparatively few are so situated that any appreciable proportion of their products can be handled by water transportation. The situation has been relieved in many cases by the use of motor trucks. In fact there are numerous instances where motor haulage of castings and forgings between the foundry or forge and the machine shop, was all that prevented the suspension of work in the shops, as the railroads were utterly helpless to handle the traffic.

This method points the way to the supplementing of railway traffic by motor truck in many places, especially where the hauls do not exceed 50 to 75 miles. Economical haulage by motor trucks, however, requires good roads, which are none too plentiful in this country and which should receive immediate attention.

Increased transportation by motor truck makes it imperative that roads be built as rapidly as possible in congested sections. This is an important war measure and has the advantage of being equally useful after the war.

Such roads cannot be built without the initiative of the machine and other industries. The highways departments have in many cases abandoned road-building programs even where the money is already appropriated. This is a great mistake at this time.

Highways officials are deterred by the priority order which prevents the shipping of road material, but this ban can be removed when urgent need is shown to the officials of the Priority Board; then also the states must probably relieve the contractors of some of the heavy risks occasioned by present conditions. This can be done by having the state supply the contractor with the material, and insure its delivery: Things which the state can more readily do than can the individual contractor, under present conditions.

If the business men of each community unite in demanding action by their highways departments, those departments will respond and their response will naturally be followed in due time, by the recently appointed Highway Transport Committee of the Council of National Defense. Immediate action is necessary, and much of this work can be expedited by getting the state highways departments to work on the local problems.

With the need for transportation facilities so evident to every machine builder, there should be no hesitation in trying to get an early consideration of the motor-haulage problem, by the local roads. This will greatly relieve the railways and leave them greater capacity for the longer hauls.

Americanizing Our Shopmen From Other Lands

THE work of Americanization is going on in many states and is beginning to show results. Much remains to be done however, and it is a really constructive work which will continue to bear fruit long after the war has become a memory.

Personal interest will probably pay a bigger dividend than any other agency which may be employed, for though good public speaking, either in the shop, in public schools or other buildings, will aid in arousing enthusiasm, it is the daily contact, the evident desire to give the foreigner a square deal, that will really win him and hold him as a loyal citizen of this republic of ours. We must give them something tangible to be loyal to.

Every shop should have some able, tactful and kindly man to take charge of the work, even though he give it but half an hour a day. He should know who are and who are not citizens; he should keep in close contact with the foreigners, find their point of view, learn their grievances, and correct their misunderstandings, if any, aid them in filling out and filing papers and in securing action in the naturalization courts. The learning of English should be encouraged and it may be desirable to make it compulsory in some cases. If this is done however, every facility for learning the English language should be given, and the women of the household should be reached in the same way, as it is necessary to have English in the home if it is to become a forceful part of the workman's life.

Self-interest must always be considered, especially in the case of a man who is far from his native land where inborn love of country, right or wrong, may be a strong factor. The fact that a knowledge of English gives him more opportunities for a job and for a better job, is a strong argument. There is also less liklihood of accident owing to a confusion of tongues. Both of these factors have considerable influence both on the man, and on the woman of the family as well. In fact much progress can be made by securing a thoroughly competent woman in a community to visit the homes and become friendly with the wives, mothers and daughters of the family. Also, single women should be encouraged: the married woman is automatically naturalized, when her husband becomes a citizen.

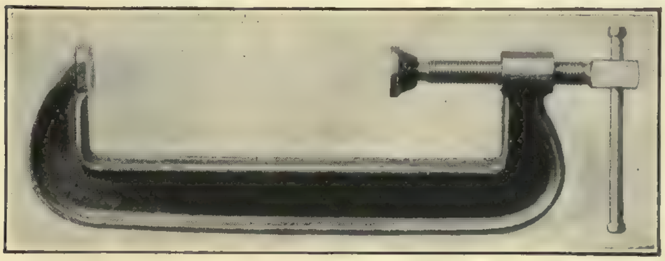
The main object is to secure good citizens, and to this end we must be able to point out the true advantages of citizenship. We must show that democracy is worth while; we must insist on the square deal in all things; we must prevent unjust and particularly any humiliating discrimination against the foreign born.

With these principles as a basis we can expect to secure the coöperation of all those who are desirable for citizenship, if we can show that they work out in practice. We must do our share, and having done that we need fear no difficulty in getting the men we are trying to help.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

LeCount Drop-Forged Clamp

William G. LeCount, South Norwalk, Conn., is making a type of clamp somewhat different from those pre-



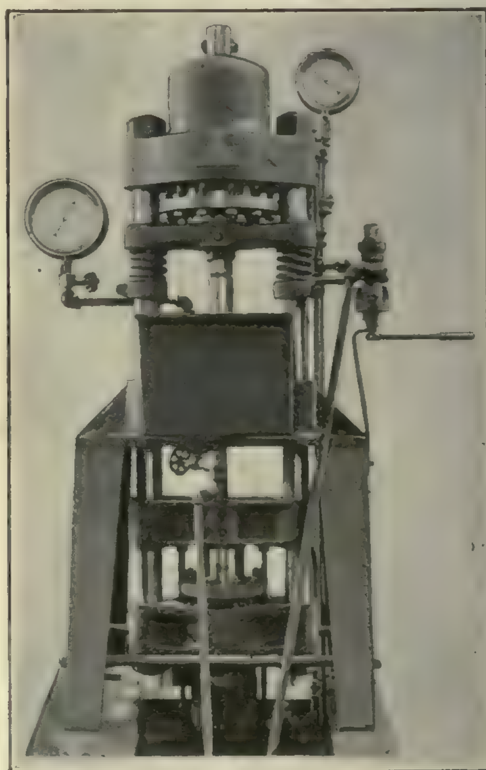
LECOUNT DROP-FORGED CLAMP

Made in seven sizes, the lengths varying from 3 to 12 in.; all have 3 in. depth of throat and screws 13/16 in. diameter by 5 3/4 in. long. The weights run from 6 1/2 to 10 3/4 lb.

viously manufactured by him. The clamp shown is of drop-forged steel with the screw made from high-grade steel, cut with U. S. S. thread, hardened and tempered.

Metalwood Shell-Testing Press

The Metalwood Manufacturing Co., Leib and Wight Sts., Detroit, Mich., is now marketing a line of hydraulic presses intended especially for testing shell forgings. The presses are made in three sizes: No. 1 for 3-in. or 75-mm. shells, No. 2 for 4.7-in. shells, and No. 3 for 6-in. shells. The illustration shows the No. 1 machine. The machine consists of an intensifying cylinder, a pull-back cylinder and a cylinder of correct size to insure a fluid-tight joint between the shell nose and the resistance head. The working cylinders are alloy-steel castings with polished bores and are tested with a pressure of 3000 lb. per sq.in. The pull-back cylinders are steel castings, the ram is of cold-rolled steel and the crosshead carrying the intensified shell plunger is a semi-steel casting with bronze bearings. The lower and upper main rams are of 40 per cent. semi-steel, and the intensifier plunger is of tool steel hardened and ground. The main packings consist of boxes and glands suitable for square hemp or preferably hydraulic packing. The packing on the resistance head is of such nature as to be fluid tight under pressures up to 18,500 lb. per sq.in. In making the shell holder, a construction has been used that allows the base of the shell to be exposed during the test. This is considered a valuable feature as it allows any piping in the base of the shell to be quickly detected. Pull-back springs are provided for a quick return of the clamp or sealing cylinder. All piping up to the regulating valves is supplied, the operation of the intensifier and sealing-clamp cylinder being controlled simultaneously by a quick-operating valve. One gage is provided for recording line pressure from the regulating valve, and one high-pressure test gage graduated to 30,000 lb. is provided for recording the test pressure applied to the

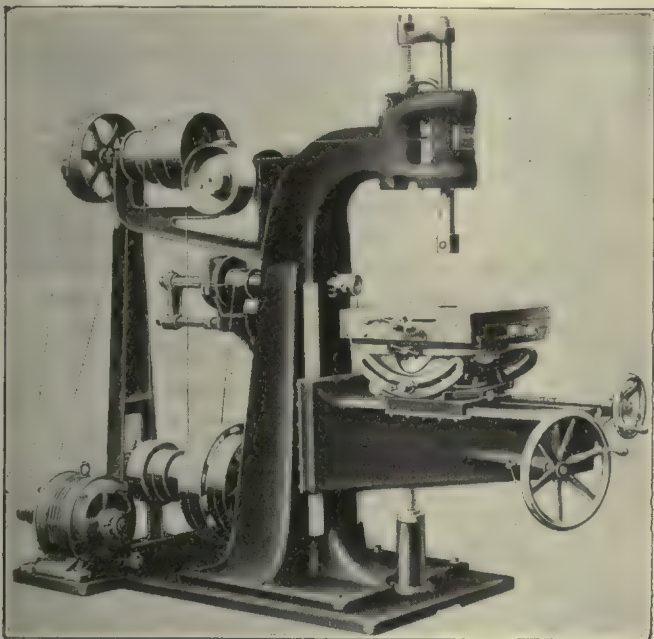


METALWOOD HYDRAULIC SHELL-TESTING PRESS

shell. The No. 1 press will deliver a maximum intensified pressure within the shell chamber from 2000 up to 18,500 lb. per sq.in. The sealing pressure exerted by the upper clamp cylinder is approximately 50 per cent in excess of the opposing intensified pressure. The displacement of water due to one operating stroke of the press is 0.6 gal. One of the valuable features claimed for this machine is that the filling and emptying of the shells is done on the machines, this feature obviating the wetting of floors and workmen.

Oliver Wood-Milling Machine

The Oliver Machinery Co., Grand Rapids, Mich., has recently added a number of improvements to its No. 75 wood-milling machine, which is shown in the illustration. The column has been broadened, making it much heavier, and the base has been made considerably larger. Another new feature is the table. This new table will rotate in a plane at any angle, which makes the machine much more universal than those previously constructed. The compound cross-slides are located above



OLIVER NO. 75 WOOD-MILLING MACHINE

the double swivel and tilting mechanism, so that these compound slides will operate in any position. It will be noticed that there are now two cross-slides instead of a single one as formerly. The top of the table is graduated with parallel cross lines 1 in. apart, which facilitate setting the work. The machine is furnished either with variable-speed motor drive, constant-speed motor drive with four-step cone pulleys, or for belt drive with four-step cone pulleys.

Lamson Shell Conveyor

The Lamson Co., 100 Boylston St., Boston, Mass., has added a shell conveyor to its line of gravity roller conveyors, power conveyors and pneumatic tubes. This shell conveyor differs from the customary roller conveyor mainly in the shape of the rolls which are spool shaped so that the shells will fit in the grooves formed in the rolls as they slide along to their destination. To insure ease of operation, ball bearings are used on the roll spindles. Hardened ball races are used, and it is claimed that these bearings reduce friction to such a degree that the shells will roll quickly and easily from machine to machine where the grade of the conveyor does not exceed 3 or 4 per cent. The rolls revolve on steel spindles, the ends of which are carried in an angle-iron frame, while the rolls and bearings are held in place by a split pin in each end of the spindle. The roll, head, and self-contained bearings are accessible, and adjustable steel supports hold the conveyor at any convenient height. The spacing of the rolls depends upon the length of the shell blanks being operated upon. Fig. 1 shows the conveyor as used for small or medium

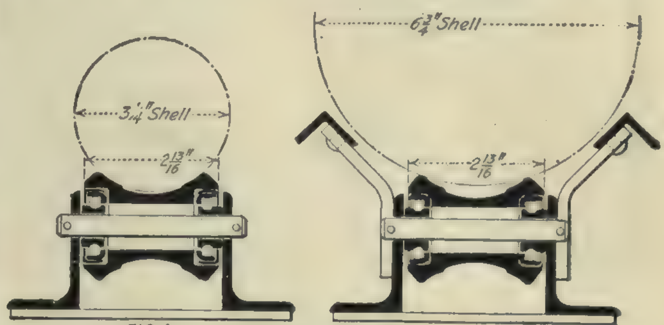


FIG. 1 FIG. 2

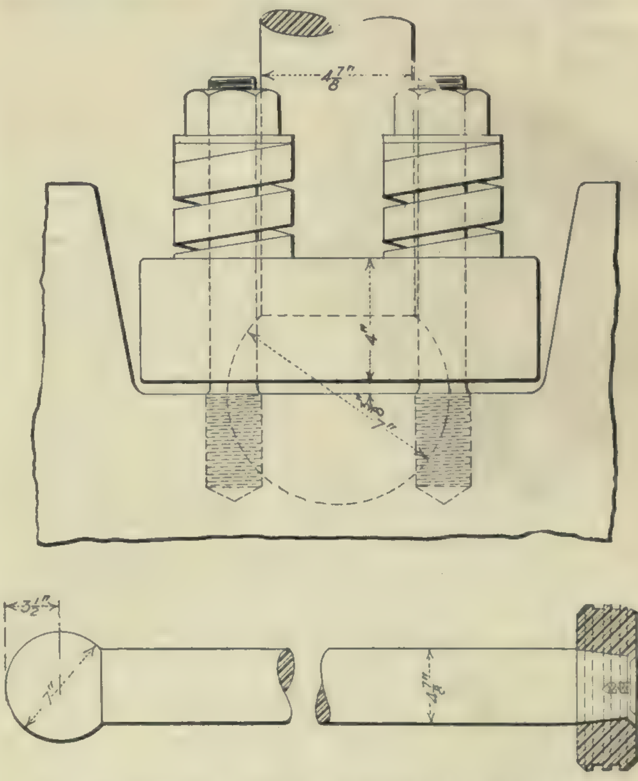
FIGS. 1 AND 2. LAMSON SHELL CONVEYORS

size shells, but where larger shells are handled, guard rails such as are illustrated in Fig. 2 are recommended and supplied. These are made from angle iron.

Ball-Joint Piston Rod for Steam Hammer

By E. L. Robenolt

We were having a great deal of trouble with the breaking of piston rods in our steam hammer, and the breakage appeared to be caused by the larger dies striking at one side which caused the metal of the rod



BALL-JOINT PISTON ROD FOR STEAM HAMMER

to crystallize. We had tried different kinds of steel without satisfactory results and at last decided to try the ball-joint rod as shown in the accompanying illustration and that seems to have eliminated the trouble.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Feb. 25, 1918—There is at the present time a plan on foot to train a reserve force of farm workers for the coming season. This includes the establishment of day and night schools thoroughly equipped with live stock and farm machinery, and with competent instructors. This is now being established in Chicago, and in the spring actual farming will be done on vacant land secured for the purpose.

Practical education of all kinds is more necessary than ever before and should be encouraged in every way possible. It is particularly needed in the machine-building industry, which has unfortunately, not been training men and boys nearly as fast as they are needed to meet the growing demands of the past years. The lack of training has been keenly felt during the past two years, and is likely to be even more vitally felt in the future. This lack has seriously handicapped our own preparations for war and is today delaying much of the work we are trying to do.

All-Around Machinists

The changes from the old method of building a few machines at a time, or one at a time, to the modern manufacturing method of turning them out in large quantities, has eliminated the necessity for all-around machinists, and has resulted in the specialized worker who only understands the operation of the particular machine he operates. If he runs a lathe, the milling and the gear-cutting machines are sources of mystery in too many cases. He becomes expert on one machine but does not grasp the fundamental underlying all machines and is afraid to attempt any kind of work not included in his experiences. This has complicated the labor problem in many ways and has been the subject of much careful study on the part of some of our most progressive machine builders.

The old form of apprenticeship is gone forever so far as training men and women for manufacturing is concerned. The subdivision of work which modern manufacturing entails, makes the all-around mechanic unnecessary, and yet the ability to shift from one machine to another is a great advantage at times, both to the workman and to the manufacturer.

Teaching Trades in The Colleges

There is a movement on foot, and it is already so well established as to be almost certain of accomplishment, for utilizing the equipment of the technical colleges for the training of mechanics of various kinds during the summer months. With this in view the college classes are being worked overtime so as to graduate their men by May 1, and in some cases even earlier. With the engineering students out of the way, it leaves the equipment of the colleges free to train mechanics and engineers of various kinds, and there is no question as to their being needed both during and after the war.

There is strenuous objection to this on the part of many engineers and educators who feel that it would be far better to begin the next freshman year immediately after the seniors are graduated, and to have the whole college closed excepting the machine shops, which are to be used for the training of mechanics. Those who object most strenuously point out that we are not yet using our public school machine-shop equipment to anywhere near its full capacity, and that this should be done before the colleges are interfered with.

There is considerable equipment in New York City alone, which is lying idle most of the time, and it certainly seems reasonable that this equipment should be used 100 per cent. of the available time before we interfere too seriously with the training of engineering students on which so much both present and future depends.

Construction of Explosives Plants

One of the encouraging parts of the situation here in Washington, is the appointment of Daniel C. Jackling who is to have charge of the construction of plants for the manufacture of explosives in various parts of the country. Mr. Jackling is the president of the Utah Copper Co., and has had a wide experience in the construction of plants of this nature. It is also understood that he will take with him a well-trained corps of men that thoroughly understands his work, and that can be of great assistance in the work which is to be done.

It is Mr. Jackling's plan to extend present plants as far as possible and in cases where it is necessary to build complete new plants, to do so with a view to their future use in the manufacture of chemicals and similar products.

In view of the many haphazard undertakings which are under way, it is refreshing to find definite plans made which take into account our life after the war as well as the conduct of the present struggle. Not that this is always possible, for there are many cases where the main problem is to get something done and done quickly without regard to its cost or to whether it can be utilized later. Wherever possible, however, such plans as those indicated are highly desirable and should always be borne in mind.

There are more sides to the housing situation than appear on the surface, and they show the complexity of our modern civilization better than we realize. The problem of housing the workers at the new plants is excellent evidence of this. One case in an out-of-the-way shop, shows what can be done by coördination.

The large increase in men needed, makes a large number of houses seem absolutely necessary because the surrounding towns are not accessible. There are electric trolley lines to be sure, but these are all independent and would not coöperate in a way to give good connecting service. A survey showed that by combining the three short lines and running through cars over them to avoid changes, the men could come and go to their homes very comfortably and no new houses would be needed; hence, the roads were taken over by the Director of Railways and the problem was solved without delay and at minimum cost. In other places the same treatment has saved several hundred thousands of dollars and many weeks of time.

Such instances as these show how interdependent are the housing and the transportation problems. They also show how the general good is served by wiping out small independent divisions of what should really be one system, and combining them into one unit.

Only What Can Be Transported Counts

There is another phase which is now receiving careful attention, which is the careful scrutiny of where the contracts are to be placed with a view of preventing further congestion in some districts. This was not considered in the early days of the war, which accounts for some of the tying up of transportation at this time; but when we remember that transportation is the "neck of the bottle," that only munitions which can be transported really count, we see how vital it is to distribute the contracts in different sections. This is particularly true when we consider the sources of raw material, because the transportation of raw materials requires even more cars and locomotives than the finished products.

Then too, the congestion of contracts in turn congests labor, and housing conditions as well as local transportation then becomes a vital question. If anything was needed to make us see how interdependent we all are, the present jam of transportation facilities gives us excellent proof.

Aside from the effect of the transportation jam on labor and in turn on the housing and on the wage problem, we have learned that it is impossible just now to ship munitions after we make them; hence, the only sensible thing to do is to slow down on production. This may be done by cutting night work or overtime, or by working shorter hours or fewer days per week. In either case it decreases the demand for labor, stops the bidding against each other to a large extent. This in turn affects housing conditions in the districts concerned, and tends to steady the whole situation.

Knowing Where You Are At

When the existing conditions are known, as is the case in the Ordnance Department by the use of the Gantt charts, it is possible to make the best of a bad situation and keep things within bounds. If it is known just how each kind of munition is coming along, known which is needed first and also the conditions of shipping facilities, one is in a good position to improve conditions instead of aggravating them as is apt otherwise to be done.

In this respect, the Ordnance Department is in better shape than any of the others, although it is understood that General Goethals is whipping the Quartermaster Department into shape also. The great difficulty seems to have been that when an order was placed the officers, both regular and reserve, seemed to think that the stuff would come along automatically. Unfortunately it doesn't; and if production engineers had been on the job no such notion would have prevailed. But the average financial man seems to feel that all you need is money, and that after having billions appropriated, there is nothing further needed but to let the contract. The results have not been altogether pleasing or productive of results.

Boring Taper Holes

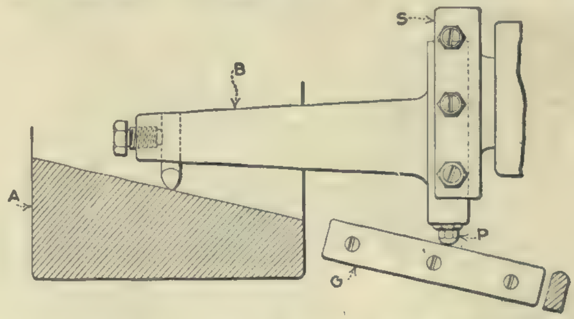
By W. Burr Bennett

Having occasion to bore some taper holes in work mounted on a boring-machine table, the following method was used with satisfactory results:

As shown in the accompanying illustration, the casting *A* was secured to the table with bolts, and an ordinary boring tool *B* set in the boring spindle. Guide bar *G* was mounted in the horizontal plane of the spindle and at the same angle with the spindle axis as the required taper.

The end of the slide of the boring tool was equipped with a hardened-steel adjustable button *P* with a spherical face.

Having the set-up arranged as noted, the gib screws *S* were tightened enough that the slide of the boring



ARRANGEMENT FOR BORING TAPER HOLES

tool would hardly move in the saddle. The guide bar was solidly bolted to the table, and upon starting up and putting a slow feed on spindle, the steel button *P* would hit the guide bar each revolution and move the slide in slightly, thus changing the diameter of the cut. The guide bar having been set to the proper taper, the result was a similar taper hole in the part being machined.

The reason for the success of this method lies in the reaction of the force developed by the pressure of the tool. Instead of moving the slide in, the cutting pressure reacts as shown by the dotted lines and cramps slide in saddle.

It should be noted that this method will not produce a smooth finish, but as in this case a taper bronze bushing was fitted, the character of the cut was of no consequence.

Personals

A. D. Armitage has been elected president of the Whitman & Barnes Co., Akron, Ohio.

H. F. Finney has been placed in charge of the Pittsburgh office of the Independent Pneumatic Tool Co.

R. I. Schönitzer, formerly general manager of the Dale Body Co., Fostoria, Ohio, is general manager of the Sidney Mfg. Co., Sidney, Ohio.

R. T. Scott has been made Eastern manager of the Independent Pneumatic Tool Co. with headquarters at 170 Broadway, New York City.

Glenn Muffly, formerly manager of the Muffly Motor Co., Chicago, is engineer of tests for the Union Switch and Signal Co., Swissvale, Penn.

S. E. Gibbs, formerly engineer of the Western Carbureter Co., Alma, Mich., is in the engineering department of the Moline Plow Co., Moline, Ill.

C. Long, formerly tool designer for the Nordyke & Marmon Co., Indianapolis, Ind., is now in the planning department of the Foster Machine Co., Elkhart, Ind.

John O. Heinze, formerly production manager with the Simms Magneto Co., East Orange, N. J., is now production manager for the Lamson Co., Lowell, Mass.

H. O. C. Isenberg, formerly mechanical engineer of the Scripps-Booth Corporation, Detroit, Mich., is with the Wright-Martin Aircraft Corporation, New Brunswick, N. J.

E. E. Richmond, formerly production engineer for the American and British Mfg. Co., is now superintendent of the Poole Engineering and Machine Co., Baltimore, Md.

W. H. Knowles, formerly chief engineer of the Saxon Motor Car Corporation, Detroit, Mich., is production superintendent of the Hale & Kilburn Co., Philadelphia, Penn.

G. H. Peterson, formerly designer and mechanical engineer of the Stewart-Warner Speedometer Corporation, Chicago, is designer with the Champion Ignition Co., Clinton, Mich.

F. D. Howe, formerly superintendent of experiments at the Akron, Ohio, plant of the International Harvester Corporation, is now chief engineer of their truck department in Chicago.

Carl T. Hewitt, formerly connected with the Remington Arms Union Metallic Cartridge Co., Inc., Bridgeport, Conn., has accepted a position with the Fafnir Bearing Co., of New Britain, Conn.

Marvin W. Singer has been made manager of the Chicago office of the Latshaw Steel and Metal Products Corporation, with headquarters in the Railway Exchange Building.

Murry V. Robinson is now with Moller & Schumann Co., Brooklyn, N. Y., dealers in paints and varnishes. Mr. Robinson's territory will cover Long Island, Connecticut and the Hudson River Valley section of New York State.

George S. Blankenhorn, formerly connected with the Allis-Chalmers Mfg. Co., of Milwaukee, Wis., as engineer in the department of the chief consulting engineer, has accepted a position with the American International Shipbuilding Corporation, of Philadelphia, Penn., in the department of machinery fabrication.

Irving R. Valentine now has charge of the melting at the Heroult Electrical plant of the Fulton Steel Corporation, Fulton, N. Y. This company is making alloy steel of various kinds, such as nickel, chromium, ball bearing, magnet, etc. Mr. Valentine for a number of years had charge of the Heroult Electric plant of the General Electric Co.

R. S. Cooper, vice president of the Independent Pneumatic Tool Co., manufacturers of Thor pneumatic tools and electric drills, who for many years was the manager of the company's Eastern Branch in New York City, is now general sales manager as well as vice president, with headquarters at the general offices of the company, Thor Building, Chicago, Ill.

Frederick Glover, member of the National Gas Engine Association Executive Committee and vice-president of the Emerson-Brantingham Co., Rockford, Ill., has been commissioned a major in the Ordnance Department of the United States army. Mr. Glover's knowledge of tractors will make his services of great value, as he has long been identified with the industry.

Business Items

The Williams & Thomas Machinery Co., with offices in the Commercial Trust Building, Philadelphia, has been formed by R. F. Williams and George P. Thomas and will handle a complete line of machine tools, railroad and shipyard equipment. Mr. Williams, president of the new company, was for seven years with Manning, Maxwell & Moore, Inc., Philadelphia, and more recently with the Sherritt & Stoerr Co., same city, while Mr. Thomas, secretary-treasurer, is also president of the Thomas Spacing Machine Co., Pittsburgh.

The Whitman & Barnes Mfg. Co., Akron, Ohio, held its annual stockholders' meeting recently. A. D. Armitage was elected president, succeeding C. E. Sheldon, who is now chairman of the board of directors. The other officers elected are: W. H. Eager and A. B. Hall, vice presidents; W. E. Rowell, secretary; S. H. Tuttle, assistant secretary. The other directors are Frank A. Seiberling, George R. Hill, C. B. Raymond and A. H. Commins. Mr. Seiberling succeeds A. B. Rinehart, who has resigned. E. A. Fisher, assistant treasurer, has been elected treasurer.

The Hydraulic Pressed Steel Co., Cleveland, Ohio, elected the following officers at its annual meeting: H. B. Bole, who had been general manager, was made first vice president, and was succeeded as general manager by George C. Brainard, who has been factory manager; the latter was succeeded by J. D. Corcoran. H. F. Pettee became secretary, succeeding Maj. Ben P. Bole. At the annual meeting of the stockholders C. A. Irwin was added to the board of directors. Mr. Irwin was formerly president of the Canton Sheet Steel Co., which was recently taken over by the Hydraulic company.

Catalogs Wanted

The Hill Pump Valve Co., Archer Ave., Canal and 23rd Sts., Chicago, Ill., desire to bring their catalog library up to date, and would like to receive catalogs from manufacturers of automatic-screw machines, hand-screw machines, small tools, toolroom equipment, foundry equipment, punching machines, etc.

Trade Catalogs

The Walton Tap Extractor. The Walton Co., Hartford, Conn. Circular. Illustrated.

Ball Bearing High-Speed Bench Saw. H. G. Crane, Brookline, Mass. Circular. Illustrated.

The New Milburn "Reliance" Portable Carbide Light. The Alexander Milburn Co., Baltimore, Md. Circular. Illustrated.

"Cut-Weld" Combination Torch for Cutting and Welding. The Alexander Milburn Co., Baltimore, Md. Circular. Illustrated.

Recuperative Gas Oven Furnaces. Tate, Jones & Co., Inc., Pittsburgh, Penn. Bulletin No. 160. Pp. 12; 8 x 11 in.; illustrated.

Plain Bearing, Belt and Motor-Driven Drilling and Tapping Machines. Langelier Mfg. Co., Providence, R. I. Catalog. Pp. 20; 9 x 12 in.; illustrated.

Baily Automatic Electric Furnaces for the Heat Treatment of Shells. The Electric Furnace Co., Alliance, Ohio. Bulletin. Pp. 8; 9½ x 12 in.; illustrated.

"New Britain" Drop-Head Polishing and Buffing Machines. The New Britain Machine Co., New Britain, Conn. Bulletin No. 1225. Pp. 8; 8 x 11 in.; illustrated.

Martell Adjustable Reamers. Taft-Peirce Mfg. Co., Woonsocket, R. I. Bulletin No. 101. Pp. 20; 8 x 10½ in.; illustrated. This describes the construction and uses to which these reamers may be put.

Sherardizing—The Globe Way. The Globe Machine & Stamping Co., Cleveland, Ohio. This is the title of a booklet which tells about the industrial value of the sherardizing process of rustproofing.

Chapman Type Ball Bearings. The Transmission Ball Bearing Co., 1050 Military Road, Buffalo, N. Y. Catalog No. 3. Pp. 52; 6 x 9 in.; illustrated. This describes bearings for power transmission, and contains testimonial letters from users.

Multiple Spindle Automatic Chucking Machines. The New Britain Machine Co., New Britain, Conn. Catalog. Pp. 44; 8 x 11 in.; illustrated. In addition to detailed description of the different sizes of machines line drawings showing work handled are given.

The Globe Tumbling Book. The Globe Machine & Stamping Co., 1250 W. 76th St., Cleveland, Ohio. Pp. 36; 4 x 8 in.; illustrated. This booklet describes the various types of tumbling and burnishing barrels, tells of their capabilities and gives some effective tumbling methods. A price list accompanies the booklet.

Electric Welding. The Wilson Welder & Metals Co., Inc., 52 Vanderbilt Ave., New York. Catalog No. 2. Pp. 64; 6 x 9 in.; illustrated. This catalog, bound in heavy cardboard, describes fully the Wilson electric welding system and specially prepared metals. Blueprints showing layout of complete equipment are included.

Obituary

Henry H. Hodell, president of the Cleveland Galvanizing Works Co. the Van Dorr & Dutton Co. and a director of severa other large and successful institutions died recently. Mr. Hodell was born ir Alsace-Lorraine, France, 68 years ago and came to America with his parents wher only a lad. After finishing his educatior he learned the trade of patternmaking and it was not long before his remarkabl ability was recognized. Mr. Hodell wa also one of the pioneers in the weldless wire-chain business, and one of the best known links bears his name, being in use in all parts of the world. He is survived by a widow and two sons, F. G. and H. H Hodell, who were associated with him in his many enterprises.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

The sixth annual meeting of the Chamber of Commerce of the United States of America will be held in Chicago, Apr. 10 11 and 12, 1918. Elliot H. Goodwin, Riggs Building, Washington, D. C., is genera secretary.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday section meeting, first Tuesday. Elmer K Hiles, secretary, Oliver Building, Pitts burgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

New England Foundrymen's Association Regular meeting, second Wednesday o each month, Exchange Club, Boston, Mass Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association Meetings, first Wednesday of each month Manufacturers' Club, Philadelphia, Penn Howard Evans, secretary, Pier 45 North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of eacl month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O L. Angevine, Jr., secretary, 857 Genesee St. Rochester, N. Y.

Superintendents' and Foremen's Club o Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regula meeting, second Friday of each month Oscar S. Teale, secretary, 35 Broadway New York City.

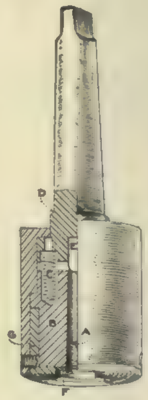
Western Society of Engineers, Chicago Ill. Regular meeting, first Wednesda evening of each month, except July an August. E. N. Layfield, secretary, 178 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Chuck, Drill

Progressive Machine & Metal Products Co., 210-212 Canal St., New York City



"American Machinist," Feb. 14, 1918

The action of the device is as folows: The drill is placed in the taper hole A in the part B; two springs C hold the driving shank D away from B so that the slot E in the driving shank does not engage the tang. When the drill strikes the work and a slight pressure is applied, the springs C are compressed and the driving shank D moves down against B, the slot E engaging the tang of the drill and providing a positive drive. When the feed pressure is released the springs C force parts B and D apart, disengaging the positive drive, and if the drill sticks in the work it will turn in the taper socket A and not be broken. The drive shank D is cylindrical, extending down nearly to the surface F while the part B is flat and fits into a slot milled in D. All the parts are held in place by the part G, which is secured in the outside shell by two screws

Press, Die-Testing "Rex"

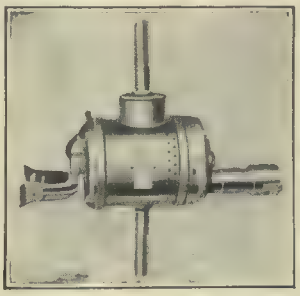
Sundstrom Manufacturing Co., 3201 Shields Ave., Chicago, Ill.

"American Machinist," Feb. 21, 1918

For the purpose of spotting dies, finding blanks, shearing-in punches, locating dowel pin, etc. The device has a leverage of 20 to 1, making it sufficiently powerful to cut blanks up to 3 x 4½ in. from sheet stock up to 1/32 in. thick. The slides are gibbed, allowing adjustment for wear, and the square shank holder takes shanks up to 2 in. in diameter. The depth of throat is 7 in., the stroke is 1¼ in., the die space with the head down is 6¾ in. and the weight is about 260 lb.

Drilling Machine, Electric

Gilfillan Brothers Smelting and Refining Co., Los Angeles, Calif.



"American Machinist," Feb. 14, 1918

An electric drill equipped with gears to give two speeds. These are changed by means of a knob at the bottom of the gear case. All gears are of chrome-nickel steel and run in grease. Ball bearings are used throughout, the speeds being 400 and 700 r.p.m. The machine is equipped with a ½-in. standard chuck and electric switch

Screw Machine, Turret, No. 4.

Defiance Machine Works, Defiance, Ohio.

"American Machinist," Feb. 21, 1918

Maximum collet capacity, 1⅝ in. rounds; maximum capacity through spindle, 2 in. rounds; spindle speeds, six, 37 to 412 r.p.m.; swing over bed, 16 in.; swing over cut-off slide, 6¾ in.; tool holes in turret, 1¾ x 3 in.; length of stock turned, 8 in.; feeds of turret, four 0.007 to 0.036 in. per spindle revolution; floor space, 36 x 102 in.; weight, 2500 lb.

Counter, "Productimeter"

Durant Manufacturing Co., Milwaukee, Wis.

"American Machinist," Feb. 14, 1918

Adapted for counting operations requiring not over five figures. Will operate with a very slight movement or at a distance from the actual point of contact. Is mounted upon a brass bracket which holds a pair of magnetic coils and an armature, the operating lever being connected to the swinging armature in a positive manner with a free and sensitive movement. Furnished for 6 or 110-120 volts d.c., or for 110-120 volts a.c., at 25 or 60 cycles. Contacts are not regularly furnished. but can be supplied if desired. Weight, 2½ lb.

Truck, Electric, Type WB

Elwell-Parker Electric Co., Cleveland, Ohio.

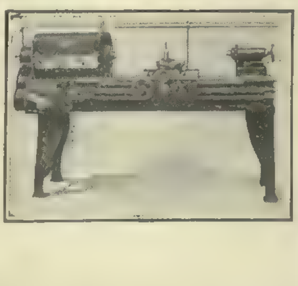
"American Machinist," Feb. 21, 1918

Drive, single worm reduction to 2 wheels; steer, 4-wheel; axle, full floating; speeds, three, 400 to 650 ft. per minute; tires, solid rubber, pressed on, 21½ x 3½ in. and 15 x 3½ in.; turning radius of outside edge, 9 ft. 3 in.; over-all dimensions, 40 x 124 x 50 in.; charging current, 36 to 60 amperes at 40 volts; weight, 2500 lb.

Lathe, Geared Head 14- and 16-In. "Filsmith"

Philip Smith Manufacturing Co., Sidney, Ohio

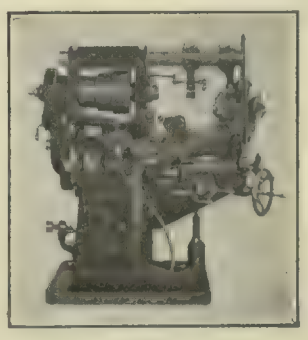
"American Machinist," Feb. 14, 1918



Swing over bed, 14⅜ in.; swing over carriage, 8 in.; distance between centers, with 6 ft. bed, 34 in.; tailstock travel, 5¾ in.; diameter of tailstock spindle, 1⅞ in.; centers, No. 3 Morse taper; front bearing, 2¼ x 4 in.; rear bearing, 1 13/16 x 3 in.; diameter of spindle nose, 3 in.; hole through spindle, 1 5/16 in.; threads cut, 4 to 46; feeds, three times threads; bearing of carriage on ways, 18 in.; width of bridge, 7½ in.; number of spindle speeds, twelve: 18 to 497 r.p.m.; size of tools, 1¼ x ⅝ in.; weight with 6-ft. bed, 1600 lb.; extra weight per additional ft. of bed, 90 lb.

Milling Machine, Universal No. 3

Becker Milling Machine Co., Hyde Park, Boston, Mass.



"American Machinist," Feb. 21, 1918

Working surface of table, 50 x 12 in., with 3 T-slots ⅝ in. wide; longitudinal power feed, 30 in.; cross power feed, 10 in.; vertical power feed, 19 in.; greatest distance between face of column and yoke, 23½ in.; spindle threaded, No. 11 B. & S. taper; front bearing 2⅜ x ⅞ in.; 12 spindle speeds varying from 12 to 412 r.p.m.; diameter of overhanging arm, 4½ in.; distance from underside of overhanging arm to center of spindle, 6⅞ in.; gear feeds, chain driven, 24 changes varying from 0.002 to 0.528 in. per revolution of spindle; floor space, 74¾ x 107½ in.; weight, 3800 lb.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Feb. 21, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$24.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia.................	33.75	33.75	30.50
*No. 2, Valley.......................	33.95	33.00	31.00
No. 2, Southern Cincinnati............	35.90	35.00	26.90
Basic, Eastern Pennsylvania..........	33.75	30.00	30.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Feb. 21, 1918	One Month Ago	One Year Ago	Feb. 21, 1918	One Year Ago	Feb. 21, 1918	One Year Ago
Structural shapes ...	$4.20	$4.20	$4.10	$4-4.04	$4.10	$4.20	$3.75
Soft steel bars......	4.10	4.10	4.00	4-4.04	4.00	4.10	3.85
Soft steel bar shapes.	4.10	4.10	4.00	4.14	4.00	4.10	3.75
Plates, ¼ to 1 in. thick	4.45	4.45	5.15	4.39	4.75	4.45	4.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Feb. 21, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York..................	4.70	3.75
Warehouse, Cleveland	3.98½	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Feb. 21, 1918	One Month Ago	One Year Ago	Feb. 21, 1918	One Year Ago	Feb. 21, 1918	One Year Ago
*No. 28 black......	5.00	6.45	5.00	5.75	6.45	5.50	6.45	5.15
*No. 26 black......	490	6.35	4.90	5.65	6.35	5.40	6.35	5.05
*Nos. 22 and 24 black	4.85	6.30	4.85	5.60	6.30	5.35	6.30	5.00
Nos. 18 and 26 black	4.80	6.25	4.80	5.55	6.25	5.30	6.25	4.95
No. 16 blue annealed.	4.45	5.65	4.45	5.10	5.65	4.95	5.65	5.00
No. 14 blue annealed.	4.35	5.55	4.35	5.00	5.55	4.85	5.55	4.90
No. 10 blue annealed.	4.25	5.45	4.25	4.95	5.45	4.75	5.45	4.85
*No. 28 galvanized..	6.25	7 70	6.25	7.50	7.70	7.00	7.70	7.25
*No. 26 galvanized..	5.95	7.40	5.95	7.20	7.40	6.70	7.40	6.95
No. 24 galvanized...	5.80	7.25	5.80	7.05	7.25	6.55	7.25	6.80

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Feb. 21, 1918	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Feb. 21, 1918	One Year Ago
New York	$15.00	$8.00
Cleveland	15.30	7.50
Chicago	15.00	6.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅝, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16..	
No. 18	
No. 20	

¹ Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Feb. 21, 1918	Cleveland Feb. 21, 1918	Chicago Feb. 21, 1918
Tire	4.10	5.00	4.00
Toe calk	5.70	6.00	4.35
Openhearth spring steel...	7.50	8.25	8.00
Spring steel (crucible analysis)	11.00	11.25	11.50
Coppered bessemer rods...	9.00	....	7.50
Hoop steel	4.95	....	4.95
Cold-rolled strip steel.....	9.00	....	8.50
Floor plates	6.19½	....	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to [illegible]......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%

BUTT WELD. EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			

LAP WELD. EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4.......	29%	17%
4½ to 6......	44%	32½%	4½ to [illegible].......	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Feb. 21, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	35.00
Tin, in 5-ton lots....................	85.00	86.00	50.00
Lead	7.00	6.50	8.75
Spelter	8.00	7.75	10.25

*Government price.

ST. LOUIS

Lead	6.85	6.37½	8.00
Spelter	7.75	7.50	10.00

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Feb. 21, 1918	One Month Ago	One Year Ago	Feb. 21, 1918	One Year Ago	Feb. 21, 1918	One Year Ago
Copper sheets, base.	31.50-33.00	35.50	42.00	32.50	44.00	36.00	43.00
Copper wire (carload lots	32.00	32.00	36.00	28.50	44.00	34.50	37.00
Brass pipe base....	36.50	36.00	47.50	35.50	52.00	41.50	46.50
Brass sheets	30.75	30.75	45.50	29.00	43.00	35.50	44.00
Solder ½ and ½ (case lots)......	62.00	48.00	28.37½	47.00	27.50	48.75	28.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Feb. 21, 1918	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.. 19.00

	In Casks		Broken Lots	
	Feb. 21, 1918	One Year Ago	Feb. 21, 1918	One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.25	22.50	21.75	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Feb. 21, 1918	One Year Ago
New York	14.00	18.00
Cleveland	17.00	26.00
Chicago	16.00	17.25

A Special Message from the SECRETARY OF WAR.

PLEASE convey to machine-tool builders my appreciation of the co-operation which they have extended to this department in the present emergency.

Many officers of this department have spoken highly of the quality and importance of the services that have been rendered by the tool designers and draftsmen who have been released to the Government by the machine-tool builders in particular and the machine industry in general.

The spirit which prompted the managers of this great fundamental industry to respond to the war department's call for these men is typical of the response of American business and American labor to every appeal of the Government. Men and institutions during this war will be judged by what they have given and the services they have rendered.

We proceed with our plans for the conduct of the war with greater confidence, feeling assured as we do of the complete devotion of those engaged in industry, either as managers or workers, to the great cause for which we are fighting, a world safe for democracy.

A Special Message from the SECRETARY OF THE NAVY.

MACHINERY plays so large a part in modern warfare that the mechanic is as necessary as the soldier and sailor. Navies depend on dreadnoughts and destroyers, guns and torpedoes, seaplanes and engines. Armies depend on artillery and tanks, flying machines and motors. Munition and aircraft factories, shipyards and navy yards must be kept working at full capacity to supply the needs of our armed forces. The man at the machine is as essential as the man behind the gun.

When so many new plants for war work and shipbuilding are being created, calling for vast amounts of machinery for their equipment, it is of prime importance that the machine-tool and machine-building industries keep up the maximum of production. Their hearty response to the heavy demands on their facilities has been gratifying, and the notable increase in output has afforded fresh evidence that the industries of America are never found wanting, when called upon to meet any emergency.

There is no greater machine than the modern battleship; every part of it, from engine to big guns, must work in perfect unison to make it effective. Nearly every vessel has its machine shop, and the Navy takes a pride in its finely equipped repair ships, floating machine shops, which include both brass and iron foundries and many other features. The expansion of our navy yards, which are not only carrying on the large amount of work required to keep our warship and auxiliary vessels in fighting trim and to convert the large number of craft taken over by the Navy into the types needed for naval service, but are building warships of every type, has required the erection of large new foundries and machine shops and the enlargement of those in existence. The number of civilian employees in our yards and stations has doubled in a year, more than 66,000 now being employed. And the Navy is only one of many branches of war work that have had to be supplied with tools and machinery of all kinds.

American inventiveness and enterprise have never failed in any emergency, and I am sure that they can be depended upon to do their full share, and more, in aiding us to win the war.

Josephus Daniels

A Special Message from the CHIEF OF ORDNANCE.

I AM PLEASED to express my appreciation of both the spirit and performance of the machine-tool builders of the United States in co-operating with the Ordnance Department since the declaration of war. Not only have they brought to bear the full output of their own facilities, but they have successfully secured and used other and additional sources of supply.

Not the least valuable portion of their work has been that of time studies for different machine-tool operations, to which effort there has been given a great deal of time and intelligent attention. They have also been very helpful in working out the designs of special tools for particular purposes.

This effective form of co-operation will enable the Ordnance Department to continue and to accelerate the remarkable achievements which have resulted up to the present time.

Great as has been the effort already made, much more is still to be accomplished. It is hoped that the machine-tool builders of the United States will make still further effort to so co-ordinate their facilities that those plants best equipped to carry out certain lines of work, for instance the machining of extremely large pieces, will to as great a degree as possible specialize and concentrate on work of this character.

It is also advisable where the shop is equipped for the more propitious handling of small material that every effort be made to specialize in this regard.

It is a pleasure to be able to give this expression of appreciation.

C B Wheeler

THE FLAG—AND YOU

YOU FLING OUT OLD GLORY; YOU SING HER PROUD STORY;
HER HISTORY THRILLS YOU THROUGH.
IN PEACE, YOU MARCH NEAR HER; YOU BID PEOPLE CHEER HER;
YOU'RE GLAD SHE STANDS GUARD OVER YOU.
BUT, FRIEND, IN WHAT MANNER DO YOU SERVE THE BANNER?
IS YOUR PART JUST PLAUDITS AND BRAG?
DO YOU SEE BUT BEAUTY WHERE OTHERS READ DUTY?

HOW MUCH HAVE YOU PUT IN YOUR FLAG?

'TIS NOT HER STAR CLUSTER, 'TIS NOT HER STRIPES' LUSTER
THAT GIVES HER SUBLIMITY,
OUR BANNER IS HUMAN; STRONG MEN AND BRAVE WOMEN
ARE WROUGHT IN THE FLAG OF THE FREE.
'TIS THE SERVICE THEY RENDER THAT CAUSES HER SPLENDOR
WITHOUT THEM OLD GLORY'S A RAG.
SHE CALLS—FOES ASSAIL HER. WILL YOU HELP—OR FAIL HER?

HOW MUCH WILL YOU GIVE TO YOUR FLAG?

COURTESY OF THE INGERSOLL-RAND CO.

III. The Receiver—II

Important operations covered in this installment include the drilling, reaming and lapping of the small hole or piston bore, the gaging by the holes to test for parallelism, the finish-facing of the ends in the turret lathe, counterboring and recessing for the locking shoulders; finish-milling of the bottom and length-milling of the platform surface. Details are given of machine and hand operations, and of methods of testing and gaging at various points.

THE drilling and reaming of the small hole or piston bore through the receiver, is accomplished on the turret lathe with tools illustrated in Figs. 26 and 27.

The tools consist of a set similar except for size, to those employed in boring the large hole in the receiver as described in the first section of this article. The spotting drill, through drill and machine reamer are seen in the turret toolholders, Fig. 26. The method of locating and holding the receiver will be understood upon examination of the illustration and the line engraving, Fig. 27.

As has already been stated, the large hole through the receiver constitutes the working point and locating medium by which all subsequent operations are positioned and to which various surfaces machined must bear a positive relationship.

In Figs. 26 and 27 is brought out the manner in which the large receiver hole is first made use of for locating the forging for other operations.

Fixture Details: Referring to the line drawing, Fig. 27, it will be seen that the turret-lathe fixture there shown carries a long, hardened and ground arbor which is offset from the center of the fixture and which is used to locate the receiver positively for boring the small hole at the correct location. This locating arbor has a long, straight shank fitting snugly in the head of the cast-iron fixture and further secured by a $\frac{1}{4}$-in. pin driven crosswise through the head and shank as indicated in the drawing, Fig. 27. The arbor has a shoulder of liberal diameter which seats squarely against the face of the fixture head, and the outer end of the arbor is reduced in diameter so as to enter a hardened and ground bushing which is pressed tightly into a machine-steel guide plate located by dowels at the front end of the fixture. The guide plate is further held to the fixture by a wing-head or flatted-head screw which, when given one-quarter turn to align with a slot in the plate, permits the plate to be removed or replaced.

In the head of the fixture at *A* is a centrally located plug, which fits into a bushing in the fixture bore, both plug and bushing being of tool steel hardened and ground. The handle of the plug is knurled, and the exposed body portion of the plug is $\frac{5}{8}$ in. long. When the receiver comes to this fixture with the large hole finished as previously described, it is ready to be placed over the locating arbor *B* for the drilling and reaming of the small hole or piston bore; and as this hole like the other is drilled half-way from each end, the short locating plug *A* must be removed from the fixture for the operation of boring the first half of the hole. With the receiver slipped over the long arbor *B*, it is located to bring the second hole into central position in the body of the metal by the two vertical-gage plugs *C*, whose lower ends bear upon the upper surface of the receiver platform where the work is rigidly held against twisting on its arbor by setscrews *D*, located crosswise at the front of the fixture.

The small hole may then be put in part way with the

turret tools, and afterward the work may be reversed end for end, with the short locating plug *A* in place in the fixture, that in the completion of the piston bore in the turret lathe, the receiver may be positively located at the inner end by this auxiliary plug. This procedure brings the two holes in line, and with their centers at the right distance apart.

It will be seen that there are two bushing plates for the front end of the fixture; one of these plates with its guide bushings and dowel-pin bushings being plainly shown on the turret in Fig. 26. The bushing plates are readily changed, the dowel pins which located the plate on the fixture being of unequal length, so that in putting on the plate it starts over one pin first, and thus is guided part way into place before the opposite pin enters its bushing at the other side of the plate.

As in the case of the larger hole in the receiver there are several subsequent machine- and hand-reaming operations in the small bore, the machine-reaming being accomplished in the gun-barrel machine. A detailed drawing of the hand reamer is given in Fig. 28.

Referring again to machine reaming, Fig. 29 is presented at this point to show the fixtures and reamers for this work. Two fixtures will be seen on the gun-barrel reaming machine; one with a receiver in place, the other empty to show the method of locating the work by means of plugs.

At the rear end of the open fixture will be noticed a fixed plug, which is in line with the knurled-handle removable plug in the front of the fixture. At the back and directly beneath the fixed plug there is a guide bushing for another removable plug, which in this view is taken out of its seat. When the receiver is placed in the fixture, the end of the large hole goes over the short plug at the rear of the fixture and the knurled plug in front is slipped into the other end of the bore. The knurled plug at the rear of the fixture is then slipped through into the smaller hole, which is to be reamed, which holds the receiver correctly while thumbscrews at the side are set up against the receiver body, after which the lower plug at the rear of the fixture is withdrawn, leaving the small hole clear for reaming from end to end.

After this machine-reaming operation, the hand reamer, Fig. 28, finishes the hole.

Putting through the two holes in the receiver is a most exacting process. Given a single piece of work of this character and length with two holes to be finished straight from end to end, of exact diameter at all points, to dead-center distances apart at each end, exactly parallel to each other in all places and without twist or deviation, a good toolmaker would consider it a task calling for a high degree of ability and workmanship. The manufacture of such work in large quantities is a mechanical undertaking that cannot be fully appreciated without first-hand observation and study of the methods and equipment that make it possible. It will be understood that shop operations of this character cannot be conducted satisfactorily without the most careful workmanship and closest degree of inspection at various stages, with the aid of accurate systems of gaging.

Some of the gages used during the boring and finishing of the receiver holes are illustrated in Fig. 30. Both large and small holes are tested for diameter and straightness by long standard plug gages which must

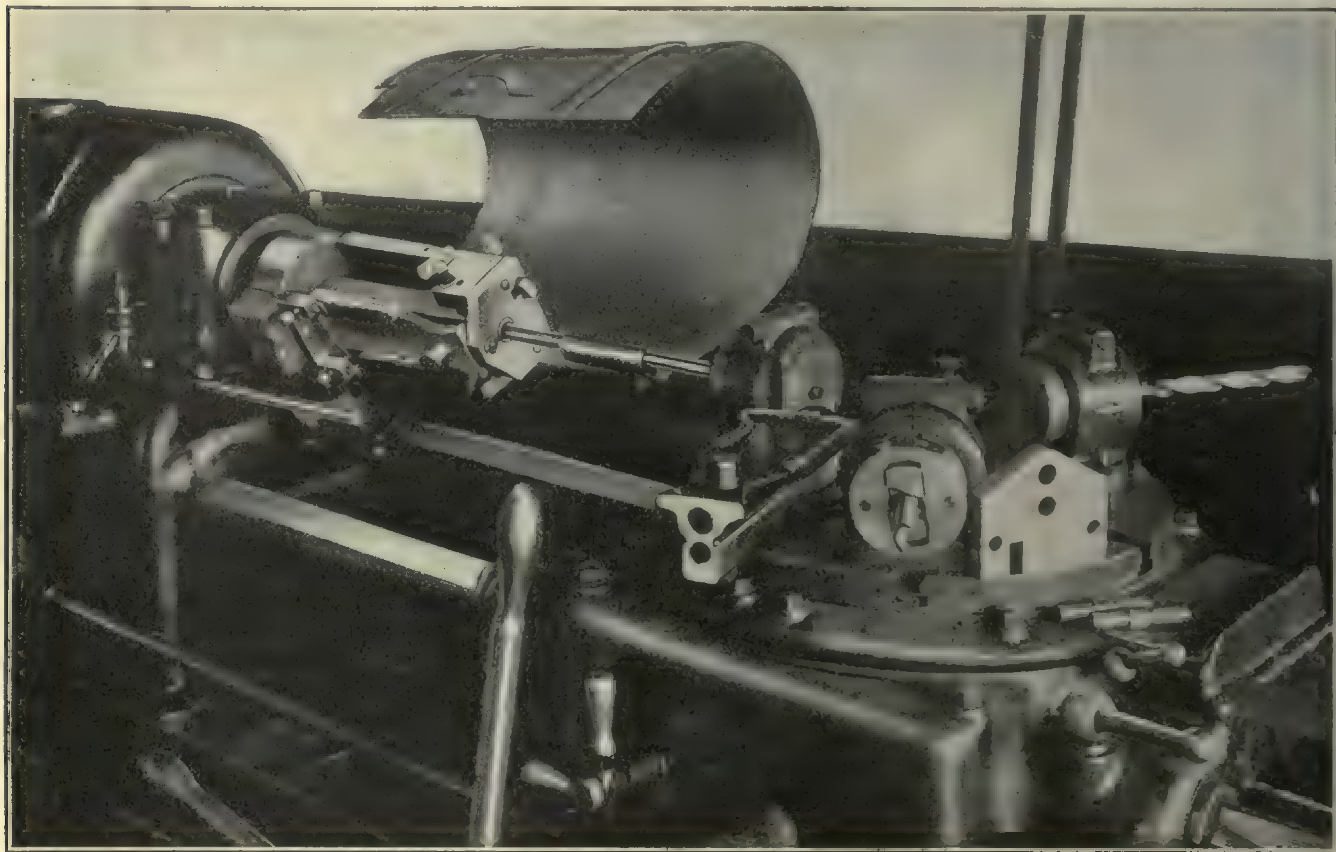


FIG. 26. DRILLING AND REAMING THE SMALL HOLE IN THE TURRET LATHE

pass through the entire length of the bore. One of these long plug gages may be seen in the small hole of the receiver near the front of the bench, in this engraving. The gages for testing the center distance between the holes at each end, consist of two standard plugs located on exact center distance in one gage body.

Two of these combined gages will be noticed on the receiver. With this test, if the holes are out of parallel by even the small part of a thousandth of an inch, the thin gages as feelers under the smaller plugs will immediately disclose the inaccuracy.

This test, it is interesting to note, is not confined alone to the inspection of the receiver after the small hole has been finished to size. Instead, the work is

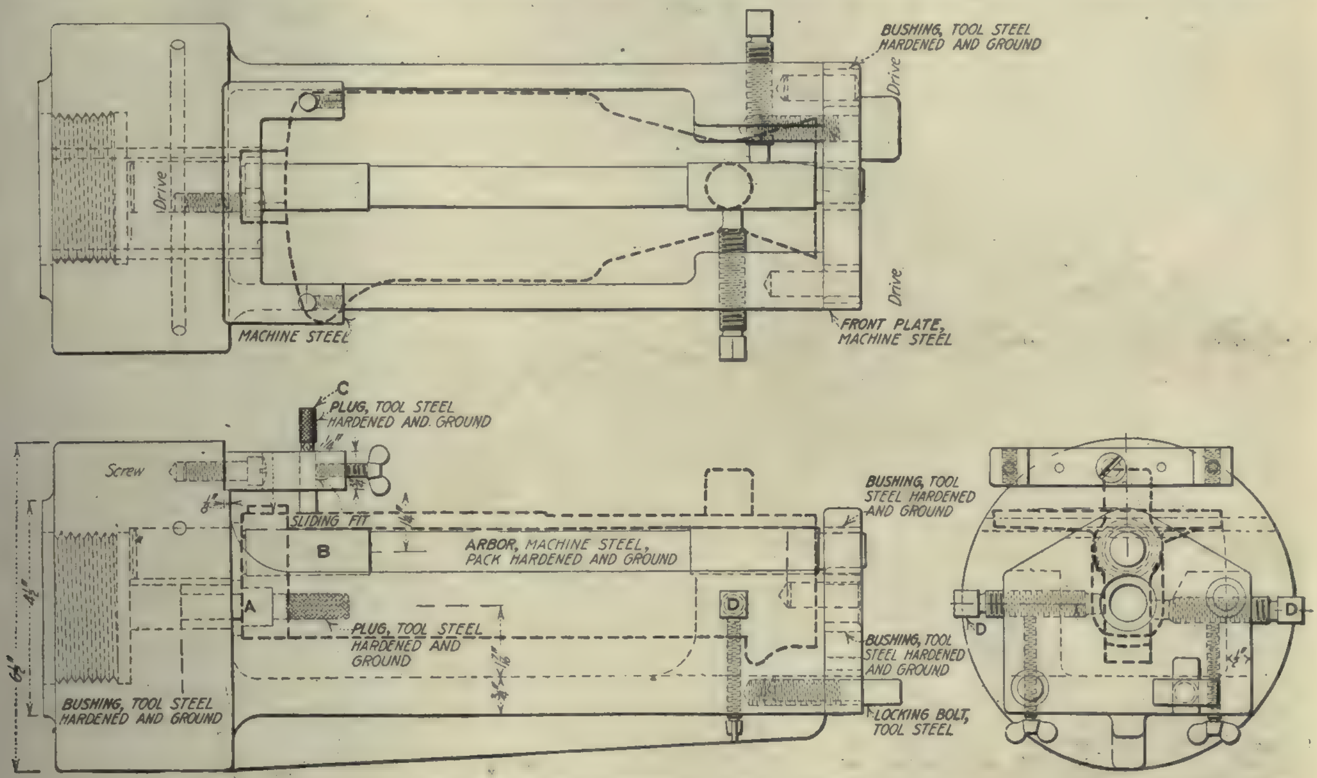


FIG. 27. THE TURRET-LATHE FIXTURE

surface plate, one of them with the plugs entered into the receiver holes.

It is quite conceivable that if tested with these gages, only, the center line of one hole might deviate from the plane through the other center line, or the two lines might cross one another at some point in their lengths and nevertheless the fixed plugs would enter properly at both ends, assuming the correct-center distance was maintained at the mouths of the holes.

In other words, the bores might fail in parallelism with one another without the discrepancy being detected by the center-distance gages alone. Because of this a rigid test for parallelism is applied, which in conjunction with the test just referred to, assures positive accuracy in respect to the foregoing conditions.

The Parallel Test

This test is illustrated in the instance of the receiver shown set up between the blocks on the surface plate. Straight test plugs are placed in both holes with the ends of plugs projecting from both ends of the receiver and the work then rests with the large plugs bearing upon the tops of the two blocks on the surface plate. These blocks are ground to uniform height and their tops form a plane surface upon which thickness gages are placed to test between the small plugs and the blocks. The thickness of these thin test gages added to half the diameter of the small cylinderical plugs, is equal to half the diameter of the large plugs in the main bore of the receiver.

tested in this way at various times during the several processes required in machining the bore. As has been stated, several reaming operations have been applied preliminary to lapping, and all through these stages the accuracy in this respect is checked up by this bench test.

To make this possible, complete sets of test plugs are lapped up in pairs, varying from one pair to another by very minute increments, and these plugs are kept in the cases shown in Fig. 30, so that as the work proceeds, a set of plugs may be selected for fitting the holes and applying the test as represented.

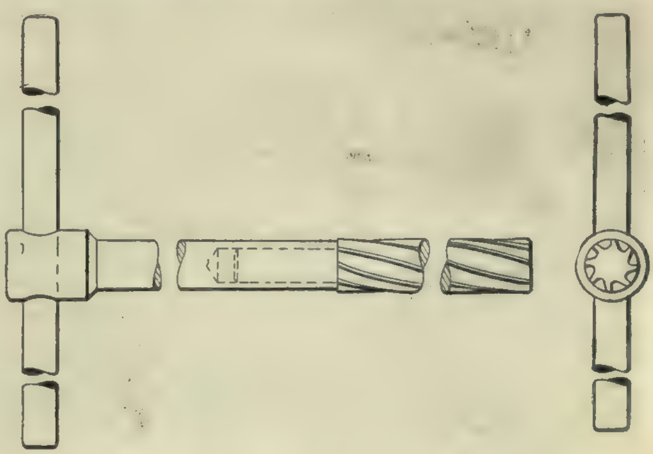
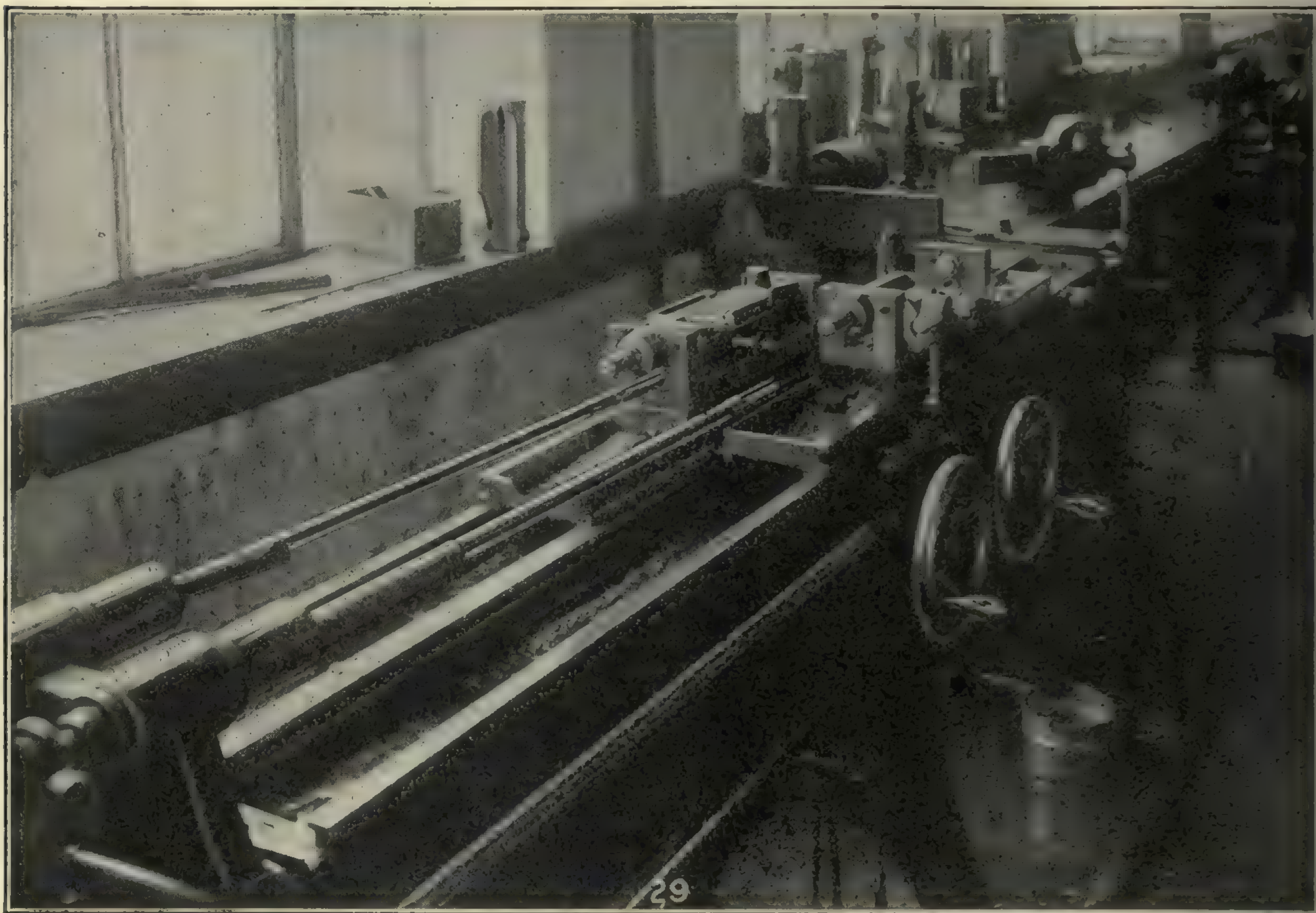
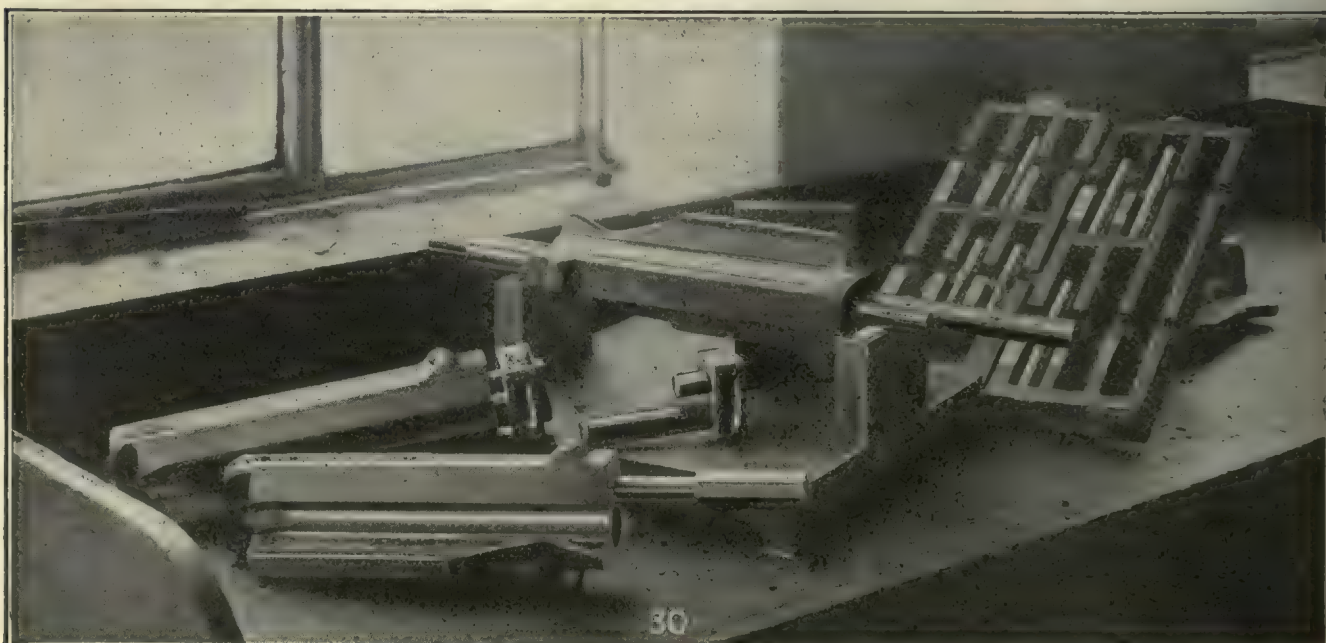


FIG. 28. DETAIL OF HAND REAMER

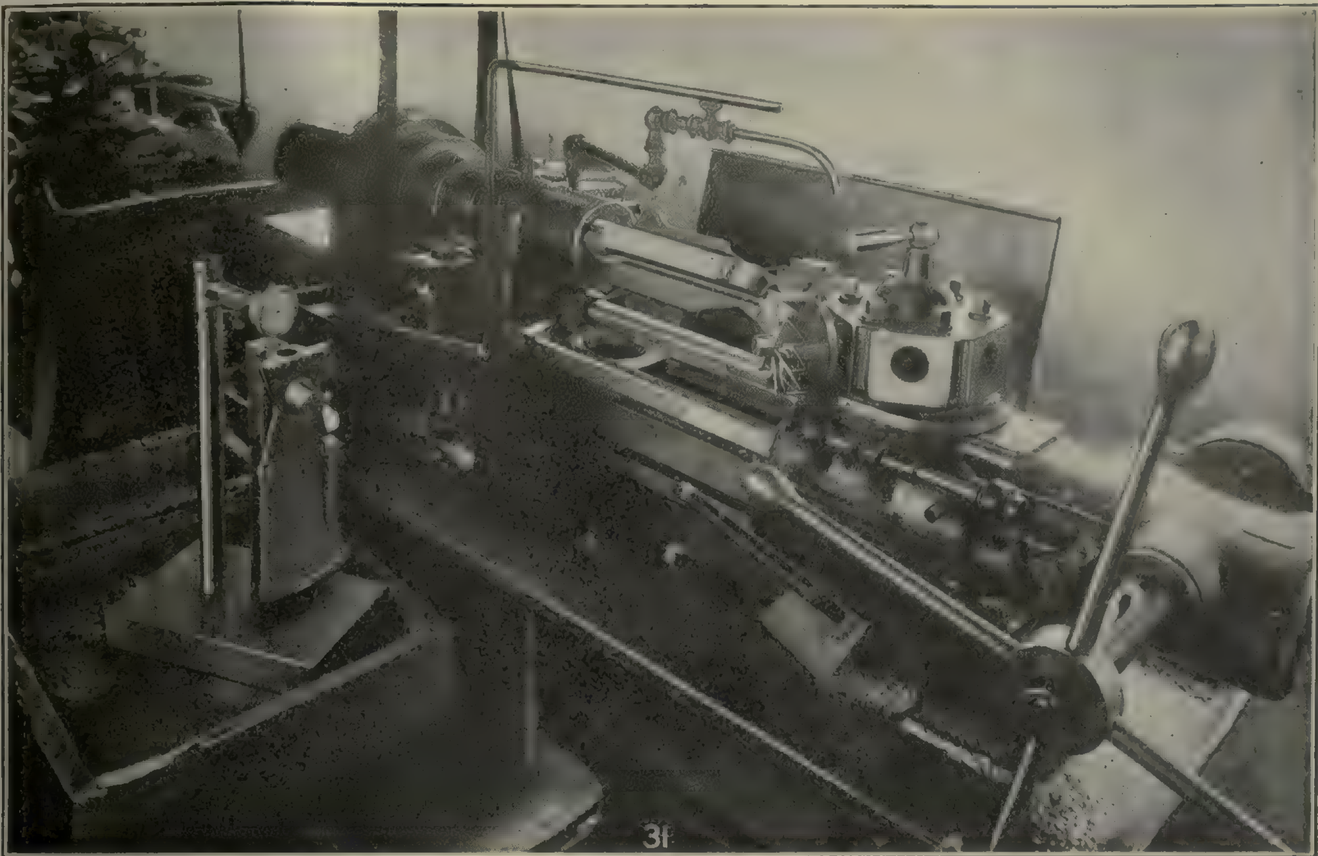
Any discrepancy discovered during these intermediate tests may be corrected in succeeding reaming and lapping operations. In this manner when the final lapping process is concluded, the two holes through the receiver test out accurately in all respects.

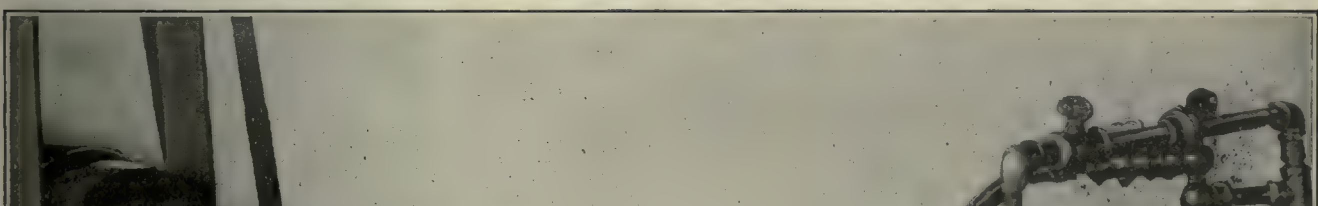
Another feature of the inspection of the receiver on the bench plate is the application of the upright-angle plate or square shown behind the forging in Fig. 30. With the work supported on the plugs as illustrated, the perpendicular edge of the square is brought against the face of the receiver platform to determine if the forging will clean up properly and evenly in the milling and profiling operations that follow. This is merely a safeguard test to eliminate unnecessary work in later operations, and forms a means by which the adjustment of the turret-lathe boring fixtures may be regulated for differ-





FIGS. 29 AND 30. REAMING AND TESTING OPERATIONS





FIGS. 31 AND 32. FINISH FACING THE ENDS AND SOME OF THE COUNTERBORING AND RECESSING TOOLS

ent lots of forgings, that the metal to be afterward milled off may be apportioned properly in relation to the bored holes.

The ends of the receiver forgings are roughed off at the outset with straddle mills as described in the preceding section of this article. After the holes have been bored through and finished, as referred to above, the ends are finish-faced square with the holes in a tur-

ret-lathe operation shown in Fig. 31. That is finish-faced so far as concerns cutting-tool processes, for they are eventually finished dead to length by a grinding process in which a few thousandths of an inch is removed with the wheel.

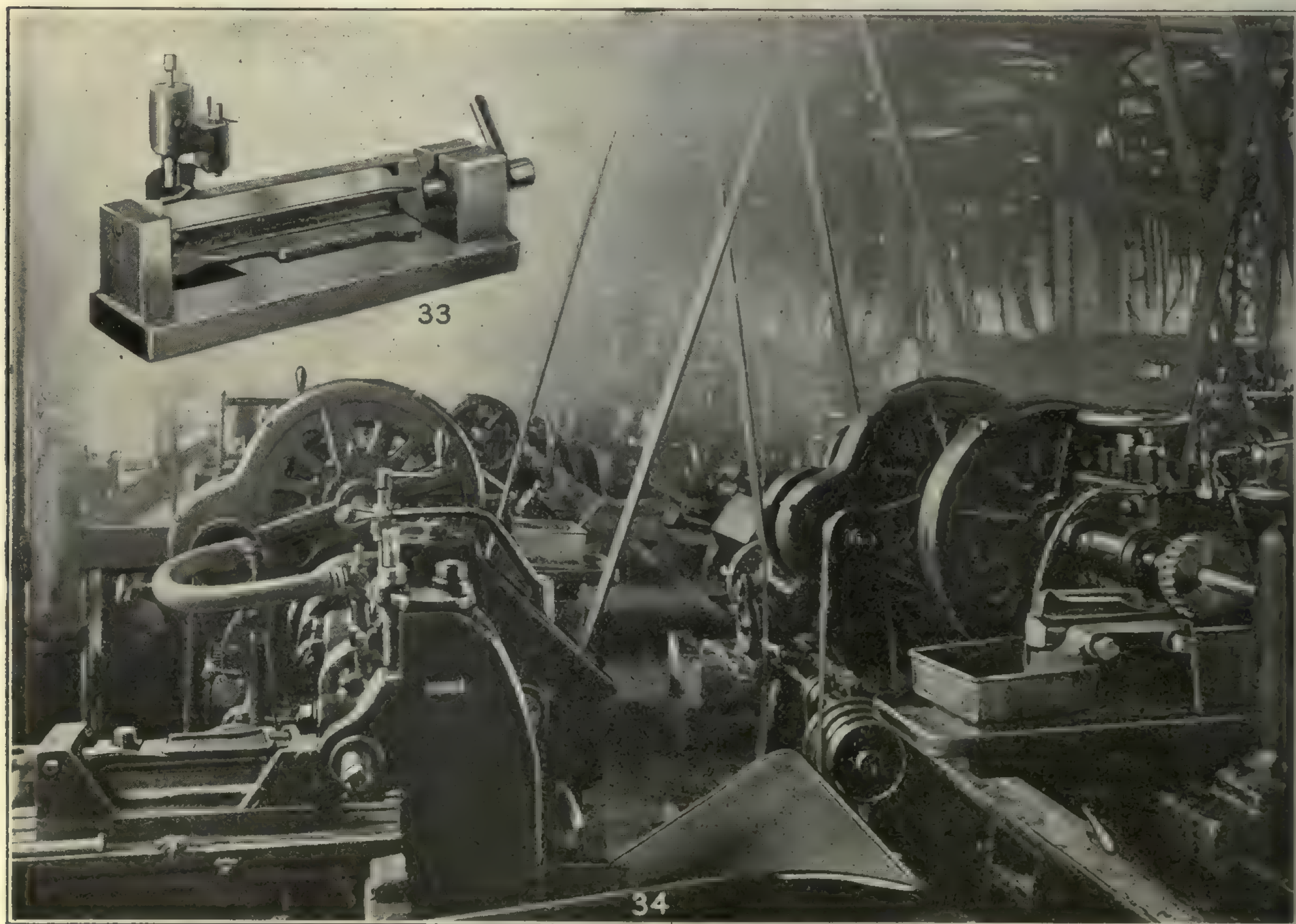
The turret-lathe fixture and facing tools are clearly represented in Fig. 31. Here the receiver is mounted upon a central locating arbor carried in the fixture head which is screwed on the spindle nose, the arbor fitting snugly in the large hole of the receiver. Another short plug in the fixture enters the small hole in the receiver, and a projecting lug on the fixture is adapted to act as a driver and further to steady the work. Two facing cutters are mounted in the turret, each with a pilot to enter the end of the large hole; and the depth to which these cutters can work is positively determined by a rigid stop-bar projecting from the middle of the turret-slide and abutting a large adjustable stop-screw tapped into the front of the head of the machine. With this arrangement it is obvious that the facing tools can work only to the predetermined point, no matter what degree of pressure may be applied to the pilot wheel, as the stop-bar provides a rigid strut between turret-slide and head, and undue pressure of the turret-slide forward, would merely be transmitted directly to the head; then acting upon that member as a whole, further cutting action of the tools upon the end of the work would be prevented.

It has already been stated that after the holes are put through the receivers, the fixtures in which they are later machined are so designed as to serve as a gage and check upon the accuracy of preceding operations.

Thus in the fixture, Fig. 31, the two locating plugs in the head of the fixture, themselves form a gage for the holes in the receiver and for the center distance between these holes. Both ends of the receiver are faced in the same manner. The front end, that is the one shown under operation in Fig. 31, is the important end-surface by which the receiver is located for end-position in other fixtures and operations.

The height gage shown on the stand to the left in Fig. 31 is used to test the length of receiver as faced off in this operation. The gage consists of a heavy baseplate carrying two vertical posts. One of these is really a hardened and ground vertical test plug, lapped off at the top to the standard height of a receiver when completely finished; and over this plug the receiver taken from the turret lathe is slipped, as shown for the application of the test for length over all. This test is made with a dial gage supported by an arm on the post at the rear. The gage is swung over the vertical plug for setting and then swung back into contact with the receiver end, to test its height over all from the gage base. Whatever allowance is desired for end-grinding can thus be provided for under this test.

After the receiver has been faced on the ends it is ready for the recessing of the grooves in the larger hole and for counterboring the front end operations, which are performed with the turret tools in Fig. 32. The fixture for this work holds the receiver in the same way



FIGS. 33 AND 34. GAGE FOR A RECEIVER BOTTOM AND THE LENGTH MILLING OPERATION ON THE PLATFORM

as the work is held for the end-facing operation; a central locating arbor being part of the apparatus as in the other case. The counterbore and the recessing tools are provided with substantial, adjustable stop-collars for positively determining the depths to which the tools are to be operated.

One of the counterbores which enlarge the front end of the hole for the fit of barrel and thread, is shown in line with the work in the illustration. The two recessing tools which form the locking grooves near the middle of the length of the bore, are in place in the turret directly in front of the observer. These tools have to be run into the hole a distance of over 5¾ in. for the cutting of the recess, and when in place with stop-collars against the front end of the receiver, the recessing cutter is fed into the metal by a movement controlled by the handle seen just behind the collars. The locking shoulder formed by this cut must be exact in position from the front end of the receiver, and the recessing tools are so adjusted as to leave a small amount of metal to be finished later by an internal grinding operation.

After this work of counterboring and recessing has been done in the turret lathe, Fig. 32, the receiver is taken to the bench, and hand tools of similar nature to those in the turret are applied for scraping out and touching the shoulders to insure these cuts coming to gage. A very complete set of gages is used in connection with the work, and these testing tools are shown in their case in Fig. 32.

The method of keeping these gages in recesses formed in a wooden frame or case, is generally employed for tools of this character throughout the different departments. There is a definite place for each gage of the set which is indicated by a stamped aluminum plate secured opposite each pocket, and the case thus forms a convenient device for handling a set of gages in a manner that leaves little possibility of any of them becoming misplaced or lost.

The set of gages shown, includes limit plugs for the counterbored openings, depth gages for the counterbored shoulders, etc. The micrometer gage at the right is a depth-tool for testing the position of the locking-shoulder recess in the larger hole.

This has the usual micrometer head and cross-bar for depth gaging, while the spindle carries a long auxiliary spindle with enlarged end for contacting with the shoulder formed by the recessing tools. Other gages of an interesting nature are included in the set, each for its specific purpose and all made to a high degree of refinement.

The receiver now passes through some important milling operations in which a number of interesting fixtures and milling devices are used. In the first of these milling cuts the bottom of the receiver is surfaced and the spring-case lug at the front end of the bottom surface is formed to shape. The nature of this cut will be understood upon reference to Fig. 33, which shows the gage for testing the bottom cut and the contour of the lug.

The gaging fixture locates the receiver bottom up, by a long arbor which is slipped through the large hole, and by a short plug which enters the front end of the small hole. The front end of the receiver is held against the inner face of the left-hand upright on the fixture, and the contour gage for the lug is then pushed down over the work to test the lug outline. The flat gage for this purpose is fixed in a round plug which is moved up and down in its seat in the fixture head, by the small knurled-head spindle above. This spindle has a shallow flat notch in its side, the lower edge of which comes flush with the top face of the gage head when the lug being tested is of correct height. The two small plugs at the right of the lug gage are flush pin gages for testing the accuracy of the finished portion of the receiver bottom, immediately adjacent to the lug.

These flush pins when slipped down into contact with work finished to the exact height, have their upper ends dead flush with the flat surface of the head in which they are carried. The pins are moved up and down by small cross-pins fitted near the upper ends of the flush pins, and they slide in vertical clearance slots milled part way down the head. It may be stated here that flush pin gages of various types are used extensively throughout the plant, and several illustrations of such tools will be presented later.

The next machine operation on the receiver is the milling of the top of the platform which is accomplished in the machine shown to the left, in Fig. 34. The platform surface to be milled is in the general form of a flat ledge extending in U shape from the back of the receiver to a point about midway of the length of the forging.

The work is held in its fixture by locating plugs and clamping device through the holes, so that the top surface of the platform is milled parallel to the main hole. A plain milling cutter is used in the operation.

We have got to win this war

Aircraft Inventors to Submit Ideas

The National Advisory Committee for Aëronautics issues the following statement:

All parties desiring to bring to the attention of the Government inventions pertaining to aëronautics, or suggestions for improvements of existing types of aircraft and their appurtenances, are requested to communicate with the National Advisory Committee for Aëronautics, Munsey Building, Washington, D. C., and to submit comprehensive outlines of the proposed devices, together with necessary drawings, data, and the results of tests, if tests have been made.

All such suggestions and inventions are considered confidential, and where devices or suggestions of merit are submitted they are referred to the proper officials with suitable recommendations.

Attention is called to the fact that many devices and proposals are submitted by persons unfamiliar with the principles and practices involved, hence such parties desiring to submit plans or devices should, as far as possible, secure competent scientific and technical advice.


Save Light and Win the War
Set the Time One Hour Ahead and Have More Sunlight for the "Plants"
H·P·PALMER·XVIII

ORDNANCE DEPARTMENT

Handling Ordnance Supplies

SPECIAL CORRESPONDENCE

PERHAPS the most striking example of the almost incredible expansion which the Ordnance Department has undergone, is that of the newly created supply division which came into being on May 23, 1917. To Col., now Gen., C. B. Wheeler was given the task of organizing the new department; and beginning with Capt., now Lieut.-Col., H. K. Hathaway and one stenographer, the supply division has grown until there are at this writing 145 commissioned officers and 862 civilians, with the end not in sight.

It is the duty of the Supply Divison to receive all properly inspected ordnance supplies, to provide suitable storage facilities for them, and to distribute these supplies as requisitions either to army supply depots, or elsewhere. This division must also maintain detailed records of supplies received and issued, of stock on hand and of unfilled requisitions. It must maintain running estimates of future requirements and advise the procuring division concerned, of any threatened shorage.

Training Personnel

This division also had to secure and train the necessary personnel for its own requirements, and to develop, establish and maintain appropriate methods for efficiently accomplishing this work.

In order to do this the division was formed of five sections, A, C, G, P, and S. The A, or Auxiliary Section performs the various routine services such as drafting, typewriting and similar work, and also furnishes emergency clerical assistance for other sections. It provides furniture, office equipment and supplies for the several sections, and secures necessary additions to the civilian personnel.

The C or Construction Section locates, designs, and coöperates with the Quartermaster Department in the supervision of the construction of storehouses and ammunition depots in the United States, and also leases such additional properties as may be required. It also coöperates with the Quartermasters' office in furnishing storage facilities for ordnance depots at cantonments.

The G or General Administration Section plans, supervises and directs the work of the division as a whole, and performs certain routine functions which cannot be readily delegated to other sections. It acts as a connecting link with other military and civil branches of the government, and coöperates with the ordnance depots as to personnel and methods.

The P or Planning and Control Section, handles all routine operations in connection with the procurement, storage and issue of ordnance supplies, and maintains records relating thereto. It also initiates action in case of actual or prospective shortage of any item.

The S or Operating Section directs the operation of all supply division storehouses, and follows up the shipments made under the direction of the supply division. It operates local storerooms for handling printed matter and office supplies, and maintains a close relationship with ordnance depots and points of embarkation.

Each section is divided into various branches, each of these being designated by a suitable symbol and in charge of a responsible head. It is impossible to secure and adequate idea of the work involved in building up such a tremendous organization without spending considerable time in actually watching its operation of handling the great variety of items which come up as a part of the work of today.

Some idea of the complex nature of the problem may be had from the fact that there are approximately 2000 items of major importance, called controlled stores, and perhaps 100,000 minor items, including spare parts of arms and other munitions. These make up a total value of approximately $2,000,000,000 a year, a sum almost unheard of before the war.

The general plan is given in the following outline issued for the guidance of officers and others whose duty it became to familiarize themselves with the work; for it must not be forgotten that here was a new division, established under stress, and with men and women to whom the work evolved was absolutely new. This planning was very largely the work of Lieut.-Col. H. K. Hathaway, whose effort along scientific management lines is too well known to need comment.

Handling of Requisitions

Before the establishment of the Supply Division requisitions were forwarded directly to the several arsenals, and in most cases were filled without reference to this office. This made it difficult, if not wholly impracticable, to maintain any up-to-date central records of supplies on hand or in prospect, and of the amounts issued or to be issued on unfilled requisitions.

Under the present arrangement a central record is maintained of supplies on hand at arsenals and other important storehouses in the United States. Stores in

camp supply and other minor depots are treated as if in process of issuance, and are not carried on the central accounts, although it is expected that certain supplemental records may later be set up to cover supplies on hand at such points.

During the process of centralizing supply control, an arbitrary and temporary distinction is made between Controlled Stores carried on the Central Records, and Miscellaneous Stores for which central records have not yet been established. Ultimately, practically all stores regularly issued to the Service with such frequency will become Controlled.

As it is desirable to avoid confusing the problem of wholesale supply and stock control by running a mass of small requisitions through the central records, each of the storehouses under control has a certain stock of Free Stores set aside for such retail distribution. This stock does not enter into the central control records, is distributed as required to army posts, etc., and is replenished from time to time by requisitions filled from local Controlled Stores in the regular manner.

Eventually it may prove convenient to establish separate retail supply depots, comparable to those at National Army and National Guard Camps, in association with each of the storehouses, in which case the distinction between Free and Controlled stores in the same arsenal or storehouse will vanish.

One form of requisition is shown in Fig. 1, and the various steps in handling a requisition are as follows:

The Audit Branch

1. Indexes and assigns a requisition number to each requisition as received.
2. Acknowledges receipt to requisitioner.
3. Attaches control cards used by the Order of Work Branch in keeping track of progress of work on, and location of requisition.
4. Edits and corrects nomenclature, checks quantities, etc.
5. Establishes priority of issue.
6. Designates the storehouse to make issue, or in special cases calls for direct shipment from manufacturer.

any business. The time lost from misunderstandings of this kind amounts to far more than we are apt to realize. This is being carefully considered, and the names in most common use will be adopted in most cases.

Symbols are also used in each case. Not for the mere sake of having symbols however, but in order that records may be more easily kept and cards punched and sorted on the Powers machines which have been

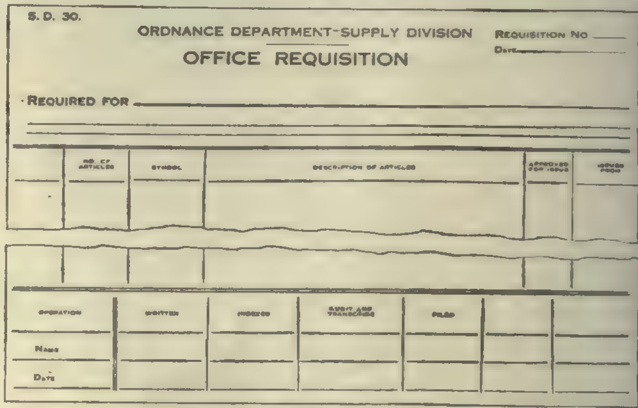


FIG. 1. THE REQUISITION FORM

installed. These save an immense amount of time and enable records to be compiled rapidly and accurately.

The Entry Slip Writing Branch writes a stores issue slip (or entry slip), for each item called for on the requisition transcript.

These slips give the essential information for making the entries on the Balance of Stores sheets, and also are used at the storehouses in connection with making the issues.

The object in writing the slips is that:

1. It permits of bringing together the slips for the same article called for on a number of requisitions, so that entries may be made of all of them on the same Balance of Stores sheet at one time.

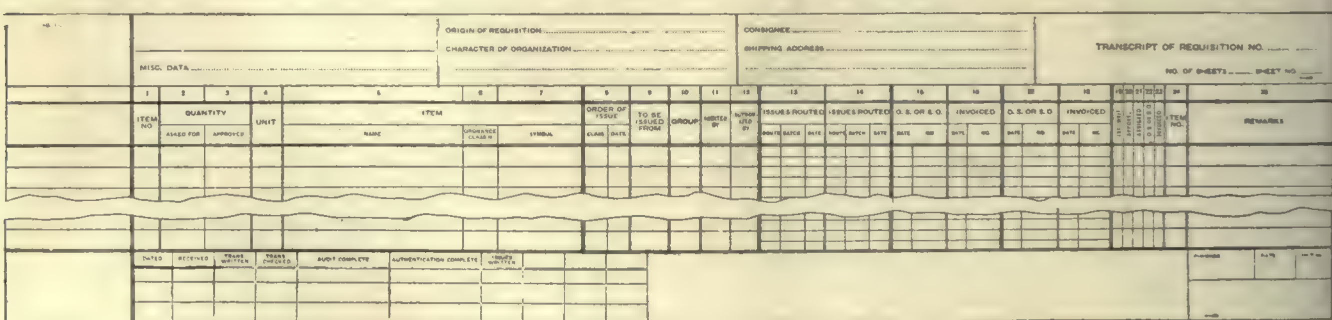


FIG. 2. THE REQUISITION TRANSCRIPT

7. Indicates each item by an abbreviated mnemonic code symbol in order to facilitate subsequent entries on records, statistical tabulations, etc.

The corrected and completed requisition is transcribed on a clean and properly arranged form known as the Requisition Transcript which becomes the working copy, and which is posted to show the status of the requisition at all times up to the shipment of the last item. This sheet is shown in Fig. 2.

The question of nomenclature, as mentioned in item 4, is always more or less puzzling. The naming of articles so that the name means the same thing to different groups of people, is a most difficult task in

2. It avoids the confusion which would result if entries were to be made directly on to the Balance of Stores sheets from the requisition transcripts through a number of clerks, each working on a different requisition, making entries of the same item on the same balance sheet at one time.

3. It permits, as will be seen further on, the issuance of orders for supplies for those items on a requisition which are on hand, and automatically causes orders for supplies of items not on hand at the time requisition was received being issued immediately upon such items becoming available.

4. It facilitates the work of issuing the material at the storehouse, through enabling a number of items on the same order for supplies to be prepared for shipment simultaneously.

Balance of Stores sheets (Perpetual Inventories), are maintained, showing for each item at each storehouse and a summary for all storehouses.

1. The quantity on hand available for issue.
2. The supply in prospect.
3. The quantity apportioned or subject to requisitions.

Form S. D. 21.
Ed. Oct. 19-17—100,000

WEEKLY PROGRESS REPORT
ORDNANCE DEPARTMENT
U. S. ARMY

DIVISION .... SECTION ....

PROCUREMENT ORDER NO .... DATE .... CONTRACT NO. .... DATE ....

NO. SHEETS .... SHEET NO. .... DATE ...., 19......, REPORT NO. ....

MANUFACTURER .... COVERING WORK FROM ...., 19......

LOCATION .... TO ...., 19......, INCLUSIVE

1. ITEM NO.			
2. SYMBOL			
3. QUANTITY ORDERED			
4. DESCRIPTION OF ARTICLE			
5. COMPLETED SINCE LAST REPORT			
6. TOTAL COMPLETED TO DATE			
7. ACCEPTED SINCE LAST REPORT			
8. LOT NUMBERS ASSIGNED			
9. TOTAL ACCEPTED TO DATE			
10. TOTAL SHIPPED SINCE LAST REPORT			
11. TOTAL SHIPPED TO DATE			
12. TOTAL SHIPPING ORDERS WRITTEN			
13. EXPECTED TO BE COMPLETED DURING NEXT TWO WEEKS			
14. EXPECTED NO. PROOF SAMPLES TO BE SHIPPED NEXT TWO WEEKS			

15. DETAILS OF WEEK'S SHIPMENTS

ITEM NO.	DATE	S. O. NO.	QUANTITY	INV. VOUCHER NO.	ITEM NO.	DATE	S. O. NO.	QUANTITY	INV. VOUCHER NO.

16. REMARKS ....

SIGNED .... INSPECTOR.

(Note instructions on back)

3—1097

FIG. 3. THE WEEKLY PROGRESS REPORT

4. The quantity available both on hand and in prospect in excess of apportionments.

The requisition transcripts, together with the stores issue or entry slips, are delivered to the Balance of Stores Branch where:

1. The entry slips for a number of requisitions are sorted so as to bring together all the slips for the same article.
2. These slips are then made up into batches representing a suitable size job.
3. The Balance of Stores sheets for each batch of entry slips are picked out.
4. The job is then assigned to a clerk.
5. The clerk subtracts the quantities called for by each slip from the column showing the balance on hand for the storehouse from which issue is to be made—providing there is a sufficient balance. This operation is called assignment.

If the quantity on hand is insufficient, an addition is made to the column showing apportionments (or obligations). In either case the quantity is subtracted from the column showing quantity available, i. e., on hand plus in prospect.

If balance sheet shows at the top a Minimum Quantity and an Ordering Quantity, if the subtraction from the quantity available brings the balance to a point below the minimum indicated, the balance clerk fills out a Storehouse Requirements Slip which is in effect a requisition against the available supply in a Primary Storehouse or being manufactured, and will result in due course in a shipment being made to the storehouse in question, sufficient to take care of its obligations.

The balance clerk indicates on each issue whether the material has been assigned or apportioned.

6. The balance sheets are then returned to the files, the entry slips are re-sorted according to requisition numbers, and when all of the slips for a given requisition have been returned and brought together, those which have been assigned—i. e., for which material is on hand—are separated from those apportioned: i. e., obligations in excess of quantities on hand.
7. An order for supplies is written covering the items assigned, and is transmitted to the storehouse concerned.
8. The requisition transcript is placed in the file of active transcripts.
9. The apportioned stores issue slips are filed according to article, by symbol, in a file maintained for apportioned items for each storehouse.

As material becomes available to take care of these apportioned items, the slips in question are withdrawn from the files, sent to the balance of Stores Section, are assigned, and orders for supplies are written as already described.

Each action taken with respect to each item is indicated on the requisition transcript, and when shipments are made the stores issue slips are returned by the storehouse, together with a copy of the invoice. These are checked off on the balance sheet and on the requisition transcript.

When every item on a requisition transcript has been actually shipped, the requisition transcript is placed in the permanent files with the original requisition, copies of orders for supplies, invoices, and any correspondence relating thereto, giving a complete history of the transaction.

Duplicate copies of the issue slips pass through the Statistical Branch, from which tabulating machine cards are punched to enable all transactions being analyzed in a multiplicity of ways.

Procurement Orders

Procurement Orders are issued by the Procuring Division for the purchase or manufacture at arsenals of all Ordnance and Ordnance Stores. A copy of each order placed is sent to the Supply Division. The principal stages in the work connected with the handling of a procurement order are as follows:

1. Enter on a Procurement Order Register, which is essentially a journal showing in consecutive order all Procurement Orders placed by each Division, each Procurement Order as received.

2. Fill out and place in a file arranged according to articles, indexed by symbols, a delivery recording sheet for each item covered by the Procurement Order. These sheets provide a running record of deliveries made of the item in question on the Procurement Order to which they apply, these entries being made from Progress Reports received weekly from the inspectors at manufacturing plants.

The Delivery Recording Sheets also show the status of each shipment made: i. e., whether it is being shipped, in transit, at destination waiting to be unloaded, or received and placed in storage.

3. Entries are made on the balance sheets for each item showing the supply in prospect being added to the previous balance of outstanding orders and to the total balance available for taking care of future requirements.

Progress Reports

Each week the inspectors at the various manufacturing plants report progress on each Procurement Order, and one copy of such Progress Reports (Fig. 3) is transmitted to the Supply Division. These reports show:

1. The quantity accepted.
2. The quantity inspected.
3. The quantity finished awaiting inspection.
4. The estimated quantity to be finished during the next two weeks.

The precedure followed by the Supply Division is:

1. Procurement Order and Delivery Record Branch makes entries on Delivery Recording Sheets, Fig. 4.

2. The follow-up and Distribution Branch authorizes the issue of shipping orders covering the quantity reported as becoming available during the next two weeks, taking into account the necessities of each storehouse as indicated by the requirements slip referred to under the heading Requisition Procedure (Balance of Stores Sheet Entries). In conjunction with the requirements slips for the various storehouses, any issue slips marked Direct Shipment are also considered.

3. Shipping orders are written in accordance with the above by the Order Writing Unit of the Supply and Shipping Order Branch.

4. The Traffic Routing Unit indicates the routing, provides any other information required by the inspector at the plant in connection with making shipment, and provides for the reports necessary in following up the shipment.

5. The Stores Unit fills in any information necessary, with respect to weights and space, and posts its records as to storage space at the storehouses affected. It also makes any arrangement that may be necessary for the storage of the materials on arrival.

In case the material covered by a Progress Report as being available is in excess of the requirements as shown by the Storehouse Requirements Slips and Direct Issue Slips, the Storage Unit designates the storehouse to which the shipment is to be made.

6. The Storehouse Requirements Slips are then replaced in a section of the files to indicate materials ordered shipped to storehouses, where they remain until notice of the actual shipment is received from the inspector at the manufacturing plant.

7. Upon receipt of notice of shipment, the Storehouse Requirements Slips covered by the shipment are removed from the file and sent to the Balance of Stores Branch, where the amounts covered are subtracted from the columns showing quantities in prospect, and added to the quantity in the column on hand for issue. This in turn releases the issue slips for items which may have been apportioned as mentioned in connection with the Requisition Procedure.

The combined information from requisitions, procurement orders and progress reports serves as the basis for anticipating shortages immediately in prospect, and initiating such action as is necessary to secure an adequate flow of new supplies. The form of issue slips used is shown in Fig. 5. The first is marked "arsenal," the last "triplicate."

Stenographic and Typewriting Unit

Stenographic work and typewriting is centralized for the entire division. Stenographers are called by one ring, and typists by ringing twice. Approximately a

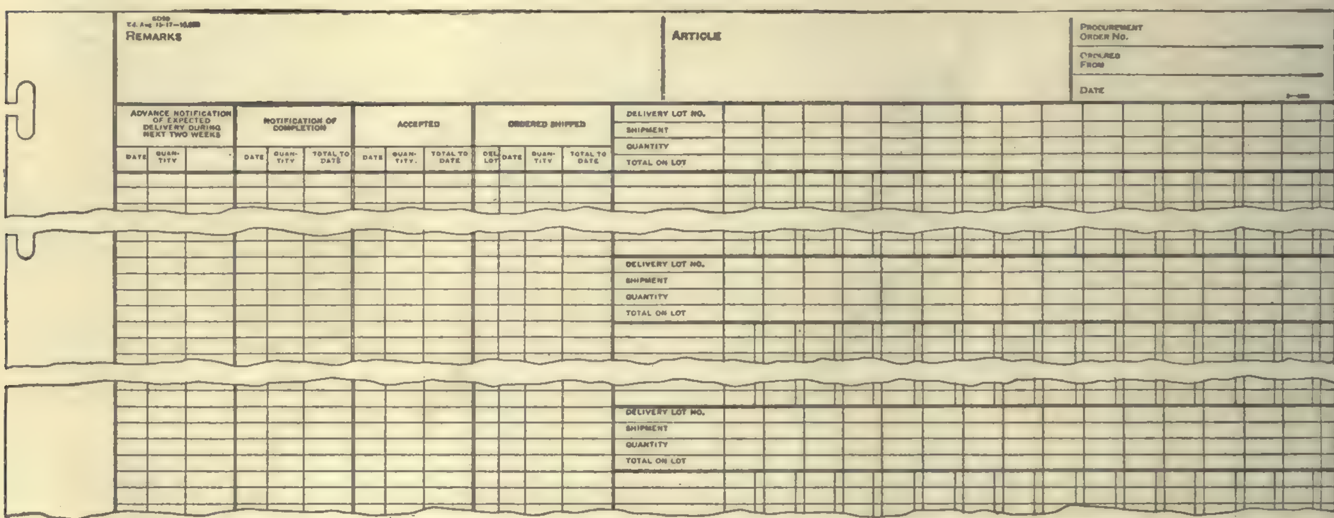
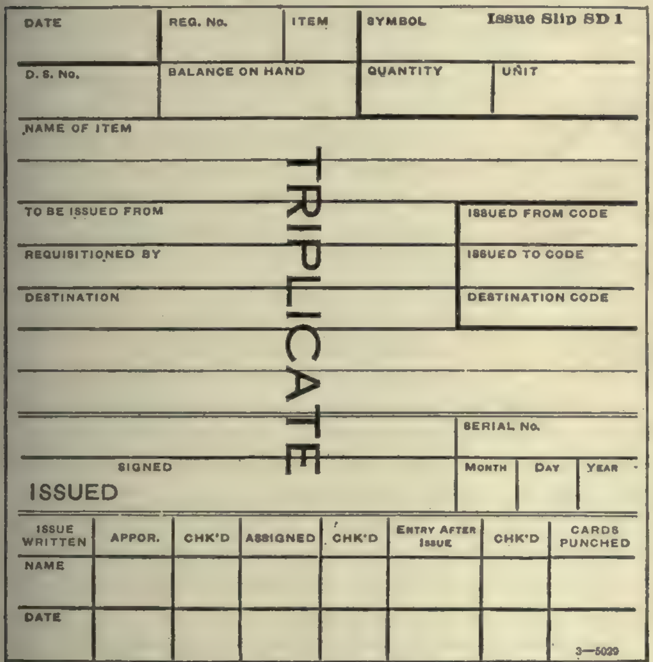


FIG. 4. THE DELIVERY RECORDING SHEET

full force of stenographers and typists is maintained from 9 p.m. to 5 a.m., except on Sundays and holidays. A limited force is also on duty until 11 p.m., week days, and from 9 a.m. to 11 p.m. on Sundays and holidays.

Supply Division

One of the extremely interesting developments of the Supply Division is the way in which it handles its stenographic and typewriting force. Machine dictation was considered to be out of the question owing to the fact that such a large percentage of the men gathered into this department was not familiar with it, and it did not seem feasible to attempt to force innovations at such a critical time. Those who are familiar with the dictaphone wil at once see how its use would have simplified much of the planning necessary to secure an



DATE | REG. No. | ITEM | SYMBOL | Issue Slip SD 1
D. S. No. | BALANCE ON HAND | QUANTITY | UNIT
NAME OF ITEM
TO BE ISSUED FROM | ISSUED FROM CODE
REQUISITIONED BY | ISSUED TO CODE
DESTINATION | DESTINATION CODE
TRIPLICATE
SERIAL No.
SIGNED | MONTH | DAY | YEAR
ISSUED
ISSUE WRITTEN | APPOR. | CHK'D | ASSIGNED | CHK'D | ENTRY AFTER ISSUE | CHK'D | CARDS PUNCHED
NAME
DATE
3—5039

FIG 5. ONE OF THE ISSUE SLIPS

adequate force of stenographers, and to utilize them advantageously.

As all office men know, the dictation is decidedly irregular, depending on the time the mail is received, the amount of investigation necessary before it can be answered, and, lastly, on whether a stenographer is available or not. The demand for stenographers is about as fluctuating as the current served in a street railway power house.

A little investigation, however, gave a fair idea of the hours when the demand is greatest, and the supply was accordingly arranged to meet this demand. The peak loads in the demand for stenographic service is met by having two shifts of stenographers overlap, so that during the period of greatest demand there are more stenographers available than either in the early morning or late afternoon. There are also other shifts, and the Supply Division is not without its stenographic service between 8 a.m. and 11 p.m.; also there are stenographers on hand for any Sunday work which may be desired.

The work is handled by a modification of a train dispatching method, which assists in distributing the work and also preventing favoritism, which is very difficult to avoid in any other way. By the plan of dispatching now in operation, each stenographer is assured of approximately equal practice, and so has the opportunity of becoming expert and familiar with all the various terms used.

Messenger Service

The Messenger Service for the entire division is centralized, and upon push-button call a messenger is assigned from the central station. A record is kept for each messenger showing: (1) calls answered each day; (2) the character of the work; (3) the time away from the central station.

Messengers are under the control of a captain of messengers. Messengers are assigned to answer calls in rotation.

Intra-office Mail

Half-hourly collections are made from the "out" basket on each desk. All papers collected are taken to a central station, where they are sorted for distribution. Distribution of all papers collected is made at half-hourly intervals.

Tickler System Unit

One Tickler System is maintained for the entire division, into which memoranda, copies of letters, etc., may be placed, being marked in such a way as to indicate that they are to be put in the tickler to come out at a given date, and to whom they are to be sent on the date specified. The Tickler will also be used for the purpose of issuing orders covering work to be done at periodical intervals, such as winding clocks, cleaning windows, inspection of various features of the system, inspection of equipment, etc.

Incoming and Outgoing Mail

Mail is received from the Postoffice, sorted, and that for the Supply Division laid aside. Mail for the Supply Division is opened and stamped with a receiving stamp by the Mail Control Desk, which routes and distributes all incoming and outgoing mail, and also registers all incoming and outgoing mail other than routine papers, so that at all times the location of any given piece of mail may be known. The mail is then sorted, and requisitions, forms, etc., immediately dispatched to the section, branch, or unit concerned, without going to the File and Record Room for classification.

A route card, serially numbered, is attached to all incoming mail other than requisitions, forms, etc. All incoming mail with route cards attached is then sent to the File and Record Room for recording, briefing, indexing, etc., and is then returned to the Mail Control Desk, where it is credited to the File and Record Room, routed to the officer in charge of the subject, charged to that officer, and dispatched through the Intra-office Mail Service to the officer in question.

Incoming telegrams receive the same treatment, with the exception that they are sent by special messenger rather than through the intra-office mail. All outgoing mail to which route cards are not attached, and other than requisitions, forms, etc., receives serial number route cards and is sent to the file and record room for indexing, withdrawal of carbons, and mailing. Requisitions, Orders for Supplies and other forms, do

not receive route cards, but are sent to the file and record room for mailing. When papers have been filed or mailed, the route cards are detached and returned to the Mail Control Desk, credited to the File and Record Room, and filed serially.

The main feature of this mail control is the follow-up system which assures mail receiving attention. This is done by a regular follow-up system in which the recipient is charged with all mail going to his desk and is forcibly reminded of his deliquency if he does not act upon it within the specified time. The follow-up clerk has strict orders to be no respecter of persons and in fact he is much more apt to be obliged to remind the higher officials of delay than the others, owing to the great press of business which comes before them.

A similar follow-up system is used in connection with the requisitions and other transactions. Under what is known as the order of work is the routing and following up of all regular transactions such as requisitions and progress reports. These enable the ready location of any given transaction at any time and is a safeguard against loss and delay of orders and correspondence relating to them. This is in itself, a very important feature.

There is also a very complete following-up of requisitions to insure that every item is shipped at the earliest possible date consistent with the comparative urgency of the need of different requisitions. This is in reality the vital part of the whole system, the heart which keeps the body alive by constant circulation. A clogged system cannot function properly and these follow-ups keep everything moving along toward completion.

We have got to win this war

The Price of Democracy

By Frank A. Vanderlip
Chairman, National War Savings Committee
Reprinted from Forbes Magazine.

"Is there anything you want?" said Emerson. "Then pay the price and take it." Always there is something to pay.

This is the great lesson the American people will have to learn. All government is costly. The better it is, the more it costs. In maintaining democracy therefore, the people must be willing to sacrifice more, not less, than in maintaining despotism.

The pearl of great price is never acquired without sacrifice. There is no easy road to anything worth having. Our forefathers paid a price in blood and treasure for the liberty of the nation. If we want to retain that blessing we must be prepared to pay in sacrifice, perhaps more costly and more constant, than our forefathers were forced to pay.

Democracy demands that we be watchful and that we also be prepared to defend it with blood and treasure, and above all that we be willing to give up liberty or life itself for its sake.

If the German Emperor now succeeds in his purpose, the cause of democracy will be thrust backward at least a century; the bloody sacrifice of the French Revolution, the American Revolution and the Civil War will be by so much neutralized, and man will face a future of which another and ultimate struggle for the right of the many will be a part.

President Wilson has said the world must be made safe for democracy. Our country can be made safe in democracy only as each one of our citizens is willing to give up life and liberty and the pursuit of happiness when the welfare of the many demands it.

Flags and patriotic thrills will not win the war, or make the world a safe place for democracy. You and I, the common citizen, must pay for what we get. Everyone must be prepared to give up his own convenience, his comfort, his chance for profit. We must be prepared to do our utmost, be that big or little, to help our Government in this great crisis.

When every man, woman and child in America realizes that a form of government worth while is costly, then will this country and the whole world be made safe for democracy, for what America does this year will decide the fate of the world.

We are in the most fateful and critical hour of the greatest crisis in our history. The cause of civilization will be lost, and lost for generations if lost now. Shall we turn back a hundred years?

Never more truly than today has our national motto possessed its true significance: "United we stand, divided we fall." Democracy's responsibility rests upon you and every loyal American.

The United States Government has now provided a simple and convenient way for every man, woman and child to help win the war by converting the smallest savings into interest-bearing Government obligations.

No greater step in the cause of national thrift, so necessary in the winning of the war, has ever been taken than by the issuance of War Savings Stamps and War Thrift Stamps by the Treasury Department, which are now on sale everywhere.

War Savings are a necessity today. Tomorrow they will be a national asset.

President Wilson sums it up thus: "No one can now be excused or forgiven for ignoring the national obligation to be provident of expenditures, now become a public duty and an emblem of patriotism."

And again: "I suppose not many unfortunate byproducts can come out of the war, but if this country can learn something about saving, it will be worth the cost of the war—I mean the literal cost of it in money and resources."

No one should now dare to say he has a right to spend his money as he chooses.

The greatest help that every individual can give is to waste nothing and save everything.

There can not be absolute distribution of sacrifice in this war, but there can be equal *readiness* to sacrifice. The spirit of sacrifice is accomplished if you have done all you are individually able.

The fullest measure of what we can do is the measure of our responsibility in this war. When each one of our hundred million people sacrifice every interest in the national service, Germany's doom will be sealed.

How the War Has Taught England Coöperation

By WILLIAM PATTEN

The author has gathered at first hand his facts as to the effect of the war on British industry. They are as vital to us as though they dealt with specific improved methods of manufacture, perhaps even more so, for the broader aspects of management and industrial relations are the most important subjects now before us.

SOME of the lessons all manufacturers must learn are beginning to make themselves apparent as time goes on. In Great Britain the principle of voluntary military service fell down under pressure. It is a hopeful sign that it did not receive serious consideration in the United States.

Up to now Great Britain had been depending to a great extent upon the volunteer method of saving food, but conscription has at last been decided upon. In America the capacity of the individual for organized action has been demonstrated in our voluntary rationing. Though the results obtained are as yet far from ideal, they are more than sufficient to show how amenable we are as a people to the principle of voluntary restriction for the common good. How far it may be necessary for the Government to go in the matter of food control remains to be seen. In the field of business regulation, however, it is quite a different story. "Sentimentally," as Gordon Selfridge recently said, "we are at war, but practically we haven't yet got into the fight." The same lack of coördination that necessitated the Government's taking over the railroads is to a greater or lesser extent affecting every industry in the United States today.

We have got to win this war

Yet in England, to meet the inexorable demands of a nation fighting for its life, the Ministry of Munitions has developed efficiency to the *n*th power. The war has taught the British manufacturer the value of team work to an extent not appreciated here, and he is rapidly learning the lesson. For the first time in her industrial life England has grasped what quantity production means. The factories, in which detail has been so organized that the output of munitions can be speeded up to maintain a high and regular quota, will never go back to the conditions that prevailed before the war, for the British manufacturer fully realizes that the plant which can maintain a maximum production of munitions can equally well maintain a maximum production of machinery of all kinds—safety razors, office appliances, low-priced automobiles and tractors, agricultural implements and phonographs.

Two great national bodies have come into existence to plan and coördinate the work of the British manufacturer. One is the Federation of British Industries, which has a membership of 503 firms and 78 trade industries and whose slogan is "Get Together." Its object is to eliminate personal jealousies and harmful competition and to so deal with the problems caused by the war as to enable manufacturers to keep their factories running at high speed all the time.

The other is the British Empire Producers Organization. Its aim is to so stimulate the productivity of the whole empire as to yield the British manufacturer a steady stream of materials of all kinds, to the end that Great Britain may never again be dependent upon the good-will of unfriendly neighbors. This means that American industries must be more closely linked together than ever before. They must increase class efficiency. Organization must be made, as far as possible, automatic. The thing is inevitable. It cannot be reasoned against any more than one could reason against the law of gravitation.

In the *American Machinist*, on page 185, Bryan T. Hawley called attention to a very important feature in quantity production—the necessity of employing inspectors and skilled mechanics to examine all machinery and keep it in repair as an insurance against production hold-up. Under the conditions that now prevail in England, factories under governmental control would prescribe such an inspection at regular intervals as a standard factory practice to be carried out automatically. Why should not manufacturers' associations in the United States get together now and adopt such inspection and repair as standard factory practice and give to all plants adopting it a special efficiency classification by enrolling them in a Class A?

Will manufacturers still continue to be jealous of each other and overlook the world markets that only can be won by specialization and concerted action? England has learned that the day when each producer thought only of himself is over. Circumstances have made the British manufacturer think in terms of national prosperity.

If the experience of Great Britain counts for anything, the unions are going to be very much stronger after the war. It may even be that every workman will be compelled to join a union and every employer an employers' federation. There will be more standardized practice than ever before as the result of such classification. It has got to come if it is desired to increase efficiency. But we ought not wait until after the war to make a beginning.

Someone has said that preparedness is the most important word in the business vocabulary today. Back of preparedness, however, is the thing that makes it nationally possible, and that is coöperation.

In war time, with limited supplies of materials confronting nearly everybody, manufacturers can coöperate

in a very effective way by restricting purchases to actual requirements and by adopting a standardized practice as to the return of empties and containers.

Before the Government took over the railroads the charge for demurrage was increased in order to hasten the return of empty cars. Though it had some effect, the coal shortage of this winter was sufficient proof that, as a measure, it had failed. The same indifference to the subject of empty containers has been observed in other industries. The big manufacturers of oxygen, acetylene and other gases have had their troubles. The breweries charge for their barrels and cases, but in the case of oxygen, for example, the leading manufacturer has had to advertise to its customers, through the trade papers, calling for "fifty-fifty" coöperation in the matter of returning empties. Yet the prompt return of containers is, of course, as important to the consumer as it is to the manufacturer if an uninterrupted service is to be maintained. In the improved and more effectually standardized business practice that is bound to come, and which will enable manufacturers to more effectually increase production and keep down costs, there is room for a more intelligent method of handling empties. Whether the railroads revert to individual ownership after the war or not, it seems probable that, by that time or even sooner, the return of empty cars will be on a very different basis than they have ever been on before. It is quite conceivable that a stiff rental charge may be imposed upon the consignee for delays instead of a nominal demurrage.

What we have accomplished in the past is as nothing to what we must accomplish in the future. The lesson the boys in the army and navy are learning is the lesson manufacturers must learn—the repression of individualism and selfishness, thorough organization of detail in a standardized practice and a spirit of real coöperation.

We have got to win this war

Fuel Shortage and the Remedy

BY MATTHEW HARRIS

The whole country is suffering on account of the shortage of fuel for which there would seem to be no excuse.

The blame for this condition is variously laid to freight congestion, shortage of cars, scarcity of labor and the slackening production of the mines while the Government was debating on price.

When the first cold snap hit the country late in December, the first of the fuel shortage was felt, and felt severely. We were told that as soon as the cold snap was over there would be plenty of fuel for everyone and that plans had been matured which would prevent the occurrence of any shortage in the future.

Early in January we had another cold snap and the fuel shortage was greater than before, with very little chance of permanent relief.

Then came Dr. Garfield's order to close down all industries for five days and to have heatless, lightless and workless Mondays for ten weeks.

What is wrong with a plan to put big electric plants at the mines, turning the coal into electricity at the source and sending it over wires to the cities! At the mines there are millions of tons of culm or waste coal that is not worth anything for shipment, but which, with properly constructed furnaces, could be converted into electricity at a very nominal cost.

This would relieve the railroads of a large percentage of the coal-carrying burden, while the traffic necessary to the hauling of coal and the removing of ashes in the cities would be eliminated. This would save much of our traffic congestion in the city streets and a tremendous amount of the wear and tear of our roadbeds. In New York alone this would mean that 50,000 tons of coal and ashes per day would not have to be hauled through the streets. Cities that are too far away from the coal mines to permit the economical carrying of electric current to their doors could build large electric plants on their outskirts and furnish the residents with electric heat as well as with power and light. Objections may be raised to this plan, on the ground that coal will have to be transported to these plants by the railroads and congestion of traffic would periodically occur; but now that the Government has assumed charge of the railroads, it could unify some of the coal-carrying roads into one system for this purpose, and let the other parallel roads carry the freight of commerce.

At any rate if the coal used for all purposes was burned in large plants, the tonnage required would not be more than sixty per cent. of that now used.

Cities the size of New York, Philadelphia, Boston or Baltimore could build municipal electric plants, build special railroads to the mines for supplying them with fuel, sell electric current to the citizens for much less than they now pay, while still making a handsome profit.

Again, objections may be raised that if the plant should accidentally be put out of commission, everyone would suffer. The answer to this is: "don't put all your eggs in one basket," but build enough plants to supply the needed current in case of such accident.

In addition to producing electric current at the mines, all the available water power of the country should be developed, and hydro-electric plants built to utilize it.

By these two ways nearly the whole Atlantic seaboard could be furnished with power without burning a pound of coal in our cities.

We are told that heat produced from electricity is not economical. It surely is not under present conditions, but if plants using cheap fuel were built on a large enough scale for such service, a dollar's worth of electricity used for heating purposes would go much farther than a dollar's worth of coal burned for the same purpose in the individual stove or furnace.

If we are to conserve our fuel in the future, and have heat, light and power at a moderate cost, our slogan must be—the total elimination of coal consumption by the individual! By these means alone can the proper conservation of fuel be accomplished and the public be assured of a plentiful supply of heat, light and power.

"Carry On, Mates"

The following poem was written by Lieut. Martin Fitzgerald, M. G. G., an English machine gun operator, while in the hospital from wounds received in the trenches.

'ERE AM I sweating my bloomin' soul out
All for a moldy bob a day. A bob
A day, aye, a bob a day and night as well.
No eight or ten hours a day for poor me
With a 'arf 'oliday thrown in as well.
Not an hour in the bloomin' twenty-four
Can I call my soul my own. Sentry-go
And fatigue, fatigue and sentry-go, till
You prop yer eyelids with matches to keep
Them from shutting right down, or for a change
You sweat up and down a muddy, bloody
Trench with a few ton weight on your aching back.
Mud to the middle, pulling one foot out
And then the other, feeling like a dam' fly
Stuck in the bloomin' fly-paper. Strike, you say!
Not bloody likely! The rations and "am-mo"
Must get up the dam' line to feed ourselves
And our friend Fritz, if I drop dead in my
Muddy bloody tracks. Then for variety
You shin over the bloomin' top, yer 'eart
In yer mouth and 'ate in yer 'eart, over
That devil's spit, No Man's Land, to pay our
Afternoon-tea call to old Fritz, or else
We're busy welcoming visitors that
Come without asking, with machine gun,
Rifle, bayonet, and bomb. What a life,
All for a blinking, moldy bob a day!

* * * *

MATES OF MINE, who make the "iron rations"
For old Fritz, you are 'ome in old Blighty
With women and beer and baccy galore.
They say you strike; well, may Gawd strike them
What told you to! What, mate, would you stab
Yer old pal in the back, and join 'ands
With old Fritz against me, me, your old pal,
Me, who gives my life and strength and blood
To keep you, the gals, and kiddies safe at home?
Strike me pink! you can't do it, not on yer life!
For Gawd's sake, play the game, don't fail us now
When we've gripped tight with the devil and strain
Every nerve for the strangle-'old, to crush him
Once and for all; don't stab me in the back
And help him free again. You can't, by the blood
Of those mates of ours who've paid the price,
Who have gone West. They'll curse you from 'eaven
And 'ell as I shall curse you from this bloody,
Battered line.

* * * *

CARRY ON, pals of mine!
If there is a grievance—wait, 'old your 'and.
Beware of 'ot air and the German gold behind it.
Death makes our vision clearer over 'ere.
And when this bloody war is over I'll come
And side by side we'll stand and see fair play and clean up old, long-outstanding debts.
But now, for Gawd's sake, mates, don't fail me.

Carry on! Carry on!

Manufacturing Base Plugs for the 80 Mark VIII Time Fuse

BY JOHN CAMPBELL

The manufacture of the fuse body is the most difficult part of the fuse, and while its production and components present no unusual difficulty, it is necessary to use extreme care. The base plug is the next most difficult piece, and it is the writer's purpose to describe how one concern produced it.

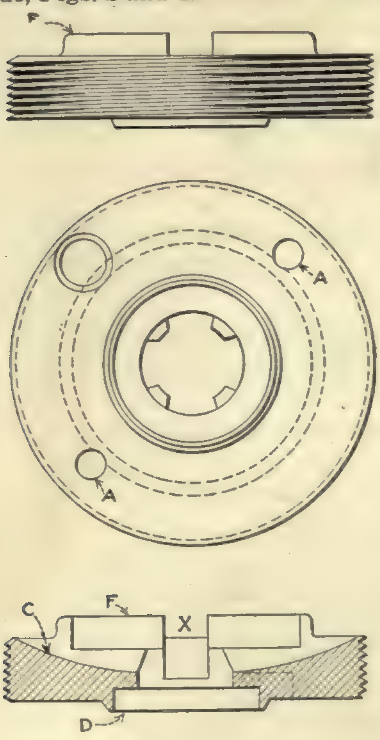
THE plug illustrated in Fig. 1 has five diameters and five depths or thicknesses; with the exception of the slot as shown at *X*, it is formed all over on a six-spindle full-automatic New Britain machine using ¼-in. stock.

The sequence of operations is:

Spindle 1. Stop.

Spindle 2. Rough-drill and form with cross-slide. Tools, Figs. 2 and 3.

Spindle 3. Finish-drill and cut lip on back with cross-slide, Figs. 2 and 4.



BASE PLUG

FIG. I

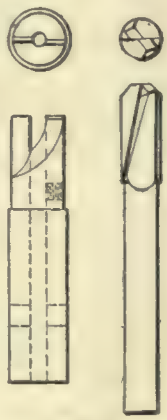


FIG. 2

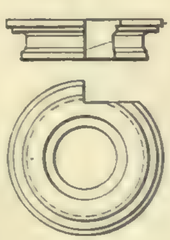


FIG. 3

FIGS. 1 TO 3. THE PLUG, AND SOME OF THE TOOLS USED IN MACHINING IT.

Fig. 1—The plug. Figs. 2 and 3—Three of the cross slide tools.

Spindle 4. Finish front with special floating toolholder. Tool, Fig. 5.

Spindle 5. Thread.

Spindle 6. Burr and cut off on cross-slide. Tool, Fig. 6.

The type of machine used is relatively new, but it has proved efficient on this class of work and other work of 1⅝ in. in diameter and 7 in. in length. There are six holes in the turret or tool slide which is operated by a cam drum. There are three cross-slides and provision for a fourth. The slides operate on the second, third and sixth spindles.

Difficulty was experienced in holding to the specified depths and diameters on the face of the plug, hence, a finishing form tool, Fig. 5, was designed, together with a floating holder, Fig. 7, which was steadied with back-rest rollers. These rollers were adjusted by means of eccentric pins, and the holder was made to float by reducing the diameter of the shank so that it would spring.

The steadyrest gripped over the ends of the spindle caps. The end form tools only removed a few thousandths, consequently there was not much wear. It was found that one set of form tools on this head would not do, as the holder would spring off-center, and the piece would not gage correctly; but after putting two sets of tools in the head, one to balance the other, no trouble was experienced.

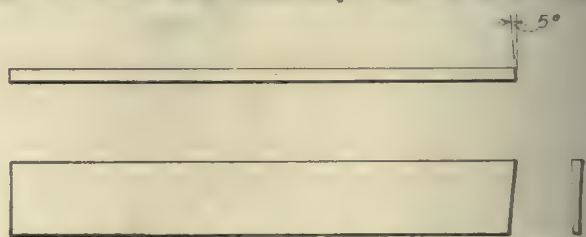


FIG. 4. FORM TOOL FOR LIP "E" ON BACK OF PLUG

The burring tool shown in Fig. 6 removes the burr left by the finishing tools on the top of the ridge shown at *E*, Fig. 1. This burr prevented gaging, and formerly necessitated a hand operation.

A Modern, self-opening type of die head was used, and it was found that if due care was exercised in the grinding of the chasers, a good thread was cut. The form tool for the main diameter was so made that the chamfer left on the plug to help give lead to the die, would allow the chasers to be ground with a 2½-thread lead, and grip nicely. If this angle were not different from the lead on the chasers they would butt up against the plug and make a bad thread.

Gaging Operations

In gaging these operations it was found that the average inspector could not use the official type of gage, but that it was necessary to design a flush-pin type. The reason for poor results from using the official type can only be attributed to the principle which made it necessary to look for light under one part of the gage for the go end, and under another part for the not-go end. The flush-pin type is positive and far quicker.

Another type of gage, Fig. 14, has proved very efficient in that it permits of quick, accurate measurement, whereas the official type is slow and must be turned over for the two tolerances. It also permits, as do the others, of rapid rectification after wear.

The next operation on the plug was putting in the cross-slots or flash vents as shown at *C*, Fig. 1. This is done on an automatic machine having two spindles. One spindle is mounted behind and projects beyond the other, and has an automatic turret for holding four plugs at one time. One spindle puts the slot one way, and when the turret revolves and the other cut is put in, the piece is turned so as to be at right angles to its first position. This machine was made by the Standard Machine Co., Erie, Penn., and the capacity is 5000 plugs in 10 hours.

The next operation is drilling the two wrench holes in the back of the plug, and this is accomplished on

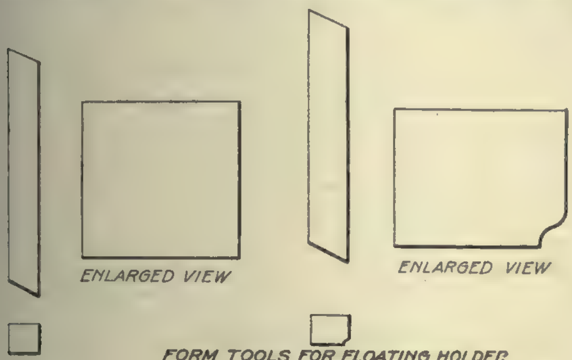


FIG. 5

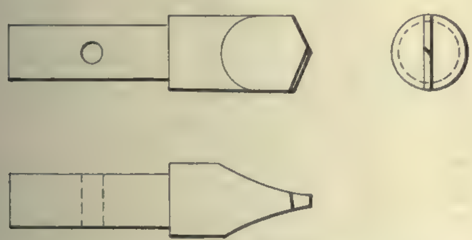


FIG. 6

FIGS. 5 AND 6. TWO OF THE TOOLS USED
Fig. 5—Tools for floating toolholder. Fig. 6—The burring tool.

a Langelier special drilling machine, Fig. 10, which drills the two holes at once. The wrench holes are drilled in relation to the cross-slots, and the locating piece for angularity is a straight rib. Locating for center of drill spindles is accomplished by a cast-iron bushing carried by the drill spindle, which moves vertically by foot pressure. This bushing carries three tapered prongs which do the actual locating.

Drilling for tapping the filling hole is the next operation, and is performed on an Avey drilling machine, the production being 10,000 in 10 hours. The distance of this hole from the center of the plug is very important, as the tap is liable to break through the outside thread or through the recess in the face if not carefully watched. The plug is located by the cross-slots, and the drill rigging needs no comment, as Fig. 11 shows clearly the operation and design.

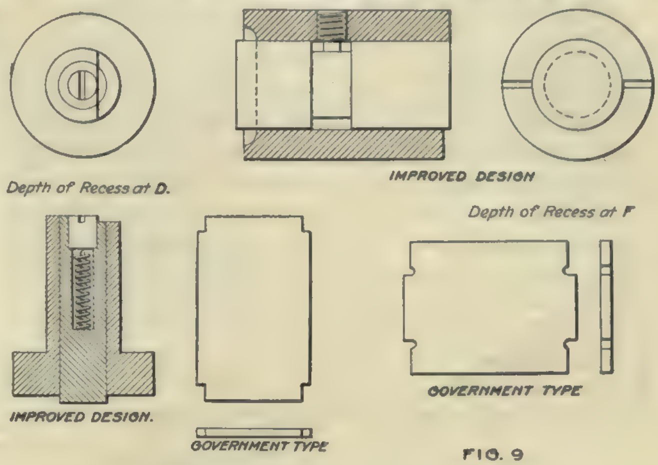


FIG. 8 FIG. 9

FIGS. 8 AND 9. TWO RECESS GAGES

In counterboring the filling hole, the tool was made with a pilot which insured concentricity, and no trouble was experienced when the head of the screw entered the counterbore in assembling. See Fig. 12.

Jig for Counterboring

The jig for this operation is shown in Fig. 13. *A* is the drilling-machine platen, *B* clamps the plug and stops the counterbore at the correct depth by means of *D* on which the regular drill-spindle stop-collar strikes. The spring *E* holds the clamping foot away from the plug at all times, thus permitting the plug to be easily inserted. *F* is a clamping bolt, and the pins *C* are for locating for angularity.

The tapping operation is performed on a Rickert-Schafer vertical tapping machine, the spindle speed being 1100 r.p.m. It was found there was too much variation in commercially-made taps, and that it was necessary to make them within very close limits. A great deal of care was taken in giving instructions to the operators of the machines, to insure that the taps should not be forced either direction, as in our experience it was

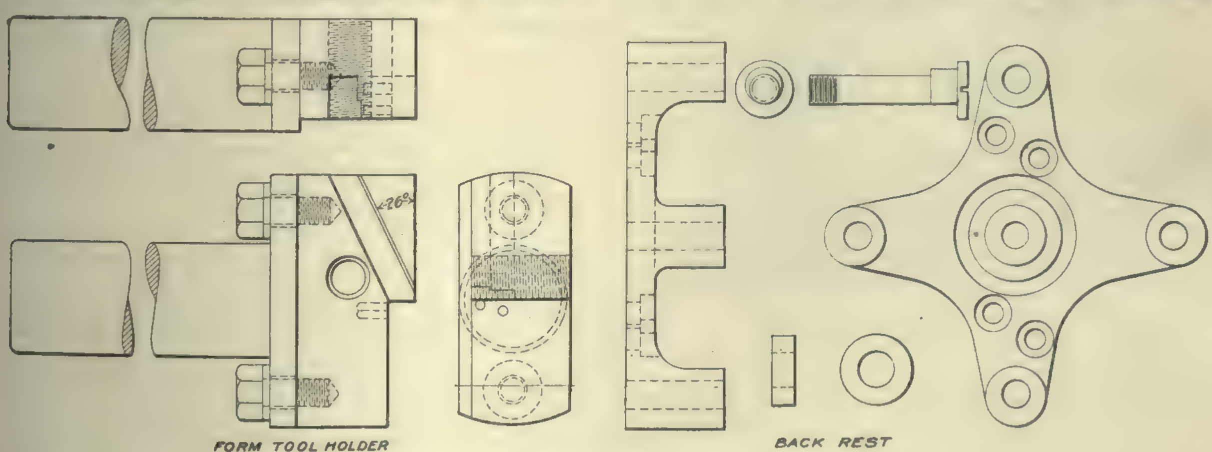


FIG. 7. THE FLOATING TOOLHOLDER

found that trouble was caused by the tap cutting oversize when backing out of the hole. It was finally decided when the machine was reversed, to allow the tap to feed itself out. The capacity of this machine was 6500 per day of 10 hours.

Recessing Operation

After tapping, the plug was recessed on the back as shown at *D*, Fig. 1. The fixture used was similar to that used for counterboring the filling hole: the principal feature being that the stopping of the tool is done from the face from which the gaging takes place. This tool is shown in Fig. 15, and the production from this machine is 15,000 in 10 hours. The operator uses both hands, and a steady jet of air is kept blowing which takes away all chips.

The next operation is removing the burrs caused in milling the cross-slot. These burrs are left at the bottom of recess *F*, shown in Fig. 1. The tool used for their removal is in the nature of an end mill, only having

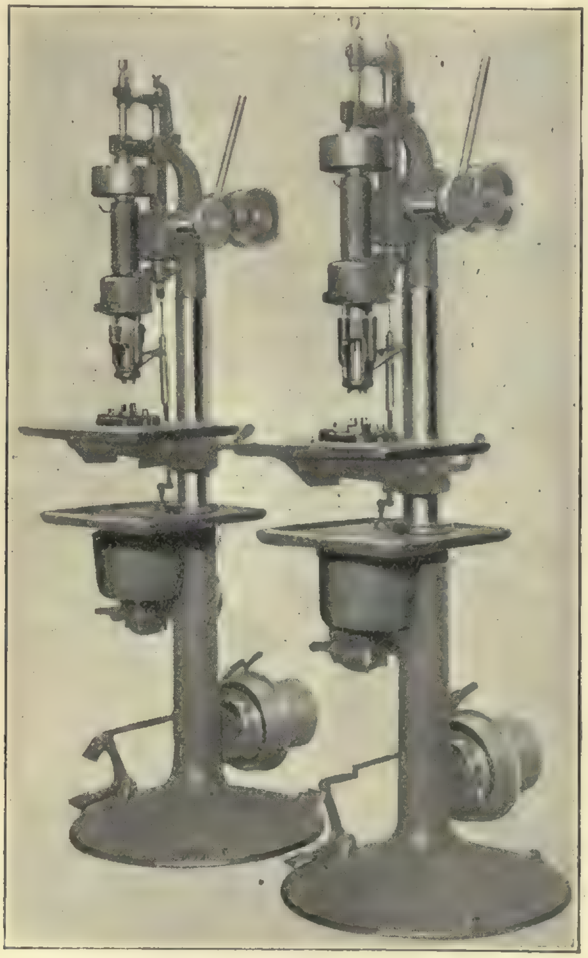
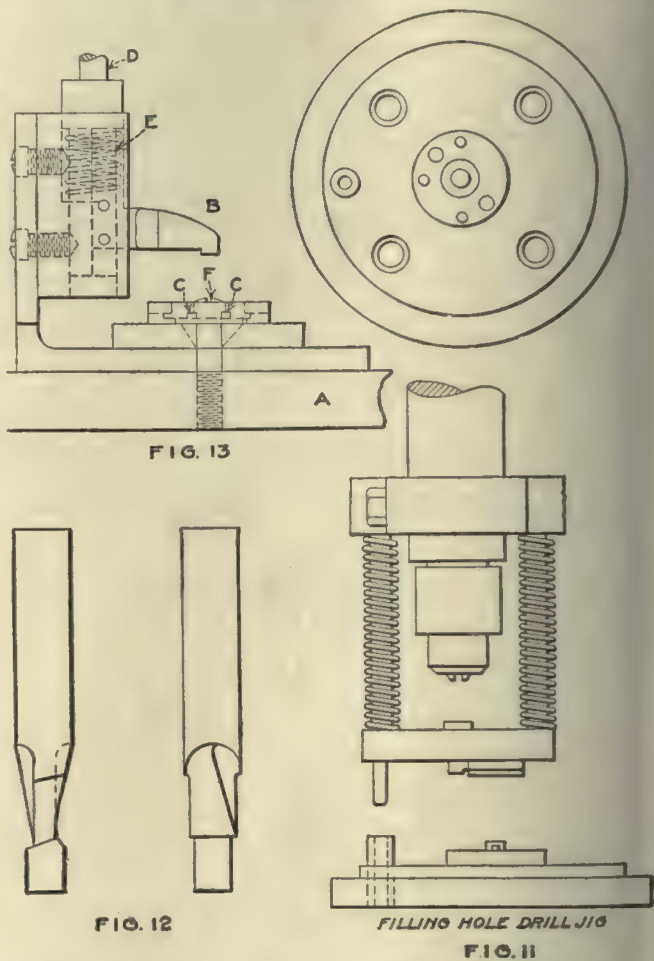


FIG. 10. SPECIAL WRENCH HOLE DRILLING MACHINES

more teeth—the idea being to wear away the burrs rather than to cut them off. The tool is illustrated in Fig. 16.

The maker's name and date is now stamped on the plug, using a Dwight-Slate marking machine, the production being 10,000 in 10 hours.

Other burrs, caused by the cutter shown in Fig. 15, and which are located at the bottom of the cross-slots, are now removed with a burring disk shown in Fig. 17; this disk is run at an average cutting speed consistent with its diameter; but as with the other burring tool, the idea is to wear away the burrs. This tool has about 150 teeth; although in an emergency, standard screw-



FIGS. 11 TO 13. TWO JIGS AND A COUNTERBORE

slotting saws bolted together may be used, and the cutting edge removed with a grinding wheel or coarse stone.

All these operations make it necessary to do a lo of handling, and this causes the fine threads on th

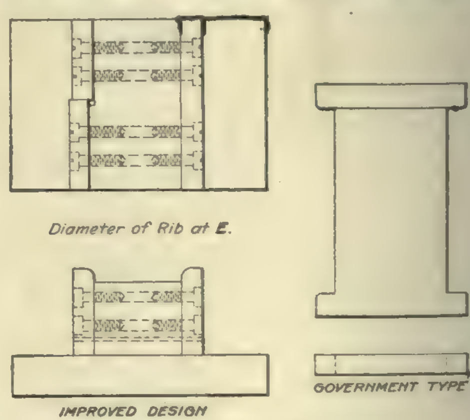
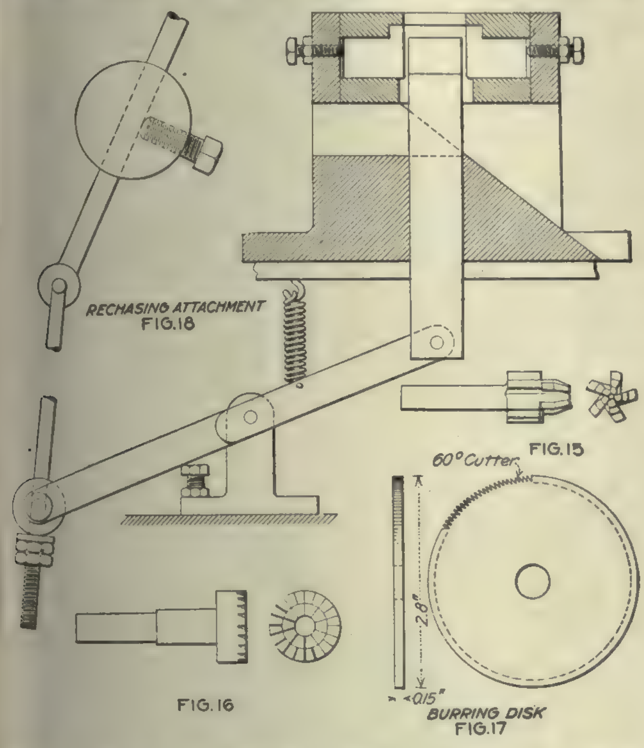


FIG. 14. GAGES FOR RIB DIAMETER

outside of plugs to become dented so that they will n enter the thread gages. This necessitates about per cent. of the plugs being re-threaded. The riggir shown in Fig. 18, was made and arranged so th

standard die-head chasers could be used. The plunger running through the center, projects beyond the face of fixture and the plug is placed on the projecting end. As the (butterfly) driver descends, the plunger recedes,



FIGS. 15 TO 18. RECESSING, BURRING AND RECHASING TOOLS

the speed being arranged so there shall be a minimum of stripping or cross threading involved in completing the operation.

Preparing for Workmen To Fill the Machine Shops

The new activities of the Department of Labor, including the Employment Service, cannot fail to have a beneficial effect on the labor situation throughout the country. This will come in several ways. Systematic training and the distribution of labor so as to prevent congestion at one point and scarcity at another, cannot fail to prove beneficial.

The enrollment of workers has already begun in some sections in charge of men experienced in this work. State and municipal employment offices are coöperating with the Government work in many sections. This includes both men and women, each being in charge of specialists.

The following example will illustrate the methods of the Government's employment system, as organized by the Department of Labor, on the Pacific Coast:

Assuming that on a certain day shipyards call upon the branch office at Portland for 50 machinists, and that 25 machinists have registered for employment; that on the same day the district office at Seattle receives similar calls for 150 machinists and has registered 25 machinist applicants for employment. The 50 applicants having been directed to the yards, 150 yet are needed. What is to be done? The district office first has recourse to reports of interior employment offices, received daily. Perhaps these show 50 machinists registered for employment. Telegrams are sent calling these men in, and the yards are notified to hold 50 jobs open for them. Not until the visible supply of unemployed workers, seeking jobs, has thus been exhausted, can the district office go to the records of the Department's registration system: the Public Service Reserve. An examination of the files of the Reserve on this day, may show first, a block of 20 cards, sent in from "A" in Montana, filled out by machinists and indexed in percentages of qualification by the examiner. Inspection of the examiner's entries may disclose that 6 of these registrants came from one plant employing only 12 machinists in all. To call all 6 would obviously disorganize such a plant, hence the district office picks out three, who may be spared without such damage, and calls them. From another plant three have registered, but the examiner has noted that the plant is making gun-carriages. The district office will mark these cards "deferred," until the plant is not engaged in such essential manufacture. Going over the reports sent in by the examiners from various towns, the district office finds the 100 machinists necessary for the day's call, and summons them from less essential industries, with due regard for local business, taking especial care not to injure manufactures of importance to the public interest. By this simple process, which will be directed from Washington and with full consideration of the advice of other departments of the Government, the protection of existing business and transfer from less to more essential industries will be carried out as far as is required.

Because the need is further developed in the Pacific Northwest, the work has commenced there. As rapidly as facilities can be organized elsewhere, the service will be extended similarly to the remainder of the United States. It is hoped that by the time the heavier demand comes in the spring, the employment service will be ready to grasp and cope with the industrial need, to assure a sufficient flow of labor to the points of demand, and care for these workers who may be displaced by coming industrial changes.

Reclamation of Material in the Shop

By H. R. Gilliam

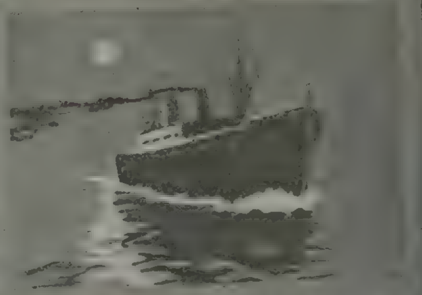
Conservation of materials as well as of time, can be affected to a very appreciable degree in most manufacturing plants, by closer attention to the subject of reclamation. The scrapping of an article in many shops, means its consignment to the junk pile, from whence the chances of its recovery are remote.

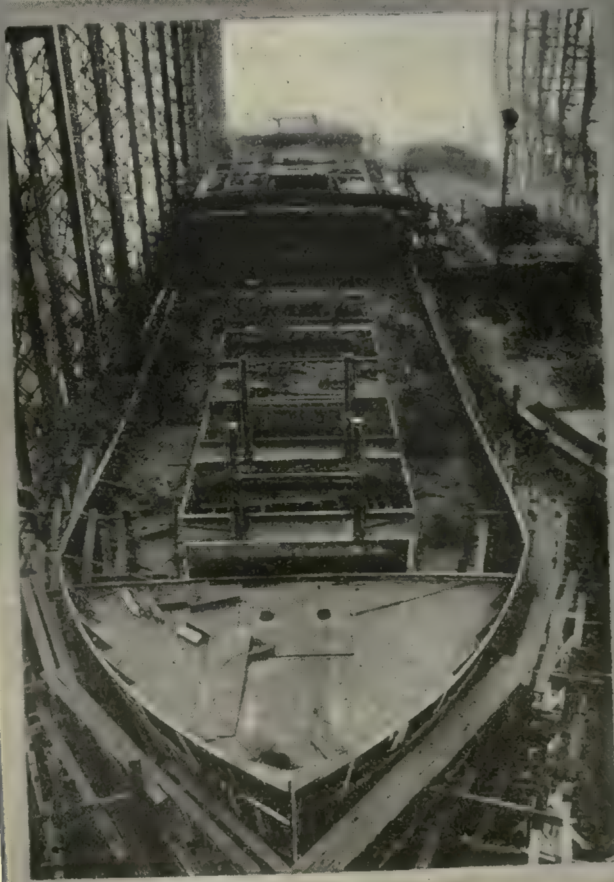
The demands on the producers of unfinished products, are becoming more and more insistent as the war progresses, and the conditions of waste could be reduced considerably if a systematic study were to be made of the general run of parts that form the bulk of scrapped material, and of their potentialities as reclaimed material.

Used bolts form a prolific source of reclamation work, and are easily reworked. Steel T-rails are made to withstand hard usage, while the head split from a heavy steel rail is good material for making stubs for the business end of crowbars, set hammers, and swages for the forge shop, etc. Most of them will take a good temper and will weld readily.

Building Our All-Steel Ships

Laying of Keel





Above: Bow View of Ship Under Construction.

Left: Bow View Showing Progress of Work.

We are all eager to know what is being done to down the Kaiser. The submarine has made serious inroads into the carrying capacity of the world's merchant fleets, and even,

PHOTOS BY NEW YORK SHIPBUILDING CO., CAMDEN, N.J.

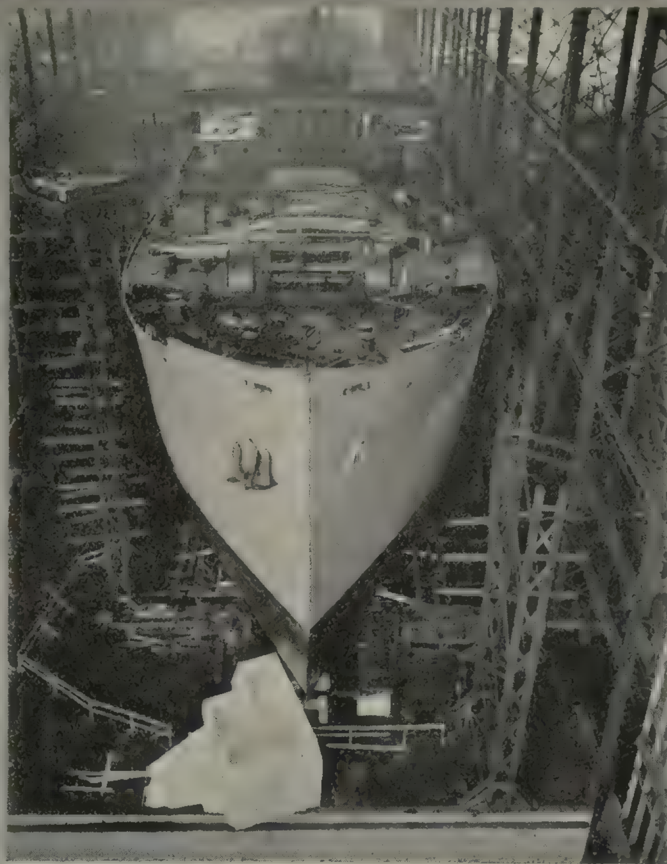
The evolution of a ship from the laying of the keel, on through various stages to the final launching, is here graphically illustrated.

Above: Broad Arrow Taking the Water.

Right: View from Gun Deck Showing Deck Houses.

though the submarines destructiveness be checked, we must have vessels in large numbers. These views show the actual progress being made at one of our large shipyards, in the construction of all-steel cargo-carrying ships.

PHOTOS BY NEW YORK SHIPBUILDING CO., CAMDEN, N.J.



The Broad Arrow Previous to Launching

Training Shipyard Workers

By JAMES A. PRATT
Director Williamson Free School of Mechanical Trades

THE construction of our cargo fleet for transatlantic service has attracted attention to the scarcity of shipyard labor. In seeking a method of overcoming this labor shortage, shipbuilding interests have concluded that some scheme of training must be adopted. Recently a manager of one of the yards which is to devote its attention to the construction of fabricated-steel ships, asked the writer to outline a plan whereby shipyard workmen of the semi-skilled class might be trained quickly and in large numbers. The following article presents the outline as arranged, in so far as the general features of organization are concerned. When the scheme was inaugurated and put in operation there were numbers of applicants for the courses, and the growth of the learners was satisfactory, considering the conditions surrounding the work.

Shipbuilding as Related to the Fabricating Plan of Construction

There has been much comment in the daily press as to what fabricated cargo steamers would look like. The designs of such ships do not show a vessel differing greatly in appearance from any other cargo boat, except that the "shear" is eliminated, which produces a craft having straight fore-and-aft lines, but the introduction of a new type of structure breaks the monotony of the superstructure lines, so that the layman would harlly notice the change in design.

The purpose of the fabricating plan is to expedite construction in that a large part of the ship is simply repetition work. Thus, having set a midship transverse section of framing, other sections of exactly the same elementary form compose the biggest part of the hull. It is evident then that a workman who has learned to construct a midship section can construct the greater portion of such a ship.

Furthermore this plan eliminates the necessity for a great deal of ship fitting in connection with the plating of the hull. Around the bow and stern a considerable amount of plate "lifting" must be done on the first ships; but when correct mold plates have been made up for these shell plates, they may be used repeatedly in a fabricating program. When a large number of ships of one kind are to be built, peculiar advantages accrue in this connection, the reasons for which are readily understood by those acquainted with mass-production methods. This brief explanation of the fabricating scheme of construction will enable the reader more readily to understand the plan of developing learners.

Shipbuilding Vocations

The plan presented does not have as its goal the production of all-around ship mechanics. To illustrate: ship fitters will be trained only as "shell men" or as "interior fitters," and to work on one type of craft. This will necessitate the mastery of a few steps by each class of workers. Furthermore this plan of building several ships of one kind permits keeping a gang of men on one class of work continuously. Thus it is evident that when these details are considered the training time can be greatly reduced. If a training course is carefully arranged and supervised by competent persons, the results obtained will prove remarkable.

A survey of the shipbuilding vocations as related to the construction of fabricated steel ships shows that men must be trained in the following callings: Riveters in gangs, each gang to consist of a heater, a holder-on and a riveter; drillers and reamers; chippers and caulkers; erectors; bolters; ship fitters; acetylene workers; pipe fitters; ship-way carpenters; installation machinists; toolroom attendants and tool repairers; and a number of other callings, such as red-lead painters, bitumastic workers, cementers, etc., which require from one to four days' training.

The first step taken by the writer in laying out the training program was to talk with a number of men concerning the trade of shipbuilding. I selected men who had never been engaged in shipbuilding, as I wished to get the viewpoint of men who knew nothing about the industry. This was important, because it was this class of men that we must train. Having been engaged in marine work at one time, I believed that a course laid out and based solely on my own judgment might leave out some things of importance to the inexperienced man. I found, by means of these conversations, that it would be necessary to teach a number of points which I had previously thought were generally known. First, it was evident that the method of indicating direction on a ship was unknown; the simplest structural features were not understood, and the purpose of very common connecting elements was not appreciated. Secondly, I found that printed descriptions, properly arranged, greatly stimulated interest as well as proving an efficient method of giving information to a large number of persons at one time. It was therefore decided as a first step to prepare a series of pocket textbooks, giving the essential elements of each vocation to be taught, as well as a book of general information. This step was carried out, and the texts proved of great assistance in handling the classes.

The Training Plan

The details of class operation were arranged on the group principle. Briefly stated, the application of this principle arranges the class in groups, each member of which may observe a demonstrator who performs the operation to be taught. The essential details of the vocation are explained in the small textbook which has been mentioned. This is studied before the group takes its place at the demonstration station. After a demonstration and a brief explanation each learner takes his turn of a few minutes in carying out the step. The advantages of this plan are that the learner does not suffer from muscular fatigue, he learns a great deal by watching his comrades, and a large number of persons may be trained with limited equipment. As soon as all learners have mastered a step, the group is advanced to the next step, and the operation before performed is repeated until all the members have mastered the work to be done.

In arranging the steps, the advances of each successive step over the preceding one is very slight, so that at no time does the learner have to master a step totally unrelated to his previous experience. The following outline as laid down for teaching the fundamentals of riveting may be regarded as illustrative:

1. Proper method of picking up the pneumatic hammer.
2. Proper method of connecting hammer to air supply, and of holding same when idle.
3. Cleaning hammer parts, oiling and starting operation.
4. Balancing hammer vertically against a flat plate; right and left hand.
5. Balancing hammer horizontally against a flat plate; right and left hand.
6. Balancing hammer inverted against flat plate; right and left hand.
7. Balancing hammer at an angle, as at bilge; right and left hand.
8. Balancing hammer vertically against jam riveter; right and left hand.
9. Balancing hammer horizontally against jam riveter; right and left hand.
10. Balancing hammer inverted against jam riveter; right and left hand.
11. Balancing hammer on point of cold pneumatically held rivet; all positions.
12. Balancing hammer against cold jam-held rivet; all positions.
13. Staving up the snap point on hot pneumatically held rivets.
14. Staving the raised countersunk point on hot pneumatically held rivets; all positions.
15. Staving the flush countersunk point on hot pneumatically held rivets; all positions.
16. Staving hot snap, raised countersunk and flush countersunk pointed rivets against the jam riveter; all positions.

Study of Manual Operations

A study of the manual operations involved in pneumatic riveting shows that it is not the process of "staving" or forcing down the rivet point which is the difficult task, but the control of the hammer. The course should be developed then to give this control in the least possible time at the smallest expense. It is self-evident that a learner should know how to pick up a hammer without opening the air valve. Uninstructed persons will commonly open the valve when they pick up a hammer; this will shoot the die and piston from the hammer, an ocurrence which is dangerous to fellow workmen, besides oftentimes damaging the die or piston. The workman must know how to hold the hammer properly when it is connected to the air line so that no mishap will occur.

These facts account for steps 1 and 2. Before we start using the tool it must be oiled and the die shank and piston cleaned, so we have a good reason for step 3.

The control of "balancing" of the hammer is a logical step after we know how to hold, connect and care for it. This control we start to develop on a flat plate because this is the easiest place to control the hammer. Furthermore we are not using up any rivets while we are getting this control. Steps 4, 5, 6 and 7 carry the learner through the various fundamental positions which must be assumed in ship-riveting practice.

The sensation of controlling a hammer against a plate surface is very different from that obtained when the hammer is working against one face of a plate and a jam riveter is working against the opposite face of the plate. The jam riveter is a kind of pneumatic hammer which works against the head to "lay the rivet up" while the point is being staved up.

Control of the Hammer

Having control of the hammer against a stationary plate, the learner is ready to take up the control against the vibrating effect produced by the jam machine. This work is done on the flat plate, and all positions are mastered as outlined in steps 8, 9 and 10, when the work of balancing against the rivet is taken up. Slightly more skill is required to balance a hammer on the point of a rivet held up by a pneumatic holder-on than is demanded to control the hammer on a flat plate against the jam riveter. The pneumatic holder-on produces no vibratory effect, but the rivet point is some distance from the surface of the plate, and muscular control must be developed in order to hold the hammer to position. Step 11 carries the learner through the positions of this combination. Following this the learner balances the hammer on the point of a cold rivet held up by the jam riveter in all positions.

With step 13 work with hot rivets is started, steps 13, 14 and 15 taking the learner through the various combinations working against the pneumatic holder-on, while step 16 takes up all positions using hot rivets and working against the jam machine.

This routine covers the essentials of riveting as applied to hull construction, and it can be completed in approximately four weeks of sixty hours each. Experience on the ways will improve the learner, but he leaves the training department sufficiently well fitted for his calling, and will prove a valuable man in the working department of the plant.

The outline of riveting is here presented because it is a typical shipbuilding vocation, and illustrates the process of analysis of the different vocations under view. All vocations may be analyzed in the same manner as described, and the class grouping adapted to the calling to be taught.

Unit Vocations

A study of the vocations listed shows that each one consists of a unit of the shipbuilding industry. The courses are short and intensive, each being devoted to a single branch of a general trade. Broadly trained men may be produced by devoting more time to their training and giving them several of the unit courses.

Neither the unit course nor the group arrangement of classes are new ideas. Unit courses are in common use in all evening and some day vocational schools throughout the country. The group arrangement for classes in industrial work is not so common, though it is in vogue in a number of places for training demonstrators, salesmen, draftsmen and machine operators. The writer's first experience with it was in one of the reformatories in New England, where it was desired to give a maximum of instruction with a minimum of

equipment. Later it was used for training lathe, milling- and grinding-machine operators in the evening classes of a large technical school.

In the organization being described, the size of the groups ranged from five men in the smallest group to 32 in the largest. The size of the group is determined by the refinement of the manual operations involved. Thus, in teaching ship fitters the principles of lifting shell plates, there are a number of minute details and lengthy manual operations which must be viewed at close range and carefully explained in order to be understood. In this class of work, models of the part of the ship to which the plate is fitted are used advantageously, five men working at each model. After the principles are explained and practice had in applying such principles on small models, the class may be arranged in larger groups and the various steps carried out on a large model, or on a ship, for the purpose of developing the learner's assurance. Ship workers may be developed by the same general plan as that by which any other class of workers is developed, namely, by apprenticeship, by a coöperative arrangement, or through the medium of a training school. Whatever scheme is followed the worker must be given the elementary principles as related to the practice of the vocation which he is to follow. The most feasible plan for training a large number of men efficiently and quickly in a short time is the adaptation of certain vocational-school methods, such a school having already been established. The buildings were inexpensive contractors' buildings, about 25 ft. wide, and long enough to serve the immediate needs of the classes being trained. The equipment consisted of a motor-driven air compressor, air piping being laid out to serve the various demonstrating units; a tool-repair outfit and a supply room which contained the necessary pneumatic tools for carrying on shipbuilding, together with ship-erecting equipment and a supply of taps, dies, drills, reamers, etc. The work fore and aft on the ships had been developed on large models during the early weeks of school operation. For the teaching of the elementaries of ship erection, a midship section of twelve frames of the ship to be built was obtained, thus connecting the practice work of the school directly with the construction development on the ways. Later it was hoped that parts of the ship would be available for the various classes of hull workers.

We have got to win this war

The site of the school plant was at some distance from the ways, where reasonable quietness prevailed. One of the great handicaps in teaching vocations in an operating shipyard working on steel construction is the excessive noise which makes it almost impossible to give efficient instruction. Explanations can be given to only one person at a time, and when two or three explanations have been made the teacher becomes so exhausted that he is unable to proceed. The result is, the learner progresses very slowly. In the school plant the work can be controlled by the instructor so that he can be heard by twenty-five or thirty persons, questions may be asked, and difficult points explained.

In speaking of the various shipbuilding operations, one should remember that by far the greater portion of the work is done with pneumatic tools, so a reliable source of compressed air must be provided for in planning a training department. And as all the riveting, drilling, reaming, chipping and caulking work is done with air tools, a great part of the training of the modern shipbuilder must consist in developing the worker's ability to handle pneumatic equipment efficiently.

In any industrial-educational program the amount of productive work which may be done in the training organization always warrants consideration. As a guide in this connection one should keep in mind the fact that training is the important element. If productive work can be done without seriously hampering the development of the learner, then such work could be economically and wisely introduced.

As related to shipbuilding a great deal of this class of work is available. For example, in drilling, reaming, chipping or caulking, it is perfectly feasible, after the learner has become acquainted with the machines, knows how to mount the tools, connect and properly oil and clean the machine, and has gained control of the elements of operation, to send a group of learners to the ways under the supervision of a demonstrator to obtain advanced practice on productive work. In riveting, erecting, carpentering and acetylene work it is possible to engage in productive work quite extensively.

The first steps in the vocations are best taught on work which does not go into the ship. The reason for this lies in the fact that the beginner necessarily makes many mistakes. If he is working on the ship a piece of equipment may be spoiled or badly damaged; if he is working on a demonstrating unit the mistake may be easily corrected because the unit is designed to allow for such errors.

The use of demonstration units is of advantage also because of the time saved in training the worker. When a teacher is working his classes on productive work alone, he hesitates to push the learners on advanced work for fear of spoiling material. He therefore "feels his way," picking out the brighter learners for the more advanced jobs and keeping the duller ones back. This "feeling one's way" is a slow process and quite trying to the teacher as well as to the learner.

With the demonstration-instruction unit, or abstract exercise, this fear is eliminated. The learner may be advanced with confidence, though never carelessly, and given all the instruction he can absorb. If he makes an error his shortcomings may be pointed out and corrected, while the step is repeated. Under these conditions he has neither lost his confidence in his ability to learn nor damaged expensive equipment. As soon as the learner has passed his period of frequent mistakes, he may be advantageously started on productive work.

The amount of time necessary to acquire the fundamentals of the various shipbuilding vocations is important in the consideration of any training scheme.

With a properly arranged course, and the necessary plant equipment, the time given below will be sufficient to develop the various classes of workers for service on the ship ways:

Acetylene workers	4 weeks
Bolters	1 week
Chippers and caulkers	3 weeks
Way carpenters	3 weeks
Drillers and reamers	2 weeks
Erectors	6 weeks
Fitters	6 weeks
Hull engineers	4 weeks
Hull machinists	8 weeks
Pipe fitters	4 weeks
Riveting gangs	4 weeks
Tool repairers and attendants	4 weeks

In receiving the training periods the reader should remember that the learner is trained for only one type of ship, and each step is specifically related to this type of craft. Manifestly to train a workman to be familiar with any type of craft, such as a yacht, torpedo boat, cargo steamer or battleship, will take a longer time.

From a labor standpoint this single-type ship idea is one of the great advantages of the fabricating program. Under a proper plan of industrial adaptation, labor can be developed quite rapidly to serve the construction requirements of the ways.

Machinery Held in Storage Awaiting Shipment

By H. M. Selson
Managing Director, The Selson Engineering Co.

There is not an exporter of machine tools doing business with the Allies who has not felt at some time a sense of annoyance by reason of deferred delivery of machines that have been sold to some customer for war work because of some priority order of a classification superior to what he has been able to get.

He may be appeased by feeling that he has done everything possible in the interest of his country and his customer and that he must bow before the decision of the authorities at Washington, but his vexation becomes insistent, and I think justifiable, when he has positive knowledge that similar machines are lying in storage in New York either not to be sold or, if for sale, to be sold at a higher price than he is able to pay.

Considering the fact that the United States Government has a complete list of machines in storage in New York, and that these machines are accomplishing nothing for the general cause, he feels that in justice to everybody, these machines should be put into service before his particular shipments are delayed. It would seem beyond argument that it would be to the allied interests if all such machines could be put to use forthwith.

I am not in a position to give a complete list of machines now out of use or to know whether in most cases similar machines in the factories are covered by priority orders, but I am confident that as regards the following mentioned machines investigation would disclose such a condition.

The following comprise a few of the machines which I know to be either on the market or in the hands of neutral or Russian firms who are unable to ship:

Gear Cutting Machines—Brown & Sharpe Manufacturing Co., D. E. Whiton Machine Co., Gould & Eberhardt, Barber-Colman Manufacturing Co., Fellows Gear Shaper Co., Cincinnati Gear Cutting Machine Co.

Universal Milling Machines—Kempsmith Manufacturing Co., Cincinnati Milling Machine Co.

Grinding Machines—Cincinnati Grinder Co., Landis Tool Co., Thompson Grinder Co.

Automatics—Cleveland Automatic Machine Co., Potter & Johnston, Gridley Automatic Machine Co., New Britain Machine Co.

Turret Lathes—Foster Machine Co., Warner & Swasey. There are also hundreds of lathes, drilling machines, etc.

I would recommend that when anybody applies to the board at Washington for priority on a certain machine that the list should be carefully consulted, and instead of issuing a priority order to the manufacturer they should allot machines from what I call or term the dead list.

The equity to the holder of the machine, who has had heavy storage bills to pay, and the difficulty in the matter of price that the buyer would have to pay, can be adjusted by the Government agreeing to replace the machine immediately after the war.

Take, for instance, a Russian firm that has purchased a machine at $500 and has already paid $400 storage. The American user can buy the same make of machine for $650 on five months' delivery. The American firm would get the Russian firm's machine at $650, and the machine-tool manufacturer would agree to supply after the war a duplicate machine at $650, which could be handed over to the Russian firm. In this way the Russian firm would be saved the expense of further storage, and the user would get his machine much more quickly, while the machine-tool manufacturer would have the advantage of holding post-war orders on his books. The only sufferers so far then would be the storehouses in New York.

In a few instances something of this kind has already been done as an amicable arrangement between the three interested parties, but the ends to be accomplished are of far too great importance to permit of only desultory acts, and the urgency of the Government's need should impel it to use its power of compulsion to bring all these dead assets into use.

Export and Import Licenses

A hasty reading of the recent proclamations regarding imports and exports might give the impression that both were forbidden, but the real meaning is that the President assumes the power to regulate, for the good of the United States and its allies, all trade outside our own borders. This power will be exercised with the single purpose of winning the war, and every effort will be made to avoid unnecessary interference with our foreign trade. No restrictions will be imposed upon either importers or exporters except such as may be necessary to the accomplishment of the great objective—the winning of the war.

The direct handling of the problem is to be done by the Treasury Department and the War Trade Board. Licenses for the export or import of coin, bullion, currency, evidence of debt or of ownership of property and transfers of credit will be issued by the Treasury Department as usual. Licenses for all other imports and exports, including merchandise, bunkers, ship's supplies, etc., will come through the War Trade Board.

Sidelights

EDITED BY E. C. PORTER

Acting on the recommendation of the advisory council on labor problems, the Secretary of Labor will appoint a policy board which will formulate a program for the settlement of difficulties between employers and employees arising during the war.

The American Federation of Labor has been asked to nominate five persons to represent the workers and the National Industrial Conference Board, five, to represent the employers. Each group will nominate a representative of the public, thus completing the board.

* * *

A company in California will soon launch a 5,000-ton, self-propelling vessel for ocean travel. In Scandinavia several companies are advertising that they will build concrete ships as large as 5000 tons, and this year they will launch several ships of 3000 and 4000 tons, equipped with Diesel engines. One Scandinavian 400-ton concrete ship has already received a Lloyd rating. It is rumored that the French and English governments will construct a fleet of concrete barges and coastwise self-propelling ships. Concrete vessels are fireproof, rat-proof and rot-proof and can stand hard usage.

* * *

Since the first week in February, the Government has systematized a means of lodging the great influx of Federal workers, both men and women, who have necessarily been pouring into the city. The United States Civil Service Commission has prepared a circular letter, to be distributed throughout the Government offices, which tells the new war worker where he may be lodged upon arriving in Washington. This letter is to be inclosed with any summons from any office, to the worker, that as much of difficulty as possible, may be eliminated for the newcomer.

This circular tells the employee that he will find a registration of lodgings in the room-registration office of the District of Columbia Council of Defense, at 1321 New York Ave. This office is conducted by the Federal Government and at that place every possible assistance will be rendered the applicant. A provision for the late arrival has been made by the establishment of a booth in the main waiting room of the Union Station in Washington, and there a night's proper lodging may be had upon application. All of this work is under Federal conduct.

* * *

On Feb. 16, there ended a great drive for men for shipbuilding work. The campaign has been conducted by the Council of National Defense, the Shipping Board, the State Councils of Defense and the Department of Labor. The drive has been from coast to coast.

Now the appeal comes through the Federal-State Directors of the Public Service Reserve for all workers, knowing themselves to be capable of working in a shipbuilding yard, to register for this work, but nevertheless to stick to their present jobs till they are summoned by the Board. Not all workmen are capable of doing the work required. Those with a certain experience and training will presently be needed, while in the immediate circumstances, every sort of laborer seems to be applying at these centers of industry, many of them being incompetent to undertake this particular kind of work.

All who can help to build ships will be needed. The Government wishes to know where to put its hands upon such men. If all such competents will register now, much time will be saved, order greatly restored and the registrants need not be losers, even though their services are not immediately demanded.

* * *

The London Suffrage Society established a while ag a training school for women welders. The Ministry o Munitions has found this school to be so desirabl an adjunct to industrial organization that it has take over all the payments and expenses incident to th work. The methods of the organization will not b interfered with, nor changed in any way, nor does th Ministry undertake to place the women, but the ac signifies government approval of the conditions estab lished by the women of London. Under the school present conduct, women have been found to be bette trained than elsewhere, and the school is more econom ically run than are other industrial schools.

Two hundred women who are skilled welders hav been trained under the auspices of the London Suffrag Society, and when placed they receive a wage of 16 an hour. After three months of experience they r ceive the minimum wage of men workers, which is a average of \$12.50 to \$15 per week.

Aluminum welding is being taught with much su cess, and though difficult, the women are engaged an work successfully at this work in airplane factories.

* * *

A move to make the week of Mar. 4 to 9 a farm implement inspection and repair week has received th approval of the United States Food Administratio The idea was started and is being pushed by the Natio al Federation of Implement and Vehicle Dealers' A sociations, with the coöperation of the United Stat Department of Agriculture, the Federal Board Farm Organizations, the Agricultural Publishers' A sociation, numerous state colleges of agriculture a farmers' organizations, farm agents, state councils defense and manufacturers and dealers. During repa week an effort will be made to have every farmer in t nation inspect his machinery and immediately place h orders for repairs or extra parts. Unprecedent scarcity of malleable and steel parts, freight congesti which might bring about embarrassing delays, and opportunity to save express and postal charges a urged as reasons for early orders to be put in throu dealers. The farmers are being urged to act promp as an act of loyalty in the effort for a maximum fo production this year.

The Work of the Machine-Tool Section of the War Industries Board

SPECIAL CORRESPONDENCE

That the work of the machine-tool section of the War Industries Board is not as well known as it should be is evidenced by the frequent inquiries, many of them from Government departments, for just the kind of information that is within their reach if they but knew it. It is simply another case where a lack of knowledge of existing data delays the work of the general plan. A real, live, walking encyclopedia or guide which would keep the different departments informed as to the mass of information which is available should prove of great value at this time.

HEREWITH is a brief report indicating the principal activities of the machine-tool section of the War Industries Board, these activities being arranged chronologically, and dating from early October, 1917, when the department first assumed actual shape.

In order to obtain an idea of the machine-tool production of the country, manufacturers were asked for shop schedules, giving in detail output per month and indicating both the sold and unsold proportions of said output. These figures were supplied for five months, from October to February inclusive, and when tabulated under types and sizes they indicated what machines were probably being produced in sufficient quantity or were overproduced or underproduced, as the case might be. This condition of course changed daily. No attempt has been made to keep a running inventory of machine-tool production.

As a result of this inventory it was possible to advise the War Trade Board as to modifications of their conservation list, which had included machine tools. This permitted the exportation of such tools as were shown to be overproduced. This was of distinct value, as the maintaining of such tools in this country imposed a hardship on the manufacturer. It also allowed the utilization of machine tools held for shipment at seaports, some of which machines were for neutral and others for enemy countries.

Finding Where Machines Were

Lists were obtained from various factories showing all shipments made in the previous five months to countries other than England, France, Italy and Japan. On this list were specified the selling and forwarding agents and warehouses where stored. This list gave the Government a source of immediate supply for many tools urgently needed both here and by our allies, and steps were taken to render such machines available for this purpose.

It should be understood that the selling agents for these machines as a rule had contracts permitting them to sell only in those neutral or enemy countries to which they could not ship, but that notwithstanding such contracts many machines were being released at high prices and dealt in by unscrupulous dealers, so that our Government, our allies and our subcontractors frequently bought such machines at prices materially above those which should have been paid.

In order to enforce contracts between the manufacturer and the agent and to prevent the selling of a machine from hand to hand before arrival at its ultimate destination, a form of "commandeer" order was drawn up and authorized by the Secretary of War. By this means any specified machine held at the ports for shipment abroad could be commandeered by an individual specified in the document, who was given authority to procure and receipt for this machine. This allowed the party either to pay a price mutually satisfactory to himself and the dealer or to seize the machine, paying a proportion of the price deemed fair and leaving the final adjustment of the matter to be settled in the Court of Claims.

In order to coöperate with the priority committee, machines held at the dock for shipment were commandeered only when priority certificates had been issued for such machines. In certain cases such machines were equipped for foreign use with metric screws, dials, feed plates and instruction plates. In several such cases these machines were commandeered by the manufacturer, taken back to his plant and changed over to the English standard in order to conform to this country's practice, and afterward applied by the manufacturer to the highest priority certificate he had on his books.

Commandeering Machine Tools

In certain other cases these machines were commandeered for our allies, rendering such a change from metric to English unnecessary, permitting prompt shipment and releasing shop capacity for our own work.

Requests were occasionally made for information as to the number and types of machine tools required for the production of specified munitions. As a good deal of this work was new no information was available in regard to proper machine-tool equipment.

The department secured for the chief of ordnance a number of experts in the use of machine tools. These experts made time studies of the various forms of munitions, arriving at a basis for determining machine-tool needs for said munitions. These time studies were complete, and specified all machinery needed for a given production. It is of course understood that the time studies would not necessarily represent the actual practice followed in a shop receiving the contract, because the shop would probably already have equipment available which could be very satisfactorily applied. The time studies were, however, of value as indicating the probable ultimate requirements.

In order to aid in properly grading priority for machine tools, both for our own and the Allied programs, manufacturers of machine tools were requested to furnish a schedule of their shop orders, specifying the dates when orders were placed, grade of priority

granted and date scheduled for shipment. With these lists in hand additional priority certificates could be more intelligently graded in order to ship machines in the order of their actual needs.

It was hoped that complete information would be available to indicate the different types of material required on which machine tools would be used. This information, in conjunction with proper time studies, would form an accurate basis for comparing machine-tool requirements and machine-tool production.

A complete statement has not yet been secured covering this point, but the matter has now been put up to the heads of the various departments and the necessary information should be forthcoming. It will then be possible to determine accurately where expansion must be made along the line of production of certain machine tools. It has been recommended and approved by the army that a machine-tool reserve be established. This reserve will consist of machine tools of the less easily procured type, a sufficient quantity of which will be ordered and held for disposition as occasion arises.

The necessity for such a reserve is confined almost entirely to the larger sizes of machine tools, of which a limited production is available, and which machines must naturally take a greater time in production. This renders deliveries less satisfactory when the ordinary course of requesting bids on such machines after a program of manufacture has been determined upon, is followed.

The intention now is to maintain a maximum and minimum stock of such machines as experience indicates are most desired and less easily procured. Such an arrangement gives the manufacturer an assured business and reduces cost. It also does away with the feverish and inefficient activity which always follows the rushed deliveries so frequently made necessary by orders placed for specific demands.

A survey was made of available machine tools of the larger sizes, and it was sufficiently evident that some means must be taken to increase in the available sources of supply. To this end manufacturers were requested to submit lists of all the large machines they had manufactured for periods ranging from 10 to 20 years. All this information has been tabulated, and a complete record now exists of the location of every large machine tool that is in any sense modern, so that should commandeering from private plants become a necessity the machinery for such action is available. This list includes about 24,000 machine tools.

New Sources of Supply

New sources of supply for certain machine tools were opened up by the department by interested concerns which did not regularly manufacture machine tools, and procuring for them patterns and drawings and the coöperation of the regular machine-tool makers. By this means the governmental departments were able to place contracts for quite a number of needed machines with concerns that had previously manufactured some articles of nonessential value.

In addition the department has a list of plants that may be used for the manufacture of machine tools, with itemized description of the equipment in their plant. These manufacturers are divided geographically into a series of districts. A number of such manufacturers have also submitted proposals for the production of certain machine tools, so that as soon as a shortage evidences itself their plants can also be utilized.

There are certain other general activities of the department, such as:

> The bringing into touch with the army, navy and emergency-fleet corporations various concerns which desire to manufacture supplies for said department.
>
> The placing before these departments of any machine tools that come to their notice, which they know to be interesting to said department.
>
> Recommendations to the various purchasing bureaus as to the prices that should be paid.
>
> Efforts towards the elimination of the scalper.
>
> Another activity of this department is the checking of prices of all machine tools purchased by our allies and paid for through the Government loan, our Government agreeing to buy equipment for our allies at the prices this Government pays. The granting of permits to purchase this equipment is also left to this department.

Blocking the Scalpers

The list referred to makes it difficult for scalpers and speculators, who are trying to hold up the Government, to obtain fancy prices on second-hand machines. Just as an example, the same machine was offered by two such scalpers, one at $22,000 and the other at $24,000. The real owner of the machine offered it at $15,000, which was a fair price. This list enabled the department to at once locate the machine in question and to block the little game of picking up from $7000 to $9000 easy money by some of those whose patriotism is always accented on the first syllable.

The knowledge of the machine tools available is also of great use in either commandeering or refraining from commandeering certain machines which are very badly needed. Incidentally it shows some surprising data as to the very small number of large machines, such as 16-ft. boring mills and the like which are in existence.

The inability to decide offhand as to what are and what are not nonessential industries is indicated by a little experience along this line. A large machine was needed for special gun work, and the list of machines only showed a very few of the size wanted. One of these, however, seemed to be in a nonessential industry, and a wire was sent commandeering it for Government use.

No reply came for the owner, who had a small shop, but it did not take long to hear from the builder of some very important machines, also for gun work, that the machine which was apparently engaged on nonessential work was in reality working night and day on parts for their new machines which the Government was waiting for. There are dozens of such cases, and they go to show how useful this section has been in unravelling machine-tool tangles and in securing machines which were not known to be available.

All this has been accomplished as an advisory board without executive authority. Many believe that it could be much more effective if the committee had more power; if it could act more as a director of machine-tool manufacture and distribution. For while this would

take over some of the activities of the Priority Board it is believed by some who have studied the matter very carefully that with the knowledge possessed by the machine-tool section executives, added to the data already collected regarding machine tools available and machine-tool production, a wider actual supervision might prove very beneficial.

One of the things pointed out is that this might relieve the congestion in certain kinds of machines which is now tying up some of the programs to some extent. Nearly every manufacturer has an idea in the way of shop equipment and wants machines of certain makes in his shop. These are the machines he naturally orders when he starts to add to his equipment, regardless of the fact that some other machine not so much in demand could do the particular job he has in hand almost if not quite as well.

If this section had power, and this suggestion is written without the knowledge or consent of those engaged in this work, it might easily secure more rapid equipment of shops if it had the power to dictate, to some extent, the kind of machine to be ordered or supplied for emergency work. By doing this the work of building machine tools would be more evenly distributed so as to secure more rapid deliveries. Shops could be prevented from ordering precision lathes for work which could be handled on a plain bench lathe, thereby leaving the precision lathe to those who really need this kind of machine. In the same way shops with too great an eye for the future would be prevented from buying universal milling machines for work which could be handled on plain millers, thereby leaving the universal machines for those who actually need them.

This is however speculative. The work which is already being done has been of great assistance to the production program, and both Mr. Merryweather and his staff are receiving congratulations from many quarters as to what they have already accomplished.

Graphical Geometrical Progression by Means of the Slide Rule

BY HARRY S. KARTSHER

The writer has never seen published this method of finding the successive steps of a geometrical progression by means of the slide rule and from those with whom he has talked it does not appear to be of common knowledge. The method can best be explained by a definite example.

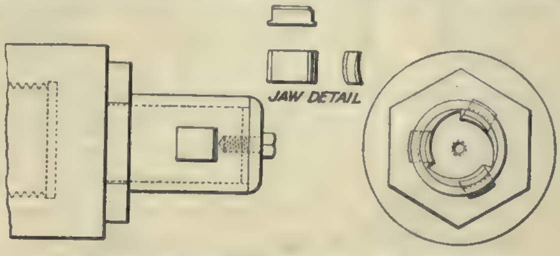
It is required to find six successive geometrical speeds between 25 r.p.m. and 360 r.p.m. (first and last speeds inclusive):

First, draw a straight, horizontal line and establish a point at the left end; remove the slide from the slide rule and lay it along the line with the 25 reading coinciding with the established point. Lay off on the line a length equal to the distance between the 25 and 360 readings upon the slide; now divide the length of line into five equal parts, giving six equidistant points along the line; replace the slide along the line, with 25 again at the established point, and it will be found that 25, 42.5, 73, 124, 212 and 360, the six successive geometrical steps, coincide with each point in the order of this rotation.

Self-Centering Driver for Rough-Turning Shells

BY H. A. WILSON

Considerable difficulty has been experienced by shell makers, particularly those machining high-explosive shells, in getting a cheap, efficient, and long-lived driver for the rough-turning operation. The accompanying cut shows a simple device which has been used on 4.5 British howitzer shells with marked success for over two years. In the rough-turning operation it is necessary for the driver to perform the dual function of driving and at the same time of revolving the shell true with the rough bore of the forging, so that after the operation is completed the walls of the shell are of a uniform thickness.



DRIVER FOR ROUGH TURNING SHELLS

Expanding mandrels which support the shell independently of the tail center, have been tried; but owing to their excessive overhang they have shown a tendency to spring and thereby produce inaccurate work.

The short driver shown, gives all the driving power necessary and centers the open end of the shell. The base end of the shell is centered so that with the aid of a tail center the shell is revolved true with the center hole of the forging.

The end view shows the construction of the three-point cam and the jaws. The deeper the cut taken by the tool, the harder the expanding jaws grip the shell.

The cam, the jaws, and the jaw holder are all made of carbon tool steel, and hardened. The jaws are serrated in such a way as to have a tendency to dig into the forging as the cut gets heavier. The jaws are kept from falling out of the fixture by small flanges on each end. No springs are used to withdraw the jaws from the work or to keep the jaws well into the fixture to enable a shell to be placed on the driver. The front end of the jaws are beveled so as to allow the shell to be easily placed in position. Originally, a piece of spring wire passing through grooves in the jaws was used; but this was discontinued, and the flanged jaw adopted instead.

The end of the fixture is protected by a cast-iron washer held in place by a capscrew. Once a day this is removed and the small chips and dirt cleaned out. A small quantity of heavy oil or cup grease is placed inside to lubricate the moving parts.

The back of the jaw holder is flanged and the flange milled, giving six flat sides, thus insuring the easy release of a shell, should it for any unforeseen reason get seized. It is seldom that a shell seizes after the fixture has machined 500 shells. Once in a while a shell in the first 500 is released through the medium of a wrench on the jaw holder. After the fixture has been worked in, all shells can be removed by hand.

The Patriotism of the Machine Industry

MODERN warfare is so largely a matter of the machine shop and its products that the machine industry in general and the machine-tool industry in particular must be utilized to their fullest extent so as to secure the best results in the shortest time. As evidence that the importance of these industries is being recognized by those high in authority we have only to refer to the letters in the front part of this issue in which the Secretary of War, the Secretary of the Navy and the Acting Chief of Ordnance express appreciation of what has already been done and urge continued effort in the same direction.

Hundreds of machine-building firms are at work on munitions of various kinds; hundreds of others are making machinery with which to make munitions or kindred products. For the machine-tool shop stands behind shipbuilding, the locomotive, the truck, the airplane and all the rest.

THE machine-building industry has been of prime assistance in other ways. It has responded splendidly to several special calls for asistance from the Ordnance Department during the past few months. It has given its best draftsmen, designers and engineers; it has responded to the call for the large machine tools needed to make heavy guns, released them when they were needed in their own shops, that our boys in France might not lack heavy artillery. The machine-building industry is doing its best to supply the machines needed in all classes of Government work; it has bought large blocks of Liberty bonds; has induced its employees to do likewise, and is now pushing the sale of War-Savings stamps with equal vigor.

Many shops are striving in every way possible to increase the production of munitions or the machines for making them. Others are lending patterns to other builders to assist in increasing the total output, some even refusing compensation of any kind for their use. Engineers and shop managers are sacrificing large salaries and incomes to serve the Government in minor capacities.

BUT while we are proud of the industry as a whole, it is time to ask ourselves individually whether we are doing our part; whether we have carried the war home to our inner selves and made it a reality to ourselves.

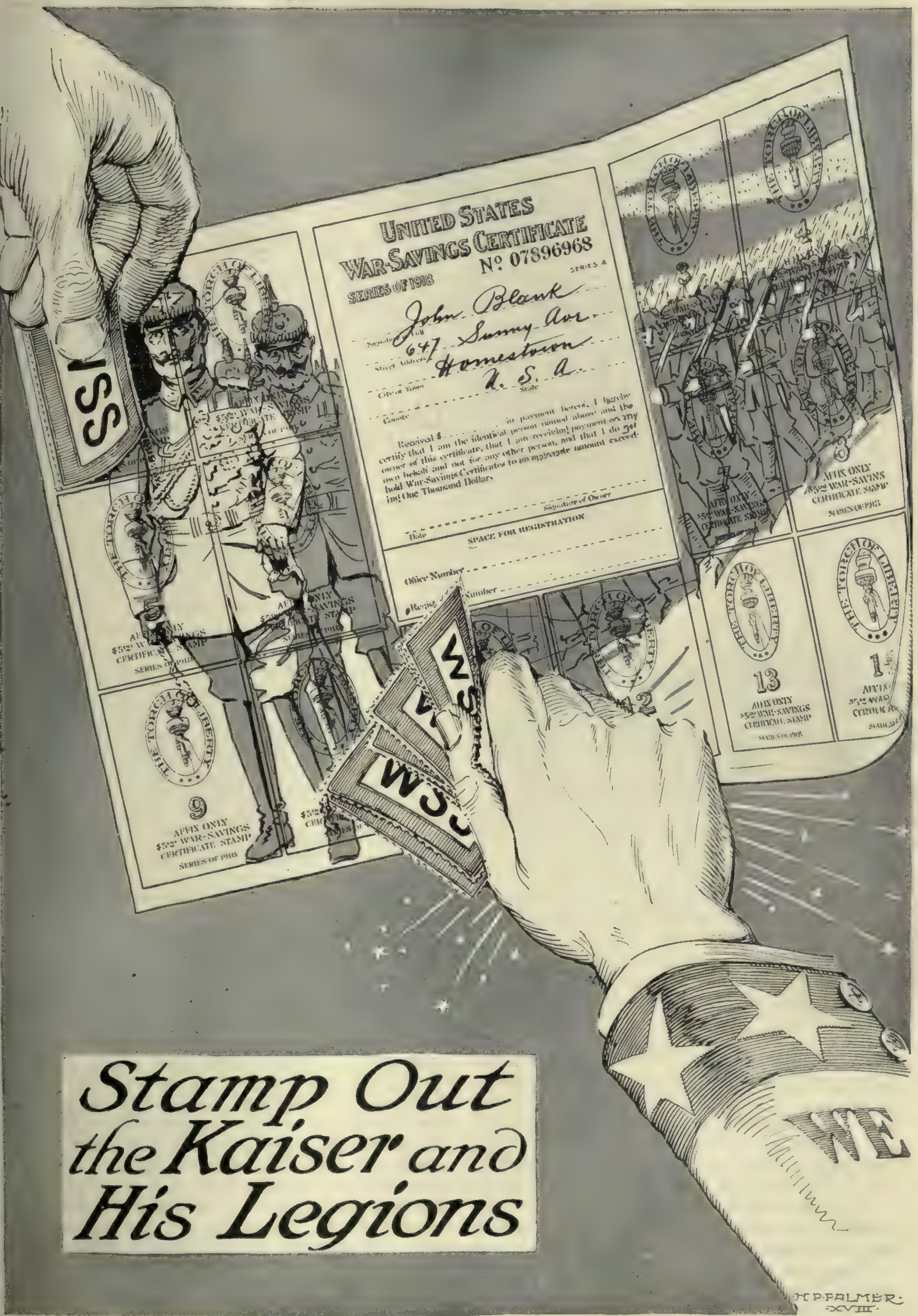
How many of us have made any real sacrifice? Unless we have actually deprived ourselves of some comfort, if not some necessity; unless we have used less sugar, or fats or wheat or meat; unless we have smoked fewer cigars, burned less gasoline for unnecessary driving; bought War-Savings stamps or other forms of Government loans as the result of some real sacrifice, we have not dug deeply into the real meaning of patriotism. Doing our "bit" is not enough. We must do our best.

PATRIOTISM means far more than the waving of flags and making pledges to support the Government. It means real sacrifices of various kinds, as we are beginning to find out. It means heavy taxes, the curtailment of comforts as well as luxuries. It has meant cold houses to many; it means sugarless coffee and other minor discomforts, and most of all it means to many that supreme sacrifice beside which all else sinks into insignificance—the parting with our sons with the knowledge that they may never return.

Patriotism may even call upon us to give up, or at least to modify, some of our older ideas and ideals as well as the more material things. The old order is changing under the stress of war conditions not only in Russia and in England, but here in the United States of America as well.

Lincoln announced that no country could exist half slave and half free. The present-day thinker with the vision of tomorrow applies this same axiom to a democratic form of government and an autocratic control of industry. The former was as difficult for many to accept in its day and the latter is for many today. But the trend of the times seems to be clearly in this direction. And while none can say just how the details are to be worked out, it is better to study the question with a desire to find the proper solution than to blind one's vision to the possibilities of such changes in our industrial life.

TRUE patriotism demands that we consider not only our own interest but that of the country as a whole; that we earnestly and honestly and without prejudice seek the forward way that will bring the greatest good to the greatest number, which means the country as a whole. And finding such a way, even if it be contrary to our former ideas and lines of thought, that we work for its accomplishment rather than attempt to stem the tide of progress.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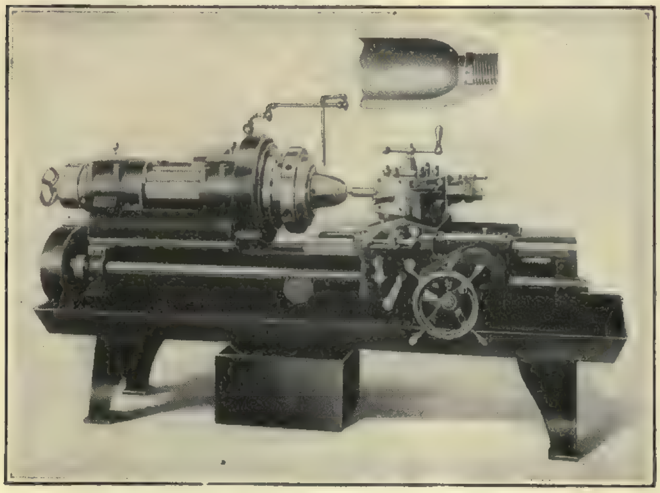
Stamp Out the Kaiser and His Legions
H. P. PALMER. XVIII

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Gisholt 16-In. Shell Lathe

This lathe made by the Gisholt Machine Co., Madison, Wis., was designed to meet simplified-operation conditions in the manufacture of shrapnel and high-explosive shells or parts made up in large lots. As single-purpose machines they are simple in design and easy for women operators to handle. The illustration shows the lathe equipped with collet chuck and tools for boring and threading the nose end of 155-mm. shells. These machines are made in 16-in. and 25-in. swing, with 3¾ and 6¼ in. spindle bore in several models, embodying many combinations with different styles of chuck and carriage.



GISHOLT 16- AND 25-IN. SHELL LATHE

Amalgamated Gun-Boring Machines

The machines represented by the illustration are made in three sizes and one type of varying lengths of bed, designated by numbers which denote approximately the spindle bearing sizes and the swing. No. 26 has a 6-in. spindle and is of 27-in. swing; No. 46 has an 8-in. spindle and is of 39-in. swing; No. 56 has a 10-in. spindle and is of 48-in. swing.

These machines are built by Amalgamated Machinery Corporation, Chicago, Ill. The beds are of close-grained gray iron with metal properly distributed throughout to absorb all vibration and be free from strains and tension due to uneven cooling. These are strongly ribbed, and when so specified by purchaser are provided with oil pans located under both ends of the work to be bored and both equalized by connecting piping. The ribs do not extend fully to the base level, in order to provide for the longitudinal flow of compound under the bed. The skirts of the bed extend fully from the guides to a wide-flanged base section and are very thick. Guides are regularly flat topped.

The headstocks are invariably cast solid with the first section of bed. All bearings are cast-iron shells of considerable thickness lined with babbitt metal and fitted to their shafts, after which they are perfectly aligned by elaborate jigs and securely locked in place by specially treated fusible metal, which expands in cooling, and has a load value of about 4000 lb. per sq.in.

Sight-feed oilers are provided for the rotating bearings that are stationary, and automatic grease cups for moving bearings, such as clutch members, etc.

The main spindles are driven by double gears, one of which is cut on the faceplate and the other keyed to the spindle at the rear of the front bearing. This arrangement insures a directly divided lateral gear thrust over the entire length of the front spindle bearing and obviates any tendency to wear the spindle-bearing bell mouthed, as is the case when the faceplate only is geared. By staggered setting of the gear teeth the smooth gear action that would be obtained if gears of half the pitch were used is secured.

The first-motion shaft on these machines carries sliding pinions adapted to engage gears on the second-motion shaft, and the position and location of these pinions is determined by a single lever on the front of the head working in a selective quadrant.

When a pulley of any sort is furnished on the main drive it is made a clutch pulley with a single adjustment, and is as nearly trouble proof as it is possible to make any device of the kind.

Any motor arrangement preferred by the purchaser is furnished. The recommendation, following the practice of experienced users, is that motors be mounted on the floor at the rear of the headstock on their own base rails, and connected by wide leather belting to a pulley on the machine. When gears are used a rawhide or fiber idler is recommended. When silent chains are specified a drive rated by the makers at 50 per cent. over the motor rating is provided, designed for slow speeds and submerged in oil. When variable-speed, direct-current motors may be supplied they are recommended on account of greater flexibility in speed con-

trol. The purchaser may determine the power required by assuming the speeds and feeds that this shop practice or judgment suggests and allowing 1½ hp. for every cubic inch of metal removed per minute. A reasonable surplus of power above this figure is of advantage in cases where chips become jammed in the tools, etc., and most specifications call for 35- to 50-hp. motors for the main drive.

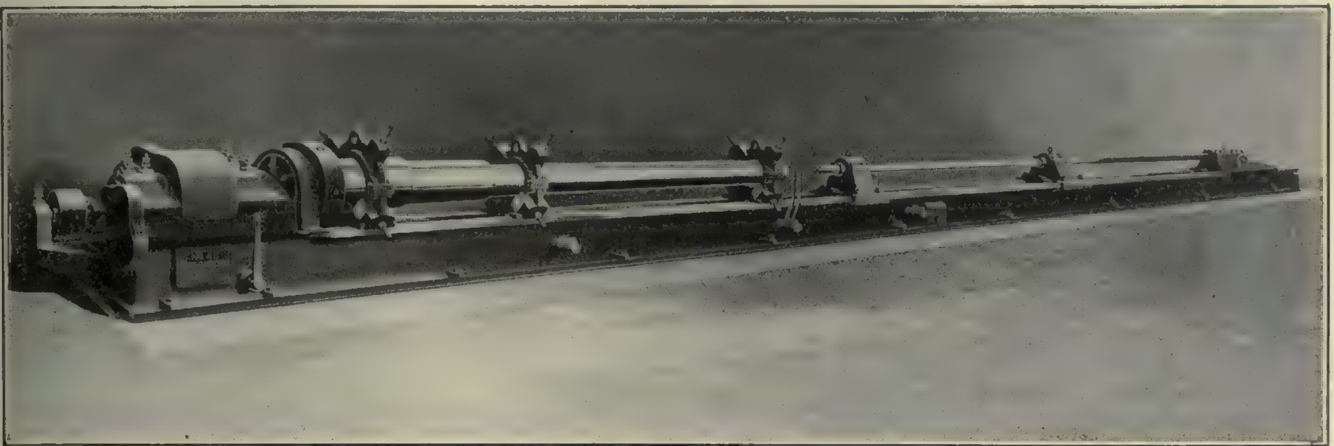
Usually three-to-one ratio motors of about 400 to 1200 r.p.m. are provided. The ratio and speeds are of course governed somewhat by the size and range of work to be performed on any one machine. A 7½-hp. constant-speed, reversing motor is required for the rapid traverse spindle. This is considered a special arrangement, and machines so constructed are designated by the letter D following the number.

No pumps are furnished with the machines, as any machine pump is inadequate and central systems for oil or cutting compound are used.

Faceplates are keyed and shrunk in place and are male faced to receive standard or special chucks, which are held in place by through bolts or studs.

No chucks are included in the equipment furnished unless separately ordered.

The controls are very simple and consist of a main motor switch, reversing switch for rapid traverse, clutch lever for feed and rapid traverse, driving clutch lever, gearshift lever.



AMALGAMATED MACHINERY CORPORATION'S GUN-BORING LATHE

Specifications for No. 26 machine: Swing, 27 in.; length of bed required for headstock, one bar guide and boring carriage, 11 ft.; space occupied by boring carriage, 4 in.; space occupied by headstock, 6 ft. 2 in.; space occupied by bar guide, 1 ft. 6 in.; width across ways, 30 in.; top of ways to floor, 28 in.; front-spindle bearing, 6 x 20 in.; rear-spindle bearing, 6 x 16 in.; length of carriage on ways, 36 in.; feed screw, 2½ in. in diameter, four-pitch Acme thread; diameter of faceplate, 16½ in.; maximum diameter of bushing in carriage, 5 in.; length of bar bushing in carriage, 18 in.; ratios of drive shaft to spindle, through four-gear shifts, 33, 26.4, 20.6 and 16.5 to 1; size of pulley, 16 x 12 in., drive-shaft gears, 2 pitch, 4-in. face; back gear-shaft gears 2½ pitch, 3½-in. face; double-spindle gears, 3 pitch, 3-in. face; feed gears, 6 pitch, 1½- and 2-in. face; speed of rapid traverse, 10 to 12 ft. per minute; feeds per spindle revolution, four, 0.005, 0.010, 0.015, 0.030 in., special feeds if desired; width of single ways, 6 in.; thickness of ways, 3 and 2 in.; bed section, 20 x 36 in.; width on foundations, 38 in.

Specifications for No. 46 machine: Swing, 39 in.; length of bed required for headstock, one bar guide and boring carriage, 12 ft. 6 in.; space occupied by boring carriage, 5 ft.; space occupied by headstock, 7 ft. 1 in.; space occupied by bar guide, 1 ft. 6 in.; width across ways, 34 in.; top of ways to floor, 26 in.; front-spindle bearing, 8 x 28 in.; rear-spindle bearing, 8 x 24 in.; length of carriage on ways, 55 in.; feed screw 3½ in. in diameter, 2 pitch Acme thread; diameter of faceplate, 33 in.; maximum diameter of bushing in carriage, 6½ in.; length of bar bushing in carriage, 24 in; ratios of drive shaft to spindle through four gear shifts, 38.8, 31.4, 24.4 and 19.4 to 1; size of pulley, 16 x 12 in.; drive-shaft gears, 2 pitch, 5-in. face; back gear-shaft gears, 2½ pitch, 5-in. face; double-spindle gears, 3 pitch, 3-in. face; feed gears, 6 pitch, 2½-in. face; speed of rapid traverse, 10 to 12 ft. per minute; feeds per spindle revolution, four, 0.005, 0.010, 0.015, 0.030 in., special feeds if desired; width of single ways, 8 in.; thickness of ways, 3½ and 2¾ in.; bed section, 20 x 36 in.; width on foundations, 42 in.

Specifications for No. 56 machine: Swing, 48 in.; length of bed required for headstock, one bar guide and boring carriage, 16 ft.; space occupied by boring carriage, 5 ft. 10 in.; space occupied by headstock, 8 ft. 4 in.; space occupied by bar guide, 2 ft.; width across ways, 41 in.; top of ways to floor, 24 in.; front-spindle bearing, 10 x 32 in.; rear-spindle bearing, 10 x 28 in.; length of carriage on ways, 66 in.; feed screw, 4½ in. in diameter, 1½ pitch, Acme thread; diameter of faceplate, 41 in.; maximum diameter of bushing in carriage, 10 in.; length of bar bushing in carriage, 34 in.; ratios of drive shaft to spindle through four gear-shifts, 54.2, 43.3, 34.2 and 27.1 to 1; size of pulley, 16 x 12 in.; drive-shaft gears, 2 pitch, 5½-in. face; back gear-shaft gears, 2½ pitch, 7 in. face; double-spindle gears, 3 pitch, 3½-in. face; feed gears, 6 pitch, 2½-in. and 3-in. face; speed of rapid traverse, 10 to 12 ft. per minute; feeds per spindle revolution, four 0.005, 0.010, 0.015, 0.030 in., special feeds if desired; width of single ways, 9½ in.; thickness of ways, 4 and 3 in.; bed section, 20 x 36 in.; width on foundations, 48 in.

and is entirely independent of the main drive. Motors and controlling apparatus are supplied by the purchaser.

Either spindle-driven feeds or independently driven arrangement may be had. The spindle-driven arrangement requires a long feed screw approximately the length of the bed, and inside the head it carries a clutch member and gear which is silent-chain driven from a 7½-hp. motor on the outside rear of the headstock or bed. This unit provides for the rapid traverse in both directions by using a motor-reversing switch conveniently placed within reach of the operator. When it is desired that a constant-direction motor be used a double clutch drive and reverse through a gear train is used.

In the independently driven arrangement a motor and reduction gearing mounted on the rear of the bed at about the center, connecting with a short feed screw in the rear of the frame only, drives the screw for both feed and rapid traverse independently of the

Standard steadyrests are four jaw, of the entirely removable top type. The top is tongued and grooved to the base and cross tongued by steel pins to secure transverse location. Chilled cast-iron jaws ground to the required radius are recommended, but on special order roller jaws will be furnished.

One bar guide is regularly furnished and will be supplied with bore of any size to take bar bushings.

The carriage is furnished with inside guide surfaces and without side gibs. Heavy outside under gibs are used. The drive is by the centrally located feed screw and semi-steel nut of considerable length. The nut is provided with a spiral, or worm, gear and is revoluble in its bearing in the carriage. A handwheel on the outside of the carriage operates a shaft carrying a spiral pinion or worm that engages the feed nut gear, and by hand operation the feed may be retarded at will.

Machines are designated by a number given in the first paragraph of this article and otherwise by the extreme length of bed casting from end to end. To determine the length of machine for any proposed length of work add together: (a) Double the length of the work; (b) length required for tools and clearance; (c) chuck backing; (d) over-all length of boring carriage; (e) aggregate length of bar guides wanted; (f) length of headstock.

The first three items are necessarily furnished by the purchaser, and the last three, for any size machine, may be taken from the table of dimensions.

Amalgamated Reinforced-Concrete Metal-Planing Machines

The machine shown was designed and built by the Amalgamated Machinery Co., Chicago, Ill. It represents one of a group especially built for planing the beds of large gun-boring machines, but machines of this type may be built in various sizes for other purposes. A big advantage is the rapidity with which these machines may be constructed. The bulk of the machine, including the bed and housings, is made of reinforced concrete. The table, ways and rack are made in 12-ft. sections. The table sections are of skeleton type, and when all are connected together concrete is poured into the cavities, making of the table a huge iron-and-concrete monolith. It is believed that this is the first time that a machine of this type has been built in this manner.

AMALGAMATED REINFORCED-CONCRETE METAL-PLANING MACHINE
Table, 90 ft. long, 13 in. thick; bed, 184 ft. long; width between housings, 72 in.; cross-rail is 4 ft. square, concrete faced with cast iron.

The machined ways, flat on one side and V-shaped on the other, are bolted in place by means of studs set into the bed after the sections have been accurately leveled by engineering instruments. The cross-rail is a large casting set on and securely bolted to the concrete housing. The feed is by hand and two 40-hp., variable-speed motors, one on each side, drive the table.

Organization For Handling Machine Tools in France

IN anticipation of the tightening of control by the French government over the importation of machine tools into France, an association of allied machine-tool importers has been formed in that country to look after the interests of factories represented by the members and to afford the government the coöperation necessary for the proper distribution of machines needed for national defense.

The association, which is officially known as the Chambre Syndicale des Representants Directs de Fabrique Anglaises ou Americaines de Machines et Outillages, includes among its members the following companies: Alfred Herbert, Ltd., France; Compagnie Ingersoll-Rand, Burton Fils, Cope & Simon, Herbert Morris, Ltd., Allied Machinery Co. de France, J. Ryan, A. Moulin, Société Française, Arnold Wicksteel, George E. Fogarty (representative of a group of Fitchburg manufacturers), Hounsfield Fils. The president of the association is F. A. Choffel, managing director of the Ingersoll-Rand Co. in France. Membership in the association is limited strictly to individuals, firms or companies of allied nationalities. All members must be direct factory representatives.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., Mar. 2, 1918—If one still has any lingering doubts as to the complexity of modern civilization or still believes that his industry is independent of all others, the present confused industrial situation should dispel these illusions. The Ordnance Department is getting straightened out in commendable fashion in spite of some attempts to "sprag" the wheels. Production has been stimulated in many quarters, but this condition, which ordinarily would be welcomed with joyous acclaim, is getting us into a tangle that no one seems able to unravel.

Commodities are beginning to pile up faster than the railroads can get them to the seaboard or than ships can take them away. And the remedy for this state of affairs has not yet been found. It is this congestion, only now becoming generally known, that was the real cause of "workless" days and not any shortage of coal. The bad weather defeated the plan to some extent and strengthened the Kaiser's claim to being on good terms with the head of the weather bureau; but the shutdowns did prevent the piling up of more freight shipments and helped to clear the situation, even if only temporarily.

The railroads are in notoriously bad shape—the outcome of several years of railroad politics in an endeavor to force an increase of rates—for dividends were paid in many cases whether new rolling stock was bought or not, and the nation is now paying the penalty. Ships are not yet being built in sufficient numbers to offset U-boat sinkings, and on top of this scarcity of tonnage come the shipyard tie-ups, which create a series of emotions. The nature of these emotions depends on whether you own stock in the shipyards, are employed in the yards, or are solely and entirely concerned with winning the war.

We have got to win this war

The situation is serious—more so than many realize, and particularly so to those who fail to understand that the labor question has more to it than merely the fixing of wages and hours. Every day's delay in the shipyards means that fewer men and less food can be shipped "over there" this year.

At a time like this the first impulse is to say all manner of unkind and even violent things about men who refuse to work for $4.88 a day. In fact it is strong enough to urge that nothing should stand in the way of industry at present, so the President's message to the strikers was considered as pointed and satisfactory. Still, on the other hand, we must not forget that at this critical time men of high repute have admitted charging the Government $2000 an acre for land which they had previously paid $200 for, and which they had bought solely for the purpose of speculation. A wage of $6.60 a day, as asked for, is high for a carpenter, but to him it probably looks rather small when compared with a profit of $1800 an acre made by merely signing a few so-called legal papers. And his patriotism is not deeply stirred if he feels that the men who have so profited already have more money than they can use, while his $6.60 a day (allowing that he gets it) does not reach much above the actual cost of living. We all resent the delay when ships are needed so badly; we feel that nothing should cause the waste of a minute in this our period of greatest need; but we ought not to hypocritically preach patriotism to $4.88-a-day men and overlook the utter lack of it in those who have absolutely no excuse for their actions. The time has come when we must look matters squarely in their face and line ourselves up on the right side, no matter who is on the other. And, incidentally, this is also a good time to make ourselves visualize and realize that the Government is not a thing apart from us, with plenty of money and resources, but that it is a boiled-down essence of ourselves.

For every $1800 profit extracted, legitimate or otherwise, we as citizens and taxpayers must dig down in our jeans for that $1800 plus the cost of collecting it and plus the cost of enacting laws by which the aforesaid $1800 comes back in the form of taxes. And the $4.88-a-day man pays his full share in the way of rents, food, transportation and otherwise—not to mention the income tax to which he is liable, if he is single, under the new dispensation.

Another slant at the complexities, in which labor and transportation play a big part, is the question of farm produce, which must be had for domestic use, for our troops and for our allies. With ship carpenters at the $6.60 a day demanded, and with munition workers at from $5 to $20 per day (depending on whether it is a cost-plus contract or not), the farmer stands mighty little

chance of getting men at $40 a month, a wage even higher than the usual rate. And yet without labor the farmer cannot produce the crops on which we depend.

But in the Middle West, at least, the failure of transportation has imperilled millions of bushels of corn which had to be garnered before it was ripe to avoid the frosts. This must be dried before warm weather comes, or it will be a total loss. The railroads do not seem able to carry it to the elevators for drying, and unless they do, or some genius devises a way to dry the corn where it lies, the farmers may lose millions of dollars. More than this, they are not likely to plant heavily this year, knowing that railroad transportation is so far behind the needs of the country.

There is no use trying to coax back the water that is already over the dam (even the other variety of "dams" have not cleared the situation); but it is evident that some sort of planning must be done—if we are to eat good, square meals ourselves, not to mention saving food for our allies—which will coördinate farming, manufacturing and transportation in such a way that there will be enough food, that it will not be wasted or sold at speculative prices, and that labor's wages will at least be sufficient to provide a modicum of well-being for themselves and families. But if no constructive planning is done by those who ought to do it we may expect more different kinds of industrial hell than we have ever dreamed of. Logic finds little response in an empty stomach, especially when the "tummies" of the kiddies are in the same condition.

The lack of ships makes it impossible to send our munitions "over there" as fast as we had planned and hoped. The railroads can thank the Kaiser for furnishing them with an alibi, for had we the ships we should then have been tied up for want of locomotives and cars to haul the products of the shops to the seaboard. The result of this is bound to show later in a curtailment of production, for obviously it is useless to manufacture two or three times as much as can be shipped. This curtailment is already felt in some quarters, and men are being laid off, bearing out the contention of labor officials that there is no shortage of man power.

This is affecting builders of machine tools as well as makers of munitions and other products, because the machine-tool industry is the foundation of all the others. And it is hard to say where the ramifications will stop.

With the stoppage of war work for lack of ships it is evident that one of two things must happen: either some avenue of employment must be found for those who will be thrown out of work, or there will be thousands unemployed in the industrial sections of the country. It is not a cheerful prospect, but it must be faced, and the more wisely it is considered and acted upon the more likely are we to win the war quickly. And time is a most important element.

We can be sure that men will not see their families starve. They will not forget that great fortunes have been made during the past three years as a result of war contracts, in spite of the higher wages that have been paid to some, and they are very likely to demand a pro-rata share of the edibles of the country. Money as such does not count when people are hungry.

How to Save Coal in Industrial Plants

By Fred R. Low, *Editor of "Power"*

FIFTY to 70 per cent. of the cost of power is for coal. Experts place the avoidable waste of coal in the boiler plants of the industries at 10,000,000 tons a year. A boiler efficiency of 65 to 70 per cent. can be easily maintained; but 40 to 50 per cent. is more common. The conditions that influence boiler efficiency change suddenly and frequently during the day.

No one thing promotes fuel economy more than keeping a record of:

1. The weight of coal fired to the boiler.
2. The weight of feedwater and its temperature.
3. The average percentage of CO^2 (carbon dioxide) in the flue gases.
4. The temperature of the gases as they leave the boiler.
5. The draft for combustion.
6. A record of the weight of steam generated in each boiler is often desirable.

PROVIDED with the apparatus for measuring these, your engineer not only can find the highest working efficiency, but by reference to his records can immediately discover sources of waste. Without this knowledge operation is mere guess work.

Some questions to ask yourself:

Is my plant making the maximum use of exhaust steam and hot gases?

Is the warm condensate from drips and industrial machines returned to the boilers or wasted to the sewer?

Are the steam traps tight?

Are the boiler settings air tight?

Would not mechanical stokers be a paying investment?

Are the steam, hot-water and refrigerating pipes suitably covered?

Won't you ask your engineer to report to you on the above?

Personals

William G. Sullivan has been elected assistant treasurer of the Standard Process Steel Corporation, Phillipsburg, N. J.

George P. Huffman has been appointed manager of the forge department of the Davis Sewing Machine Co., Dayton, Ohio.

M. Beck, formerly research engineer, Duesenberg Motors Corporation, Chicago, is with the same company at Elizabeth, N. J.

E. W. Edwards, president Edwards Mfg. Co., Cincinnati, Ohio, has been reëlected president of the Cincinnati Rapid Transit Commission.

V. L. Downing, formerly assistant chief draftsman of the Nash Motors Co., Kenosha, Wis., is now designer with the Mitchell Motors Co., Racine, Wis.

G. M. Carter, formerly general manager of the Adams Truck Foundry and Machine Co., Finlay, Ohio, is now general manager and vice president of the Adams Axle Co.

Raymond M. Everhard, formerly with the Cole Motor Car Co., Indianapolis, Ind., is now final tester and inspector of automobiles for M. C. Kale & Co., Laporte, Ind.

C. C. Jett, who has been connected with the enginering offices of Julian Kennedy, Pittsburgh, has been appointed chief draftsman of the Donner Steel Co., Buffalo.

E. H. Delling, formerly research engineer of the Saxon Motor Car Corporation, Detroit, Mich., is now designing engineer of the Stanley Motor Carriage Co., Newton, Mass.

C. S. Ash, formerly with the Wire Wheel Corporation of America, Buffalo, N. Y., is now chief engineer and plant manager of the National Wire Wheel Works, Inc., Geneva, N. Y.

David P. Ballard, for a number of years purchasing agent of the Wellman-Seaver-Morgan Co., Cleveland, has joined the forces of the National Acme Manufacturing Co., that city.

L. H. Thullen, formerly in the employ of the Hall Switch and Signal Co., New York, has assumed the duties of general manager of the Grand Rapids Brass Co., Grand Rapids, Mich.

E. P. Worden, has resigned his position of chief engineer for Henry R. Worthington to accept the position of mechanical engineer for the Submarine Boat Corporation, New York City.

Allen Breed, formerly with the Lodge & Shipley Machine Tool Co., Cincinnati, has resigned to accept a position as special sales engineer for the Brown & Zortman Machinery Co., Pittsburgh, Penn.

George Endicott, for two and half years mechanical engineer at the Morgan Spring Co., Worcester, Mass., has resigned to accept a position in the sales department of the Wickwire Steel Co., of Buffalo, N. Y.

Edwin A. Moore has terminated his relations with the Union Switch and Signal Co., Swissvale, Penn., as works manager, and has assumed the duties of manager of the Liberty Ordnance Co., Bridgeport, Conn.

James McNaughton has been elected president of the Eddystone Munitions Co., Philadelphia, Penn. Prior to his going to Eddystone he was vice president of the American Locomotive Co., New York City.

James M. Welch, tool foreman of the American and British Mfg. Co., Bridgeport, Conn., has resigned to become an assistant superintendent of a department of the Bethlehem Steel Corporation, Bethlehem, Penn.

Eliot A. Kebler, secretary and treasurer of the Matthew Addy Co., Cincinnati, has resigned to take the position of president and secretary of the Fawcus Machine Co., Pittsburgh, succeeding the late Thomas Fawcus.

James Brakes, Jr., formerly in the employ of the Kimberly-Clark Co., Neenah, Wis., as testing engineer, has accepted the position of inspector in the power department of the Western Electric Co., Hawthorne, Ill.

B. D. Thompson, formerly superintendent of the L. O. Gordon Mfg. Co., of Muskegon, Mich., has resigned and taken charge of the engineering and sales department of the Charles A. Strelinger Co., Detroit, Mich.

J. H. Bickley, for 17 years mechanical engineer of the Reading Iron Co., Reading, Penn., has resigned to accept the position of superintendent of inside engineering for the Merchant Shipbuilding Corporation, Bristol, Penn.

J. B. Phillips, for eleven years superintendent of the Borden Co., Warren, Ohio, has resigned this position to accept the factory management of the Nye Manufacturing and Tool Co., 108 North Jefferson St., Chicago, Ill.

William A. Carrel, formerly general superintendent, Beaver Motor Mfg. Co., and superintendent of one of the plants of the International Harvester Co., is now chief engineer and works manager of the Erd Motor Co., Saginaw, Mich.

Earl E. Eby, for the past two years manager of the industrial-bearing division of the Pittsburgh office of the Hyatt Roller Bearing Co., has been appointed assistant sales manager and will be located in the Metropolitan Building, New York City.

Clarence R. Vogt, formerly manager of Vogt Brothers Mfg. Co., Louisville, Ky., is now in Federal service. He has been stationed at the Frankford Arsenal at Philadelphia since June and has just been promoted from first lieutenant to captain, U. S. R.

C. E. Conkling, formerly with the Mesta Machine Co., Pittsburgh, Penn., has been commissioned a captain in the Ordnance Department of the army. He will be attached to the steel-production division, which has charge of speeding production in that industry.

Cameron C. Smith, president of the Union Steel Casting Co., Pittsburgh, who was recently appointed a major in the Ordnance Reserve Corps, has been assigned to the production department, carriage division of the Ordnance Department of the United States Army, and his headquarters will be in Washington, D. C.

William G. Hammerstrom, chief engineer of the Lynchburg Foundry Co., has been promoted to the position of general superintendent and will be located at Lynchburg, Va. He will continue in general charge of all engineering matters for the three plants of the company, the other two being at Radford, Va., and Anniston, Ala.

Ethelbert Favary has recently taken charge of a course in motor vehicle engineering that will be given evenings at Cooper Union, New York. The course will include classroom work, in which the study of principal parts and the theory of construction will be given together with laboratory work, the latter being devoted mostly to engine testing.

J. W. Lauren, formerly vice president of the Reynolds Wire Co., Dixon, Ill., and **L. H. Bergman**, until recently fuel engineer of the Midvale Steel Co., Philadelphia, have incorporated the American Industrial Engineering Co., with offices in the Monadnock Bldg., Chicago, and will specialize on wire-mill equipment, pulverized fuel installations, furnace work and fuel economy.

J. H. Foster, president of the Hydraulic Pressed Steel Co., Cleveland, has been appointed chairman of the War Industries Committee of the Cleveland Chamber of Commerce. This committee will open a Washington office and will coöperate with the various Washington departments and Cleveland manufacturers, with a view of furnishing the different departments with information as to products that can be made for the Government by the manufacturing plants of Cleveland, Ohio.

Obituary

George J. Althen, treasurer of the Driver-Harris Co., Harrison, N. J., died Friday, Feb. 15. Mr. Althen was born in Newark, N. J., in 1857, and for many years was engaged in the grocery business. For the last four years he has been connected with the Driver-Harris Co. and was well known because of his affiliation with the National Credit Men's Association, for which he represented New Jersey on the executive committee.

Business Items

The W. F. Davis Machine Tool Co., New York, Chicago, Cleveland and Cincinnati, has been made sole agent in the United States for the Chicago automatic screw machine.

The Searle Manufacturing Co., Anderson, Ind., is now renewing old and dull files by a process which does not make use of acids or sandblast or does not, it is claimed, disturb the temper of the steel.

The Fawcus Machine Co., Pittsburgh, Penn., has elected as president Eliot A. Kebler, secretary and treasurer of the Matthew Addy Co., Cincinnati, Ohio; vice president, G. E. Shaw, of Shaw, Reid & Bros.; general manager, A. F. Cooke, formerly sales manager; sales manager, W. C. Bates, and treasurer, T. J. Haley.

The Hale & Kilburn Co., New York City, was reorganized at a special meeting of the stockholders. The plan of reorganization provided by the W. D. Baldwin committee was made effective. The certificates of the new corporation are expected to be ready for delivery by the Bankers' Trust Co. some time in March. The name of the company has been changed from Hale & Kilburn Co. to Hale-Kilburn Corporation.

Catalogs Wanted

J. Straus, 47 Fort Washington Ave., New York City, requests that manufacturers of lathes, presses, millers, shapers and other toolroom equipment submit catalogs and other data of interest to prospective manufacturers.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, first Tuesday Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

The sixth annual meeting of the Chamber of Commerce of the United States of America will be held in Chicago, Apr. 10, 11 and 12, 1918. Elliot H. Goodwin, Riggs Building, Washington, D. C., is general secretary.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

The National Metal Trades Association announces the following program of its forthcoming convention, which will be held at the Hotel Astor, New York City: Monday, Apr. 22, 10 a.m., executive committee meeting; 7 p.m., secretaries' dinner. Tuesday, Apr. 23, 10 a.m. to 5 p.m., council meeting; 10 a.m., meeting of local secretaries; 6:45 p.m., alumni dinner. Wednesday, Apr. 24, 9:30 a.m. and 2 p.m., convention; 12:30 p.m., buffet luncheon; 7 p.m., banquet. Thursday, Apr. 25, 9:30 a.m., and 2 p.m., convention and meeting of the incoming administrative council. Homer D. Sayre, People's Gas Building, Chicago, Ill., is the secretary.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Feb. 28, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$24.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	30.00
*Bessemer, Pittsburgh	37.25	36.30	35.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia................	33.75	33.75	30.50
*No. 2, Valley.....................	33.95	33.00	31.00
No. 2, Southern Cincinnati............	35.90	35.00	26.90
Basic, Eastern Pennsylvania..........	33.75	30.00	30.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Feb. 28, 1918	One Month Ago	One Year Ago	Feb. 28, 1918	One Year Ago	Feb. 28, 1918	One Year Ago
Structural shapes ...	$4.20	$4.20	$4.10	$4-4.04	$4.10	$4.20	$3.75
Soft steel bars......	4.10	4.10	4.00	4-4.04	4.00	4.10	3.85
Soft steel bar shapes.	4.10	4.10	4.00	4.14	4.00	4.10	3.75
Plates, ¼ to 1 in. thick	4.45	4.45	5.15	4.39	4.75	4.45	4.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Feb. 21, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York..................	4.70	3.75
Warehouse, Cleveland	3.98½	3.70
Warehouse, Chicago	4.10	3.65

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Feb. 28, 1918	New York One Month Ago	New York One Year Ago	Cleveland Feb. 28, 1918	Cleveland One Year Ago	Chicago Feb. 28, 1918	Chicago One Year Ago
*No. 28 black......	5.00	6.45	5.00	5.75	6.45	5.50	6.45	5.15
*No. 26 black......	490	6.35	4.90	5.65	6.35	5.40	6.35	5.05
*Nos. 22 and 24 black	4.85	6.30	4.85	5.60	6.30	5.35	6.30	5.00
Nos. 18 and 26 black	4.80	6.25	4.80	5.55	6.25	5.30	6.25	4.95
No. 16 blue annealed.	4.45	5.65	4.45	5.10	5.65	4.95	5.65	5.00
No. 14 blue annealed.	4.35	5.55	4.35	5.00	5.55	4.85	5.55	4.90
No. 10 blue annealed.	4.25	5.45	4.25	4.95	5.45	4.75	5.45	4.85
*No. 28 galvanized..	6.25	7 70	6.25	7.50	7.70	7.00	7.70	7.25
*No. 26 galvanized..	5.95	7.40	5.95	7.20	7.40	6.70	7.40	6.95
No. 24 galvanized...	5.80	7.25	5.80	7.05	7.25	6.55	7.25	6.80

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Feb. 28, 1918	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Feb. 28, 1918	One Year Ago
New York	$15.00	$8.00
Cleveland	15.30	7.50
Chicago	15.00	6.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16..	
No. 18	
No. 20	

[1]Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

***Special Welding Wire**

⅛	33.00
5/32	30.00
3/16	38 00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Feb. 28, 1918	Cleveland Feb. 28, 1918	Chicago Feb. 28, 1918
Tire	4.10	5.00	4.00
Toe calk	5.70	6.00	4.25
Openhearth spring steel...	7.50	8.25	8.50
Spring steel (crucible analysis)	11.00	11.25	12.00
Coppered bessemer rods...	9.00	....	7.50
Hoop steel	4.95	....	4.95
Cold-rolled strip steel.....	9.00	....	3.50
Floor plates	6.19½	....	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to [illegible]......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4......	29%	17%
4½ to 6......	44%	32½%	4½ to [illegible]......	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. **Cast iron, standard sizes, 15 and 5%.**

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Feb. 28, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	35.00
Tin, in 5-ton lots..................	85.00	86.00	50.00
Lead	7.25	6.50	8.75
Spelter	8.00	7.75	10.25

*Government price.

ST. LOUIS

Lead	7.10	6.37½	8.00
Spelter	7.75	7.50	10.00

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Feb. 28, 1918	New York One Month Ago	New York One Year Ago	Cleveland Feb. 28, 1918	Cleveland One Year Ago	Chicago Feb. 28, 1918	Chicago One Year Ago
Copper sheets, base.	31.50-33.00	35.50	42.00	32.50	44.00	36.00	43.00
Copper wire (carload lots	32.00	32.00	36.00	28.50	44.00	34.50	37.00
Brass pipe base....	36.50	36.00	47.50	35.50	52.00	41.50	46.50
Brass sheets	30.75	30.75	45.50	29.00	43.00	35.50	44.00
Solder ½ and ½ (case lots)......	62.00	48.00	28.37½	47.00	27.50	48.75	28.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Feb. 28, 1918	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:
Carload lots f.o.b. mill.................................... 19.0

	In Casks Feb. 28, 1918	In Casks One Year Ago	Broken Lots Feb. 28, 1918	Broken Lots One Year Ago
Cleveland	21.00	23.00	21.25	23.25
New York	20.00	22.00	20.50	23.00
Chicago	21.25	22.50	21.75	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Feb. 21, 1918	One Year Ago
New York	13.50	18.00
Cleveland	17.00	26.00
Chicago	16.00	17.25

MANUFACTURE of the 75-MM. HIGH-EXPLOSIVE SHELL

Part One

This article and the ones to follow will describe the methods used in the manufacture of the 75-mm. Mark I, high-explosive shells by the Worthington Pump and Machinery Corporation, at its Jeanesville Iron Works plant, Hazleton, Penn.

By S. A. Hand

THE forgings for these shells are furnished by the Government and are made by the Valley Forge, Verona, Penn.

The composition of the steel in these forgings is: carbon, 0.50 to 0.60 per cent.; manganese, 0.60 to 0.80 per cent; silicon, 0.15 to 0.25 per cent.; sulphur (not over), 0.05 per cent.; phorphorous (not over), 0.05 per cent.

The physical properties required are: a tensile strength of not less than 90,000 nor more than 120,000 lb. per sq.in. of section; an elastic limit of 45,000 lb., and an elongation of 12 per cent. in 2 in. when the test piece is a round bar 0.505 in. in diameter. When tested by the scleroscope the reading is from 23 to 25, which on the average would correspond to a Brinell reading of about 217. The illustration, Fig. 1, shows the forging in heavy lines, and the comparative size of a finished shell body in section.

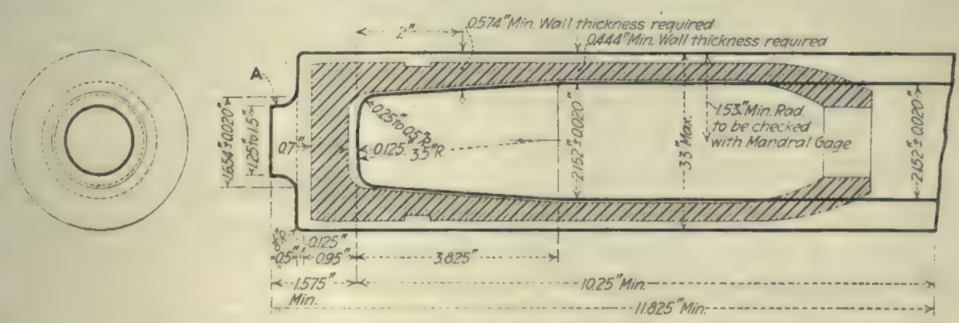


FIG. 1. OUTLINES OF FORGING AND FINISHED SHELL

Figs. 2 and 3 show gages for testing the thickness of the wall of the forging at two points. The contact points of these gages can be spread apart to enable them to pass over the walls of the forgings, and when released the springs bring the points in contact with both the interior and exterior surfaces of the walls. Pointers at the other end of the gages travel across graduated pads as the gage points are opened or closed, and indicate any deviation from the normal wall thickness.

By using these gages at several points in the same plane, any eccentricity of the hole in relation to the outside will be noted and the amount can be measured.

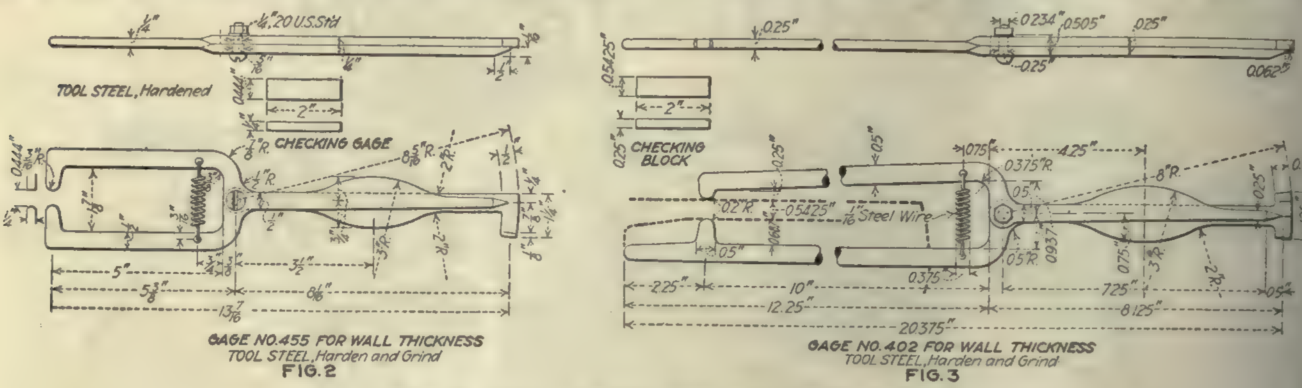
The amount of eccentricity allowed in these forgings is $\frac{3}{32}$ in. from the axis. In other words, if the forging was chucked true with the inside and rotated, an indicator should show a deflection of not over $\frac{3}{16}$ inch.

All forgings have the heat number stamped on the base, and forgings bearing the same heat number are kept in a separate group. Each group is put through the various operations as a unit. Fig. 4 is a reproduction of the drawing of the completed shell. The first machine operation is cutting off the open end of the shell as shown in the illustration, Fig. 5. This is done in a lathe and the shell is held in an air-operated chuck having an interior ring that is cut into three equal segments, one of which is shown at *A* in the illustration. Each segment has a serrated pad *B* of hardened steel on its inner surface.

When the air pressure is applied, the three segments close in on the shell and the serrations in the pads serve to prevent the shell from slipping in a rotative direction when under pressure of the cut that is taken in this machine.

When the air is released the segments are forced outward by springs *C*, which releases the shell.

The cutting-off tool is a stellite blade about ⅜ in. thick and similar in shape to the blades generally used in cutting-off toolholders. In this case no toolholder



FIGS. 2 AND 3. GAGES FOR WALL THICKNESS

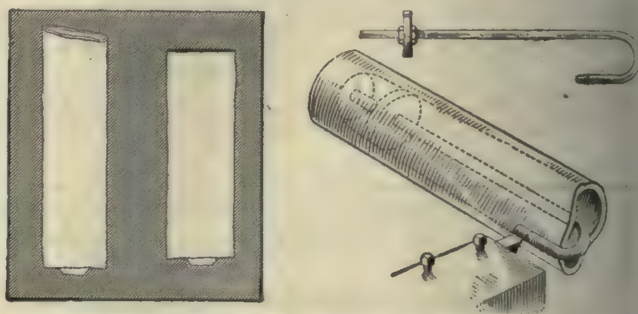
is used, as the blade is clamped in a channel at the side of the tool block which is very heavy and rigid.

SEQUENCE OF OPERATIONS

1. Cut off open end.
2. Grind tit.
3. Center.
4. Rough-turn.
5. Face base and cut off center.
5A. Rough-bore and face for depth.
6. Finish-bore.
   Volumetric test.
7. Recenter.
8. Forge in nose.
9. Machine nose and check for length.
10. Thread-mill nose.
11. Heat treat.
12. Sandblast interior.
13. Screw in plug and test for eccentricity.
14. Finish-turn.
15. Grind bourrelet.
9A. Profile with form tool.
   Form-grind nose.
16. Turn band groove and form base.
17. Remove center plug and test for concentricity.
18. Knurl band groove.
19. Shear off tit.
20. Grind base.
21. Wash.
22. First Government inspection.
23. Hydraulic test.
24. Press on band.
25. Groove base for gas check.
26. Turn band.
27. Assemble gas check and washer.
28. Marking.
29. Second Government inspection.
30. Slushing and packing.

the hole, washer end first, the function of the washer being to keep the gage rod approximately in the center of the hole. When the end of the gage rod bottoms in the hole, the lathe carriage is moved until the left side of the tool is brought flush with the inside face of the bent part.

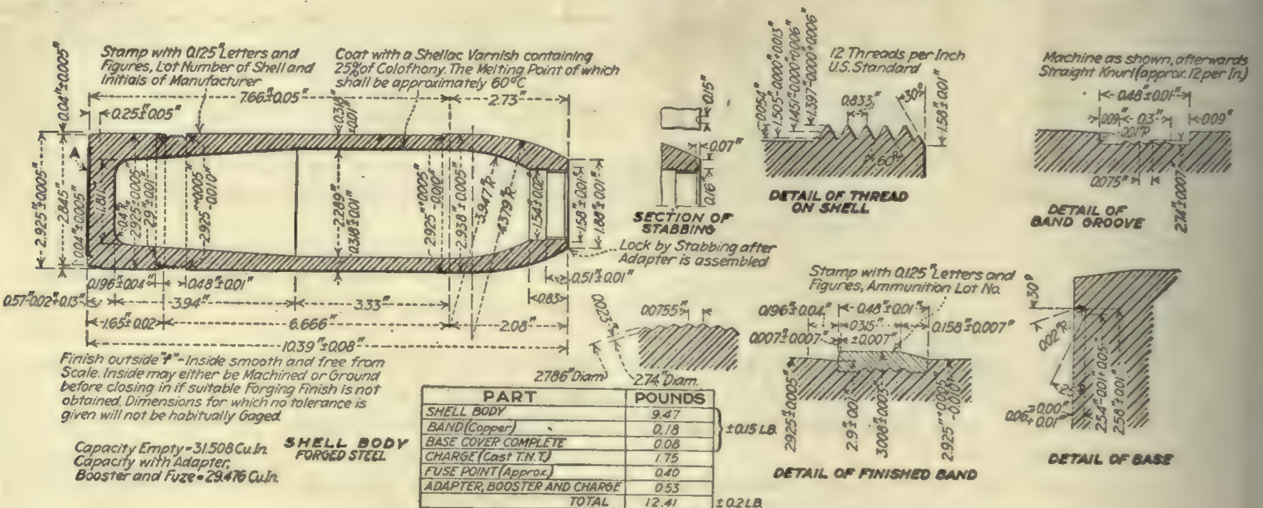
Cutting off the end with the tool in this position



TRANSFORMATION FOR OPERATION 1: CUT OFF OPEN END

Machine used: American or LeBlond lathe; Special fixtures: Air-operated chuck; Gages: 1, for setting tool; Production: 60 per hour; Cutting tool: Stellite.

leaves an allowance of ⅛ in. for facing the bottom of the hole to bring it to the proper depth. Ordinarily this allowance would be ample, but in machining these forg-



PART	POUNDS	
SHELL BODY	9.47	±0.15 LB.
BAND (Copper)	0.18	
BASE COVER COMPLETE	0.08	
CHARGE (Cast T.N.T.)	1.75	
FUSE POINT (Approx.)	0.40	
ADAPTER, BOOSTER AND CHARGE	0.53	
TOTAL	12.41	±0.2 LB.

FIG. 4. FINISHED SHELL

The gage D is for setting the tool to the proper position. It is a steel rod with one end bent around to form a half circle. The other end is threaded and has a thick washer about 2 in. from the end which is held by 2 nuts. After being chucked the gage is put into the hole, washer end first, the function of the washer being to keep the gage rod approximately in the center of the hole.

ings it is sometimes necessary to remove more than in. of stock from the bottom of the hole, as will be explained later. As in the illustration the pieces cut from the open end of the forgings are very irregular in shape and vary in length from 1½ to 2½ inches.

After the end has been cut off, the tit, shown at *A*, Fig. 1, is ground a t the end to remove the scale. This is done to expose any cracks or flaws that may have been developed during the process of forging. It also gives a clean surface at that point for drilling and countersinking the center.

For centering, the shell is held on an air-operated mandrel having six serrated buttons of hardened steel, three of which are near the front and three near the rear and equidistantly spaced in relation to the circumference. When air pressure is applied these buttons are forced outward and grip the interior of the shell. When the pressure is released the buttons are forced inward by flat springs, allowing the shell to be easily removed from the mandrel.

After being mounted on the mandrel the shell is revolved while the combination drill and countersink is held stationary in the tailstock spindle and is fed to the work by means of a lever.

Next, the shell is rough-turned on the outside, and for this operation it is held on a mandrel similar to the one just described, and the outboard end is supported by the tail center.

The tool used is stellite and is rigidly held in a special tool block as may be seen in Fig. 6.

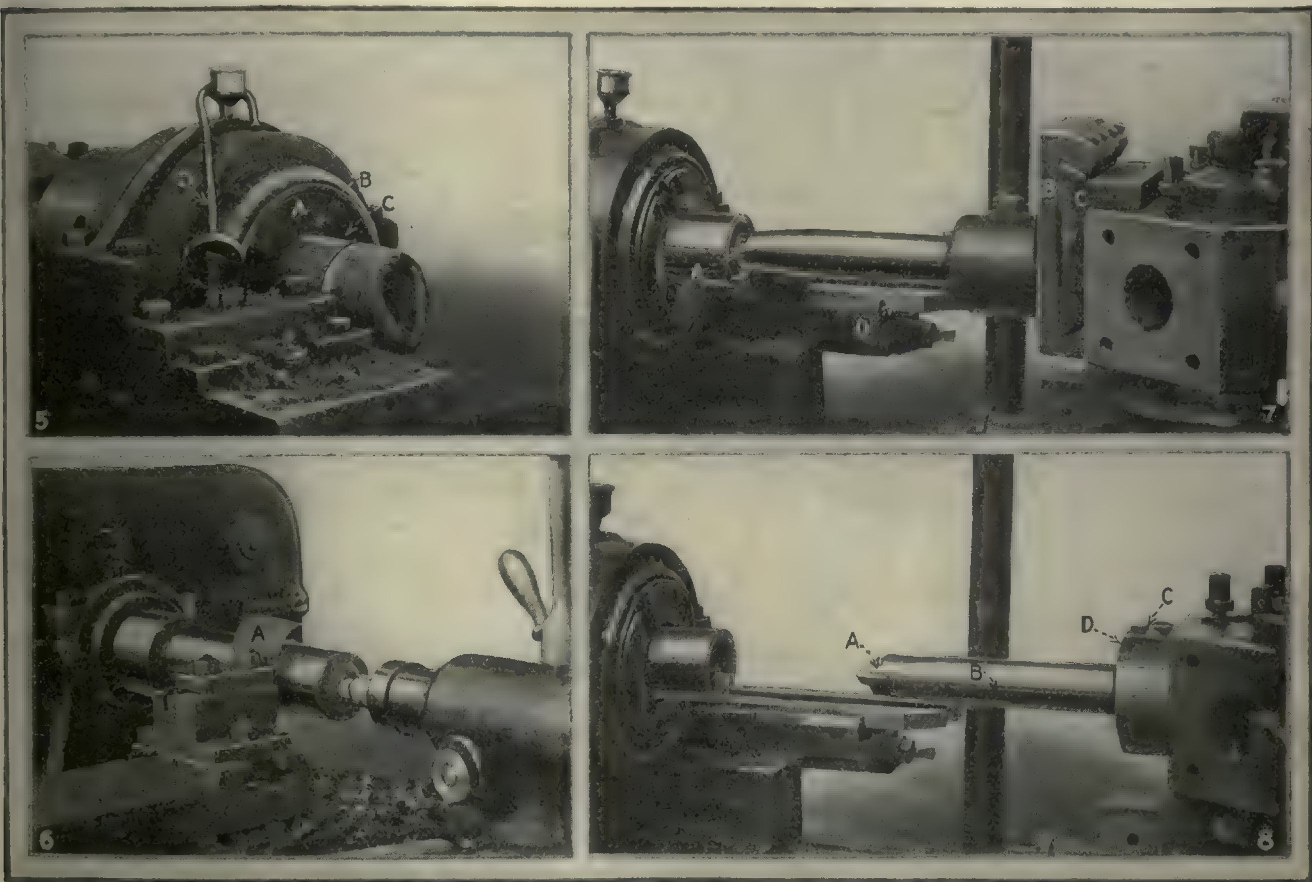
At *A* is a guard which has proved very effective in preventing the chips from flying toward the operator.

In roughing, the diameter is reduced from 3.30 to 3.12 in. This would indicate that the chip removed is only 0.09 in. thick, but in reality it is much thicker; the thickness according to the eccentricity.

Even with this comparatively light chip, a surface speed of 67 ft. per min. is all that can be maintained continuously without destroying the cutting edge of the tool.

An attempt was made to do the rough-turning at a speed of 100 ft. per min., but the stellite tools would not stand up, so the speed was reduced.

After the rough-turning, the shell is transferred to a turret lathe to be rough-bored and the hole faced to depth. It is held in an air-operated chuck similar to the one used in the cutting-off operation, and the boring is done with a single pointed tool held in the end of a boring bar as shown at *A* in the illustration, Fig. 7.



FIGS. 5 TO 8. VARIOUS OPERATIONS ON THE SHELLS

Fig. 5—Cutting off open end. Fig. 6—Rough-turning. Fig. 7—Rough-boring. Fig. 8—Facing bottom of hole.

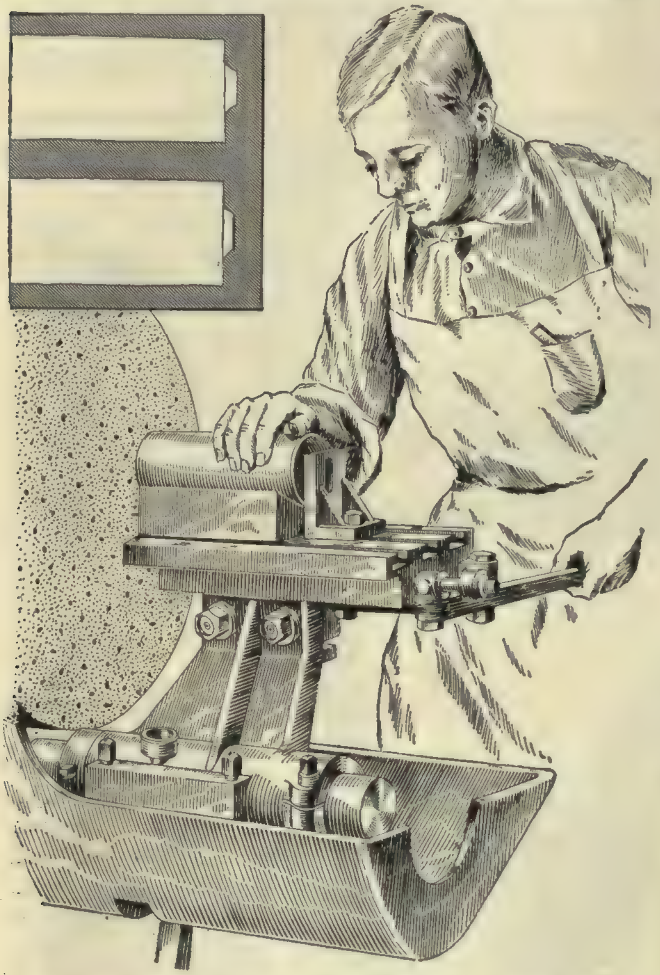
By referring to the illustration, Fig. 1, it will be noticed that the hole in the shell is tapered for a considerable distance at the base end, so that in boring the hole it is necessary to provide means for guiding the boring bar and tool to produce this taper.

For this purpose the bar, Fig. 7, carrying a single-pointed tool *A*, is mounted on the movable member of a cross-slide *B*, the stationary member *C* being fastened to the turret. In addition to carrying the boring bar, the movable member of the slide is provided with a lug projecting to the rear. This lug carries a hardened-steel roller which fits into a profile guide or cam *D*, rigidly mounted on the lathe shears at the rear. This guide or cam which is also made of hardened steel, is of the proper profile to produce a hole of the required contour.

The hole is next faced at the bottom to bring it to the proper depth; this is done by a cutter *A*, Fig. 8,

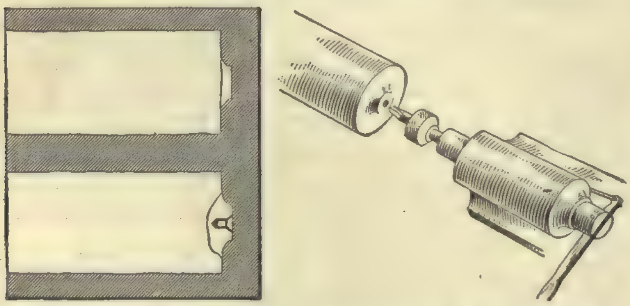
at the extreme end of the bar *B*. On the bar *B* near the turret will be seen a collar *C* which carries a flat-nosed tool *D*. The distance between the faces of the cutter *A* and the flat-nosed tool *D* is equal to the depth of the hole in the shell.

Thus it will be seen that if it should be necessary to deepen the hole more than was allowed for in previous operations, a corresponding amount of metal will



TRANSFORMATION FOR OPERATION 2: GRIND TIT

Machine used: Gardner disk-grinding machine; Special fixtures: None; Production: 200 per hour.



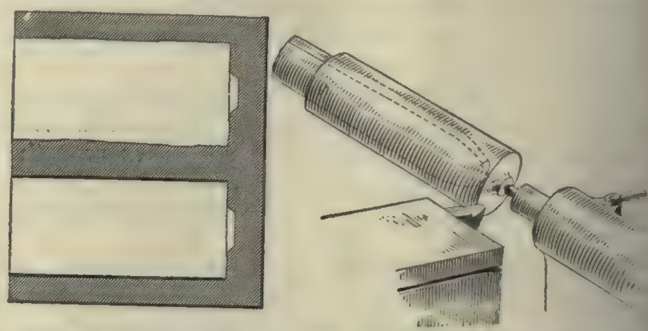
TRANSFORMATION FOR OPERATION 3: CENTERING

Machine used: American or LeBlond lathe; Special fixtures: Air-operated mandrel; Gages: None; Tool: Combined drill and countersink high-speed steel; Production: 45 per hour.

be removed from the open end of the shell by the tool *D*, and the proper depth of hole will be maintained.

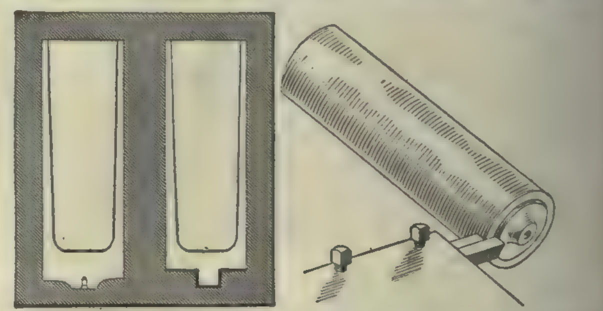
This provision is necessary because in forging the shell blank, the piercing punch becomes so hot during continuous use that the end is gradually burned away; this leaves the hole somewhat shallower that it should be, greatly enlarges the radius at the bottom corners and makes the metal spongy at the bottom.

In facing the bottom of the hole it is often necessary to remove the shell from the chuck, shake out the chips and carefully examine the appearance of the metal at



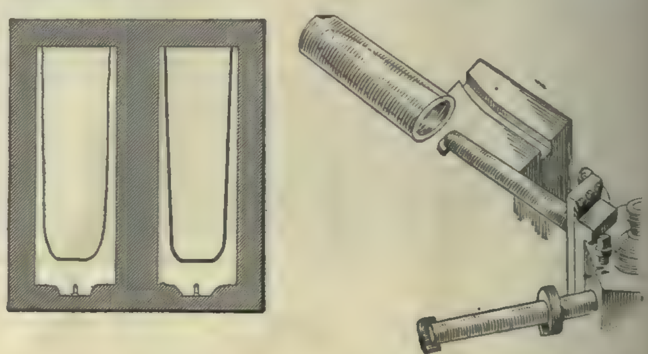
TRANSFORMATION FOR OPERATION 4: ROUGH TURN EXTERIOR

Machine used: American or Hamilton lathe; Special fixture: Air-operated mandrel; Gages: Snap and machine stops; Speed: 67 ft. per minute; Cutting tool: Stellite; Production: 24 per hour.



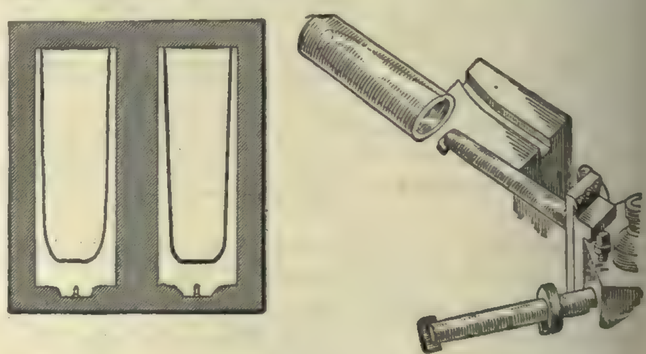
TRANSFORMATION FOR OPERATION 5: FACE BASE AND CUT OFF CENTER

Machine used: LeBlond lathe; Special fixtures. Air-operated chuck and two tools set in gang; Gages: machine stop; Production: 30 per hour.



TRANSFORMATION FOR OPERATION 5A: ROUGH-BORE AND FACE TO DEPTH

Machine used: American, LeBlond or Foster turret lathe; Special fixtures: Air-operated chuck, cross-slide on turret, profile guide on machine, boring bars and collar with facing tool; Gages: Plug; Production: 15 per hour.



TRANSFORMATION FOR OPERATION 6: FINISH-BORE

Machine used: LeBlond lathe; Special fixtures: Air-operated chuck, cross-slide on turret, profile guide on machine-boring bars and collar with facing tool; Gages: Plug and depth; Production: 15 per hour.

the bottom of the hole and if the metal at that point is not clean and sound, to continue the operation until good metal is found. This operation is essentially one of cut-and-try, as the amount of poor metal that it is necessary to remove is an undetermined factor.

After the rough boring has been completed the base of the shell is faced off to cut out the original center and to form a tit for the new center. This is done in a lathe and the shell is held by an air chuck of the same general type as has already been described and which is in general use for all operations where chucking is necessary. Two tools $\frac{1}{2}$ in. wide are used. They are set side by side in the tool block, and the one on the right projects $\frac{3}{8}$ in. beyond its neighbor. Thus it will be seen that when the tool on the right has reached the

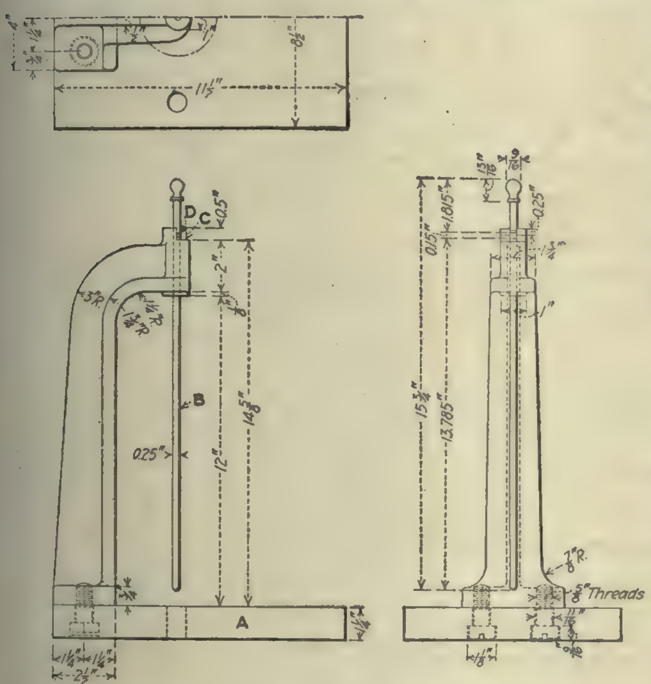


FIG. 9. GAGE FOR BASE THICKNESS

center the other tool is still $\frac{3}{8}$ in. away from it. This leaves a new tit $\frac{3}{4}$ in. in diameter and $\frac{1}{2}$ in. long.

The next operation is that of finish boring which is practically a repetition of the rough-boring operation. After finishing the bore the hole is gaged for diameter with a limit gage, and the base thickness is gaged by the gage shown in Fig. 9. The shell is stood on end on the base *A* and the rod *B* is let down to the bottom of the hole. The two marks *C* and *D* near the top of the rod represent the maximum and minimum thicknesses allowable.

Why Small Tools Do Not Last

By W. D. Forbes

There has come to my ears of late a great amount of grumbling about the quality of material now used in small tools such as taps, reamers, drills, etc., and to poor material is laid the unsatisfactory quality of tools. I took the trouble to make inquiries of those who manufacture small tools, and such toolmakers assured me that no change in the quality could be traced by them, nor would they admit that the work was not up to previous standards; but they did admit that they had received endless complaints about their products. On looking into the matter I found that there was good reason for the complaint, namely, that the tools were being used by very unskilled men—in fact were abused. Taps were used without proper oiling: they were wrenched about and treated without any knowledge of their requirements. This was also the case with all other small tools. Where the tools were in the hands of skilled men they were doing never less than twice as much work in a given time as previously. These two conditions told the whole story to me. Unskilled men have to be used, while skilled men just do more than formerly, and it is evident that under these conditions small tools will not last as long as heretofore.

I found milling cutters were among those complained of, and the cause of dissatisfaction was traceable to the reasons I have cited. Another reason for some of the tool troubles is that harder material is being used in many Governmental articles; also on account of hurry in the annealing of steel it is not always properly done. There are those who may differ from me in my deductions, but my reasons may be easily proved by observation. I believe that the small toolmakers are making their products up to standard and are not to blame for the many complaints made against the durability of their products.

Safeguarding Sales

By H. D. Murphy

The article on safeguarding sales by George W. Shaw, on page 100, brings to my mind an instance where we considered ourselves properly safeguarded, and our experience may be of interest to your readers.

A corporation made a contract with us to supply certain equipment for a building which it was erecting for the United States Government. The material was supplied without hesitation inasmuch as not only was the general contractor bonded but Uncle Sam was the paymaster.

Practically over night the corporation was thrown into the hands of a receiver and it developed that the general contract was not between the corporation and the Government, but concerned only one member of the corporation, who as an individual had secured the contract and had been duly bonded. Upon the formation of the corporation he assigned to it all his assets, including this contract. The receivership was caused by the fact that the two sureties who had bonded the individual had also gone into the hands of receivers.

Since, these differences have arisen, the United States Government has refused to advance any money to the individual, because he is without bonds, or to the corporation because no assignments of contracts are recognized by Uncle Sam. It therefore became necessary for the various subcontractors to proceed with their work so that the building could be inspected and accepted as completed. Of course payment in full for completing this work is assured by the court, but payment for work done previous to the date of receivership, even in the case of subcontracts entirely completed, is subject to unknown shrinkage. Furthermore the legal lights state that all creditors are entitled to a slice of that money whether interested in this particular building or not.

The Call

By BERTON BRALEY

THE nation calls for service and for labor
  Of soul and body, intellect and brawn,
For after years of peace we draw the saber,
  And every man must help to "carry on!"
Amid the quiet office or the clamor
  Of shop and forge, the call to war is heard;
The draftsman's pen, the workman's lathe and hammer
  Must gain new zest in answer to the word.

SHIPS, more ships, and motors and munitions,
  Tools, supplies, in streams that never cease,
These we send upon their mighty missions,
  To aid the war that we must make for peace.
Nor is this challenge and this call to duty
  For labor only, capital must do
It's yeoman service—not for spoils or booty,
  But with the will to see the nation through!

THE country's task is huge, let no man scoff it,
  But though machinists have a vital share
In that vast job, they must not look for profit,
  In wage or dividend, save what is fair;
The soldiers who are serving in the trenches
  Know well enough what they are fighting for;
It is the men at drawing boards, at benches,
  At office desks—who must wake up to war!

Heat-Treating 3-In. Shrapnel Shells

SPECIAL CORRESPONDENCE

The munitions department of the Houghton research staff has compiled the following data on the heat treatment of three-inch shrapnel shells, one of the most largely used projectiles, and which the Government has under heavy contract for manufacture at present.

THE schedule given herewith enables the plant which perfected it and is now using it on shells that are being rushed to Pershing's batteries in France to turn out 7300 shells every 24 hours.

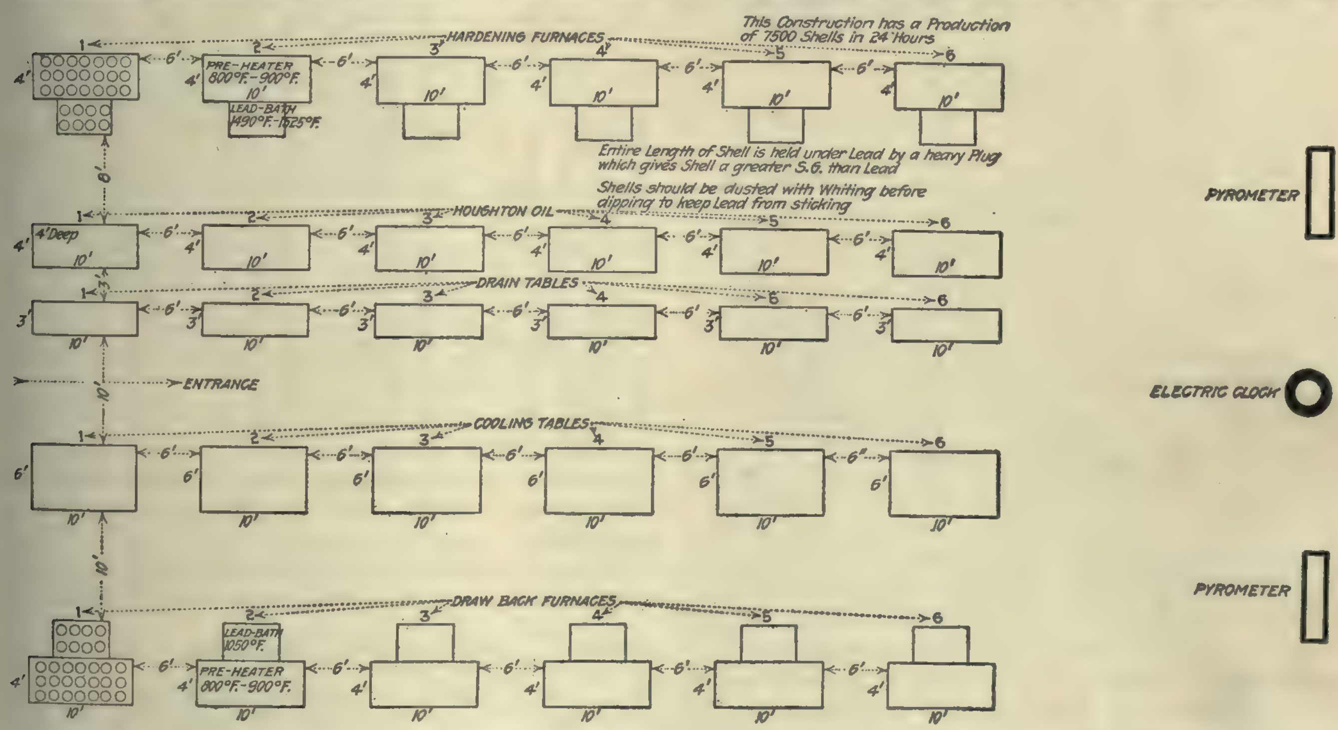
The accompanying illustration shows the layout of the heat-treating room most necessary to carry out efficiently the schedule of operations given.

First Operation—The billets are placed in the muffle furnace and brought to an even heat. It is very important that an even heat be used in order to avoid a light or heavy, uneven wall. In order to avoid the possibility of such condition the billets must be turned over so as to receive an even temperature.

Second Operation—After the shells come from the muffled operation they are placed in another furnace for annealing purposes. The heat for this operation will depend wholly upon the chemical analysis of the steel. For instance, upon steel testing, carbon, 0.44 to 0.63 per cent.; manganese, 0.65 to 0.76 per cent.; phosphorus, 0.018 to 0.022 per cent.; sulphur, 0.032 to 0.036 per cent.; silicon, 0.18 to 0.25 per cent., the heat required would be 1360 to 1425 deg. F. The shells should be brought up to this heat within a period of six hours and held at this heat from one to two hours—a total run of about eight hours. The shells are allowed to cool slowly in the furnace until a temperature of 400 deg. F. is reached. They are then removed from the furnace and allowed to cool in the air.

Third Operation—After the annealing operation the shells are sent to the rough-turn operation and then back to the heat-treating room.

Fourth Operation—One shell per minute is put in the preheater of the lead pot. Temperature of the preheater, 800 to 900 deg. F.; capacity of preheater, 20 shells. One shell per minute is then removed from the preheater and placed in the lead pot. Temperature of lead pot, 1490 to 1525 deg. F.; capacity of lead pot, 8 shells. One space to be left unfilled, which space is used



LAYOUT OF THE HEAT-TREATING ROOM

In the hardening and drawback furnaces the 21 holes in the preheaters and eight in the lead bath are so designed in number as to give the correct time of heating the shells.

The space between the furnaces is utilized in piling up shells previous to their going into the preheater.

The oil tanks are arranged so that there is one for each hardening furnace. These tanks are adequately cooled by means of cold-water pipes.

Below the oil tanks will be seen the draining tables, which are so equipped that the oil runs back from the tables into the tanks.

From the draining tables the shells are placed on trucks and taken to the draw-back furnaces. (See seventh operation). This draw-back operation follows the same procedure as the hardening operation.

From the draw-back furnace the shells are placed on the cooling tables. The tops of the cooling tables are made of a heavy meshed wire, so as to allow a free circulation of air around the shells while they are cooling.

When the shells are sufficiently cooled they are placed on trucks and sent to the machine shop. (See eighth operation). The electric clock referred to in the fourth operation is so designed that it will ring once a minute. Thus the shells are removed from the furnaces every minute.

One pyrometer takes care of the six hardening furnaces and the other pyrometer takes care of draw-back furnaces.

The furnaces, tanks and tables are numbered from one to six so that the chief heat treater can keep track of the shells in process.

It will be seen that the passageway between the hardening furnaces, oil tanks, drain tables, cooling tables and draw-back furnaces are very wide. Liberal width is allowed so that the work can be handled with the greatest facility and congestion of shells in process avoided.

The shells are pre-heated to increase production. If a cold shell was placed directly in a lead pot heated to 1490 or 1525 deg. F., it would naturally reduce to a considerable extent the temperature of the lead pot.

as a starting point. This method will give the shells 27 min. under heat. Many concerns are equipped with an electric clock for timing this operation.

Fifth Operation—The shells are removed from the lead bath and quenched in Houghton's No. 2 soluble quenching oil and allowed to cool.

Sixth Operation—Shells are taken from the quenching tanks and placed upon the draining table and surplus oil is allowed to drain.

Seventh Operation—The shells are removed from the draining table and given a draw-back operation. The required heat on the draw-back operation should be 1050 deg. F. The shells are drawn at the rate of 1 per min., receiving about 27 min. heat overall, and then placed on the cooling table.

Eighth Operation—From the cooling the shells receive what is known as the nose operation. The machinery used for this operation is generally a large punch such as that used for hot punching. This operation was tried out for hot nosing by a superintendent of a very large plant in the Middle West, but it was discovered after considerable experimenting that the process could be done by cold nosing at the rate of 3500 shells every 10 hours.

Ninth Operation—The shells pass to the final machining, and are finished and packed.

The Great Value of Constructive Inspection

By D. G. Meikle

No mechanic in his senses would take exception to the articles by "Teckeer" regarding constructive inspection on page 213 of the *American Machinist*.

It is unfair to many toolmaking establishments, however, to imagine that no such inspection exists, because it would be equivalent to self-destruction to neglect any possible precaution that would prevent the scrapping of valuable tool work. It would be impossible to avoid any such contingency if work were allowed to ramble from the planing machine to the boring mill and so on without checking over each consecutive operation and correcting the error before it was multiplied.

In our own shop each operation on every detail is estimated and typed on a sheet fastened to the blueprint of the detail, time saved on the estimate going as bonus to the workman. We have a superintendent, two foremen and three machine inspectors, whose combined duties consist in seeing that work is carried through with the minimum amount of error and delay. The machine inspectors are responsible for the checking of each operation on the machine, and every boring job has the buttons checked up before any hole is bored.

The foremen are on hand at all times to give advice and straighten out difficulties. The superintendent has charge of the whole, and adjusts all differences. This system has been in operation for some time and its success is unquestioned.

Each detail is held up on completion until all component parts are finished, and then sent to assembly. So we agree with "Teckeer" in the main points of his argument, and will be glad at any time to show him one toolroom at least where constructive inspection is carried out in every possible way.

Lathe Gears for Cutting Metric Screws

By Edward J. Rantsch

I have arranged the accompanying table of gearing, to be used when cutting threads of metric pitch in lathes having lead screws of English pitch. The proportion of gears necessary to cut pitches given in table may be determined at a glance. Mention is here made that should one desire to cut a ½-mm.-pitch thread on a lathe having a 6-pitch lead screw, it would be necessary to resort to compound gearing (in this case $\frac{15}{127} = \frac{3 \times 5}{5 \times 25.4} = \frac{3}{5} \times \frac{12}{12} = \frac{36}{60}$ and $\frac{5}{25.4} \times \frac{5}{5} = \frac{25}{127}$ in which gears 36 and 25 are the driving gears and 60 and 127 the driven gears. The 127 gear should be placed on the screw. The 127-tooth gear is special,

TABLE FOR CUTTING METRIC THREADS

M M Pitch To Be Cut	No. of Threads per 1 Inch of Lead Screw								
	1	2	3	4	5	6	8	10	12
½						15-127	20-127	25-127	30-127
1			15-127	20-127	25-127	30-127	40-127	50-127	60-127
1½		15-127	22½-127	30-127	37½-127	45-127	60-127	75-127	90-127
2		20-127	30-127	40-127	50-127	60-127	80-127	100-127	120-127
2½		25-127	37½-127	50-127	62½-127	75-127	100-127	125-127	150-127
3	15-127	30-127	45-127	60-127	75-127	90-127	120-127	150-127	180-127
4	20-127	40-127	60-127	80-127	100-127	120-127	160-127	200-127	240-127
5	25-127	50-127	75-127	100-127	125-127	150-127	200-127	250-127	300-127
6	30-127	60-127	.0-127	120-127	150-127	180-127	240-127	300-127	360-127
7	35-127	70-127	105-127	140-127	175-127	210-127	280-127	350-127	420-127
8	40-127	80-127	120-127	160-127	200-127	240-127	320-127	400-127	480-127
9	45-127	90-127	135-127	180-127	225-127	270-127	360-127	450-127	540-127
10	50-127	100-127	150-127	200-127	250-127	300-127	400-127	500-127	600-127
11	55-127	110-127	165-127	220-127	275-127	330-127	440-127	550-127	660-127
12	60-127	120-127	180-127	240-127	300-127	360-127	480-127	600-127	720-127
13	65-127	130-127	195-127	260-127	325-127	3 0-127	520-127	650-127	
14	70-127	140-127	210-127	280-127	350-127	420-127	560-127	700-127	
15	75-127	150-127	225-127	300-127	375-127	450-127	600-127	750-127	
16	80-127	160-127	240-127	320-127	400-127	480-127	640-127		
17	85-127	170-127	255-127	340-127	425-127	510-127	680-127		
18	90-127	180-127	270-127	360-127	450-127	540-127	720-127		
19	95-127	190-127	285-127	380-127	475-127	570-127			
20	100-127	200-127	300-127	400-127	500-127	600-127			
21	105-127	210-127	315-127	420-127	525-127	630-127			
22	110-127	220-127	330-127	440-127	550-127	660-127			
23	115-127	230-127	345-127	460-127	575-127	690-127			
24	120-127	240-127	360-127	480-127	600-127	720-127			
25	125-127	250-127	375-127	500-127	625-127	750-127			

but with it and the regular gears supplied with the lathe, many different leads can be cut without compounding.

Should it be desired to cut a 15-mm.-pitch thread on a lathe with a 10-pitch lead screw, the proportion of gearing $\frac{750}{127}$ would require compounding. Thus $\frac{750}{127} = \frac{30}{5} \times \frac{25}{25.4} = \frac{30}{5} \times \frac{4}{4} = \frac{120}{20}$ and $\frac{25}{25.4} \times \frac{5}{5} = \frac{125}{127}$.

Thus gears with 120 and 125 teeth as driving gears, and with 20 and 127 as driven gears, the desired lead can be had.

Should any millimeter pitch be desired that is not given in table, the formula used would be $\frac{\text{lead screw of lathe}}{25.4}$ written as a fraction such as $\frac{6}{25.4}$. This would be the ratio of gears for 1-mm. pitch. Therefore, should it be desired to cut 3⅓-mm. pitch on a lathe having a 6-pitch lead screw, the proceeding would be as follows: $\frac{6}{25.4} \times \frac{5}{5} = \frac{30}{127}$ = ratio of gears for 1-mm. pitch; then by multiplying 30 by 3⅓, we get 100 as the gear on stud and 127 as the gear on screw.

Tools and Fixtures for Aircraft Mechanics

By B. Z. Reiter

THE fixture shown in Fig 1 is convenient in building up airplane wing ribs from the separate parts which are first machined in units and afterward assembled into the complete rib. This fixture is cut from a wooden block, the distance *A* being equal to just half the thickness of the rib. Dimension *A* is equal to but half the thickness of the center or web

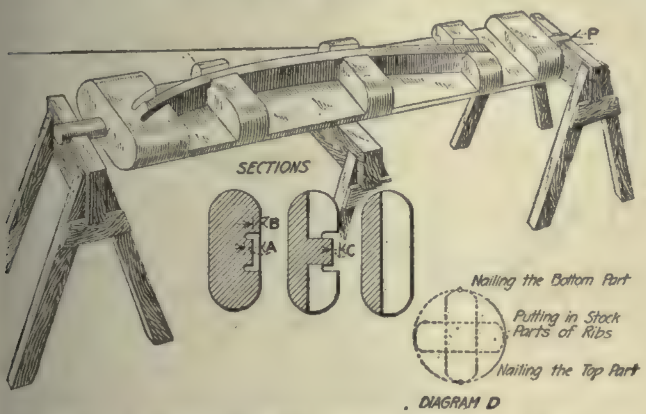
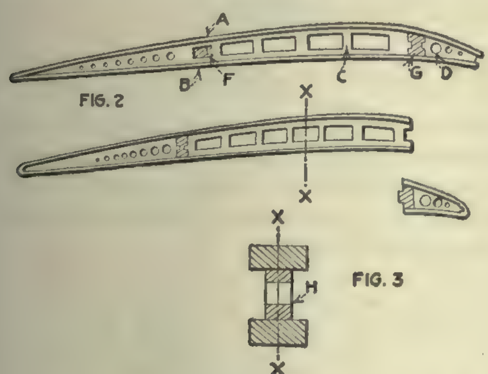


FIG. 1. FIXTURE FOR AIRPLANE WING RIBS

section of the rim, while dimension *B* is half the thickness of the upper and lower members which constitute the top and bottom of the rib. The other sections of the fixture allow openings by which the rib parts can be reached from either top or bottom, the projection *C* holding the other side of the web. The different views show how the rib is held while being assembled.

The pin *P* at each end of the fixture is mounted in a suitable bearing on a horse or in any kind of a stand, so that the whole fixture can be revolved in order to get at any part of the rib construction. The diagram *D* shows that a 90-deg. upward movement is used for nailing on the bottom strip and a similar downward movement is used when nailing on the upper part. In



FIGS. 2 AND 3. DETAILS OF THE FIXTURE AND THE ASSEMBLED RIB

its normal condition the fixture is held horizontally so that the different parts can be easily laid in place before fastening. The top and bottom of the fixture are rounded so that it can be revolved freely over the center stand which then supports it to prevent sagging or springing during any of the operations.

Referring to Fig. 2 it is easily seen how the different parts are built up, the top and bottom strips being shown by *A* and *B*, the center piece by *C*, the front section by *D*. The two openings indicated at *F* and *G* are for the longitudinal spars which are the main support of the wing itself. The sectional view at *H*, taken at the point *XX*, gives a good idea of the complete construction.

The assembled rib is shown in Fig. 3, which shows a somewhat different construction. In this case the front

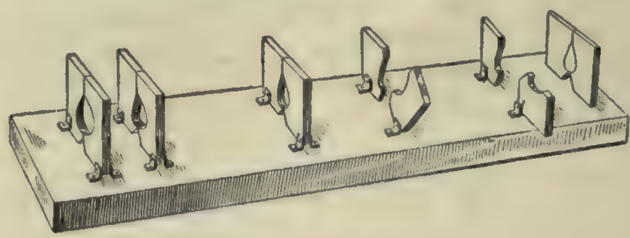


FIG. 4. GAGE FOR WING STRUTS

portion is separate, and the fixture is only used for part of the work.

After the parts are assembled, as shown, the fixture is turned 90 deg., so that either the upper or lower piece can be nailed or screwed into place according to the practice of the shop. The whole fixture is then

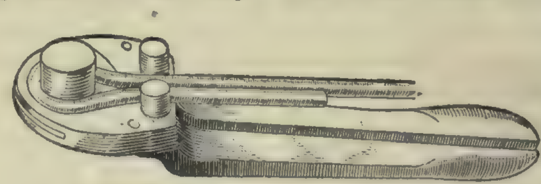


FIG. 5. PLIERS FOR BENDING EYES IN WIRE

revolved half way around and the other parts of the rib fastened in place. By making the opening in this fixture a fairly close fit to the completed rib, it is not necessary to use clamping devices of any kind.

Where airplane struts must be worked out by hand the form of gage shown in Fig. 4 will be found very convenient and accurate. In case of an irregular-shaped strut, these gages should be placed every 3 to 5 in., although this will probably not be necessary in many cases. The gages can be shaped from a spare strut so that future repairs can be in accordance with the original design.

General Arrangement

Wherever necessary, upright gaging pieces are fastened to the baseboard, those on one side usually being fixed while those on the other side are hinged to the board. This arrangement can, of course, be varied as may seem desirable.

The workman simply places the strut in the fixed half of the gage and brings the other parts up into position to test the contour at any given point.

The pliers shown in Fig. 5 are useful in making eyes in the ends of wire. The two small pins are set in the jaws, and the large pin acts as the pivot

of the pliers. This enables the eye to be formed easily and quickly. The ferrule is first put in place over the end of the wire before the eye is formed. The short end is bent out most satisfactorily by using a small tube as shown in Fig. 6.

Gage for Wire Length

It is frequently necessary to replace the diagonal bracing wires in the airplane and for this purpose some convenient means of taking the measurements is very desirable. A handy measuring device, or gage, for this

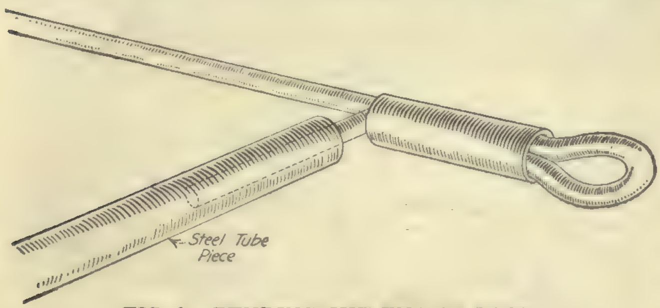


FIG. 6. BENDING THE END OF LOOP

purpose, is shown in Fig. 7. This consists of two light strips of wood held together by bands as shown, so arranged that they exert a slight pressure, just sufficient to prevent the strips from slipping, but allowing them to be readily moved when necessary. This gage is very convenient to use, as the proper length can be readily determined and carried to the shop where the wire can be made up to the correct length.

Where only slight curves are to be made it is sometimes convenient to be able to bend wooden strips into a permanent form when facilities for steaming are not at hand. A method of doing this is shown in Fig. 8. The piece to be bent must be sawed, as shown, with a very thin saw so as to remove as little kerf as possible. The slots should be thoroughly glued, after which they can be bent to a proper form and clamped in posi-

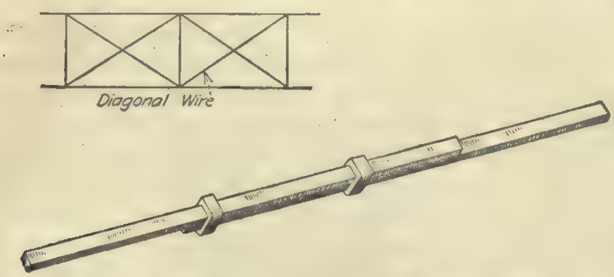


FIG. 7. MEASURING LENGTH OF WIRE

tion by separate clamps placed close together. Pieces glued up in this way should be allowed to dry at least 36 hours.

This method, of course, makes the bent portion thinner than the rest of the piece. This is sometimes obviated by building the whole piece up from thin strips, which, after being glued, are placed in suitable forms and allowed to dry, the same as before.

In some forms of airplane construction, copper thimbles, or fittings, are used in the eyes of struts and sockets to prevent rusting at the various joints and to avoid chafing the wires which go through them. A method of inserting these is shown in the Fig. 9.

A view of the thimble in place in the sockets is shown at *A*, while *B* shows the fixture for putting these thimbles in place. The dimension *C* on the anvil should be enough larger than the diameter of the wire to insure an easy fit. The strut, with the copper thimble in place, is then placed over this stud. Around the

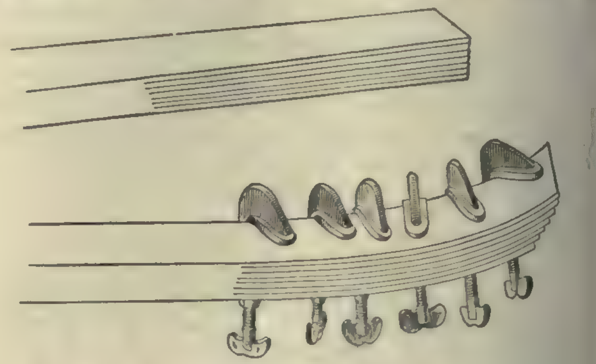


FIG. 8. BENDING UNSTEAMED WOOD

base is a washer *D*, with a knockout pin *E*. This also shows a spring below the washer to raise the socket as soon as the thimble has been put in place. The punch *F*, carrying a projection of the same size as the

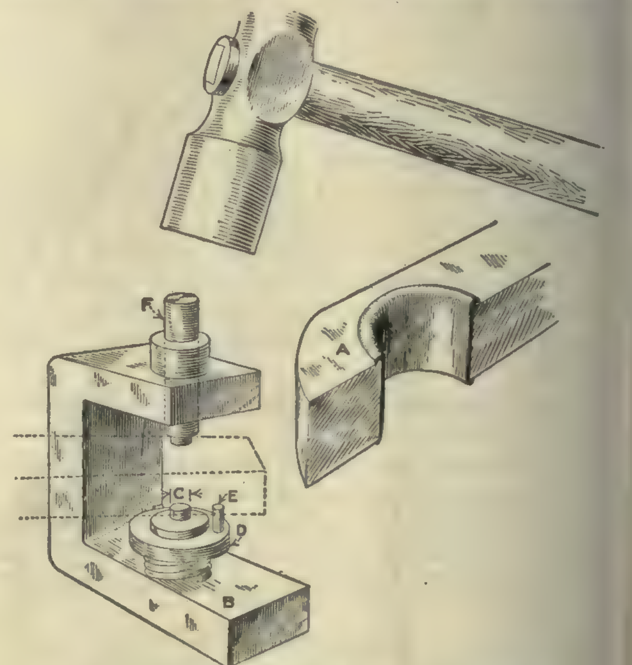


FIG. 9. INSERTING THIMBLES IN STRUT ENDS

pin *C*, slips down in the bushing in the thimble and a blow from the hammer upsets the thimble on both side of the strut. This is an easily made device and ca be readily used in repairing in the field shop shoul it be desirable to do so.

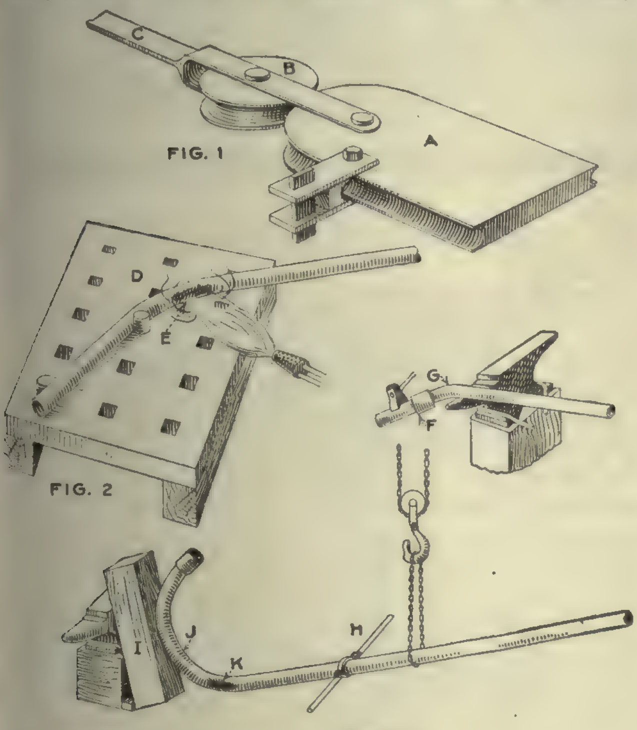
Bending Heavy Pipe in the Blacksmith Shop

By J. V. Hunter

A few days ago one of our shops was called on t make a half-circle bend on the ends of four pieces o $3\frac{1}{2}$-in. black iron pipe to be used for the ornament railing of a new bridge. The circle was rather sma for a pipe of this size; the radius allowed being on 18-in., while the specifications called for a smooth ben free from kinks, and with no noticeable degree of fla

tening of the pipe. It was likewise desirable that there should be no coupling near the curved portion. This necessitated using a full 20-ft. length, which for this diameter of pipe is rather heavy to handle. For jobs of smaller sizes of pipes and in larger numbers, it might pay in such a case to rig up a bending jig similar to that shown in Fig. 1, on which the pipe is bent around a curved and grooved form *A* by means of a similarly grooved roller *B* fitted to the diameter of the pipe being handled, and located between the arms of an operating lever *C*.

However, for small quantities of job bending, the production of such a jig would be expensive, and so heavy as to be out of the question. For others, who may some day run into a task of the same nature, the following description of two methods of handling this work may be of interest.



FIGS. 1 TO 3. VARIOUS METHODS OF BENDING PIPE
Fig. 1—A common bending fixture. Fig. 2—A simple method of bending. Fig. 3—Method used on bridge-railing job

The method illustrated in Fig. 2 is simple, but requires a careful workman to get a smooth job, and though adaptable to the largest sizes of pipe, may require a tedious amount of work. Two stakes are required for the necessary leverage to pull the pipe around, and although these have in this case been illustrated as inserted in a plate *D*, the latter is in itself unnecessary although desirable for keeping the bend in a true plane.

The procedure consists of heating the pipe in a small spot at a time on the inside of the bend, as shown in the shaded portion at *E*. If the heat should extend around to the outside of the pipe, this should be chilled with water immediately before bending, the object being to keep the outside cold to prevent flattening of the pipe while the pressure of the bending causes the inside to upset, and so furnishes the shorter radius for the inside.

Only a very small portion of the pipe can be heated at a time, and should the pressure cause the inside to start to kink at any point, that place must be instantly chilled with water, and the bending continued further along. On account of the constant shifting of the heat on a very short portion at a time, the use of an oil-torch for heating is a great advantage, as it saves carrying the pipe to and from a forge, but the latter can be used if necessary.

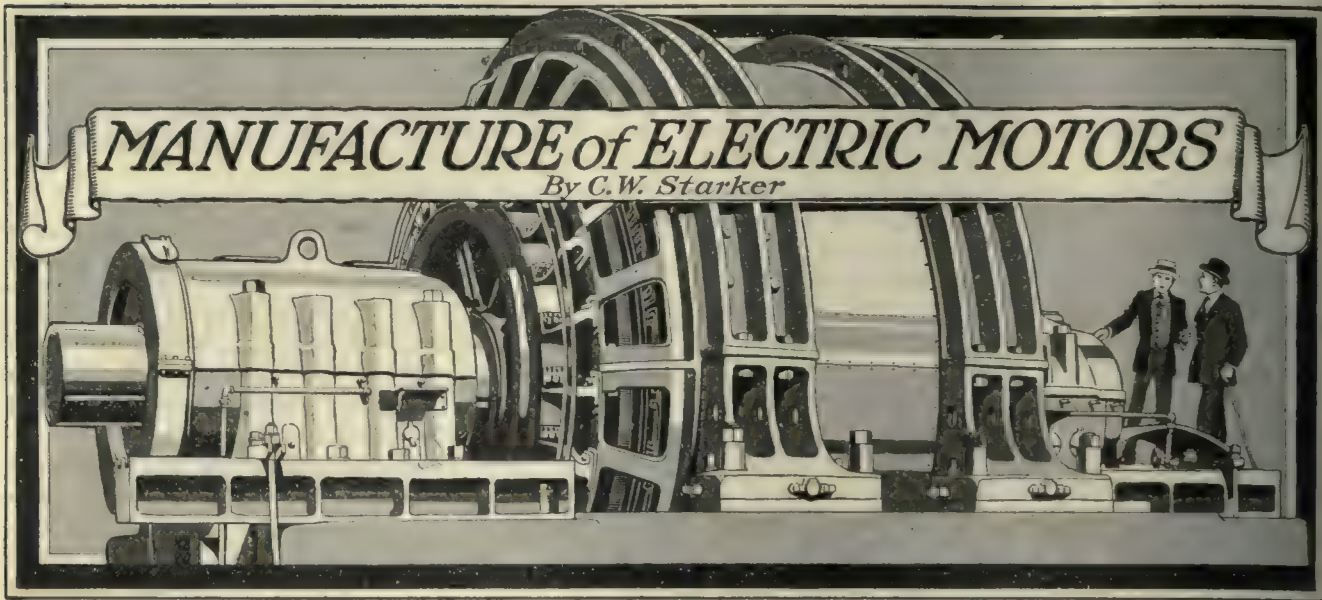
The method that was used on the bridge-railing job is illustrated in Fig. 3. A coupling and short length of pipe are temporarily fitted on the end at the start as shown at *F*. A short heat is taken close to the coupling at *G*; the pipe laid over the horn of an anvil and with a swage and sledge the bend is started; turning the pipe over on its side if necessary to work out any kinks or flattening that may occur while this first bend is being made. The added section of pipe is then removed and a quite different method continues the work. The clamped band handle *H* is now bolted on some distance back from the end; and the pipe itself is suspended by a block and sling so that it may be easily raised and lowered as necessary; and must be hung from a support far enough above it so that it may be swung pendulum fashion through a swing of three or four feet. A heavy wood block *I* for a "butting-post" is leaned up against a convenient anvil or wall, as shown.

A short heat is then taken on the pipe just beyond and adjoining the portion that was first bent. It is then swung like a ram against the block, and the force of the blow acting on the tangent of the first bend causes a continuation of the bending in this next section, while sufficient upsetting of the material takes place at the same time so that there is no flattening down of the outside, and the pipe holds up to its full form. This same procedure is continued for one section following another, and the pipe rolls up into forms as illustrated at *J*, where in this case the shaded portion *K* indicates the place where the bending is taking place. Care must be used that the bend does not run out of a true plane, and if there is any tendency toward doing so, the work must be laid on a faceplate or anvil and trued up.

In working both this method and that shown in Fig. 2, the smith must work up to an inside templet, which has been made up for the radius of the inside of the bend; using care to keep each added bend close to the templet size to save any unnecessary bending or straightening of the work later on when it might not be so easily performed without reworking the whole piece.

Imports of Tin

In the report of the Bureau of Foreign and Domestic Commerce, Department of Commerce, it is announced that our imports of tin have greatly increased, and that this tin comes from the Straits Settlements, from England and from the Dutch East Indies for the most part. In 1916 we imported 49,415 tons from England and the Straits Settlements, but in 1917 this amount was reduced somewhat, while tin from the Dutch East Indies increased to 14,148 tons, or 20 per cent. of the total. The Straits tin came by way of England as usual, and this year the importations from that source are expected greatly to increase over those of last year. It is expected that the present year will witness an increase in direct shipments.



XI. Pressed-Steel Parts for Motors

In direct-current motors there is hardly a part which has been given more thought and for which a greater variety of constructions have been produced in the past than for the brush-holders They are of particular importance, as their proper working and standing up in service are essentials having as much to do with overcoming the commutation problem as interpoles, commutator construction and carbon quality.

IN THE evolution of brush-holders, the simplest and therefore best construction has as sometimes happens come last. Compare the simple pressed-steel holder, Fig. 113, with some of the older, complicated types of brush-holders. This design was originally brought out in 1909 and since that time has been manufactured at the rate of over a quarter of a million a year. It has been used with uniform success on all sorts of motor drives in the industrial field, has been applied to large generators and to railway work, and frequently has replaced holders in service on older machines of every make. Where used in connection with the alternating current on collector rings, the same parts are being employed in the double holder, Fig. 114. The brush-holder sides and box are pressed from cold-rolled, strip steel, $\frac{3}{32}$-in. to $\frac{1}{8}$-in. stock, and not from thin, sheet steel as has been attempted in some quarters.

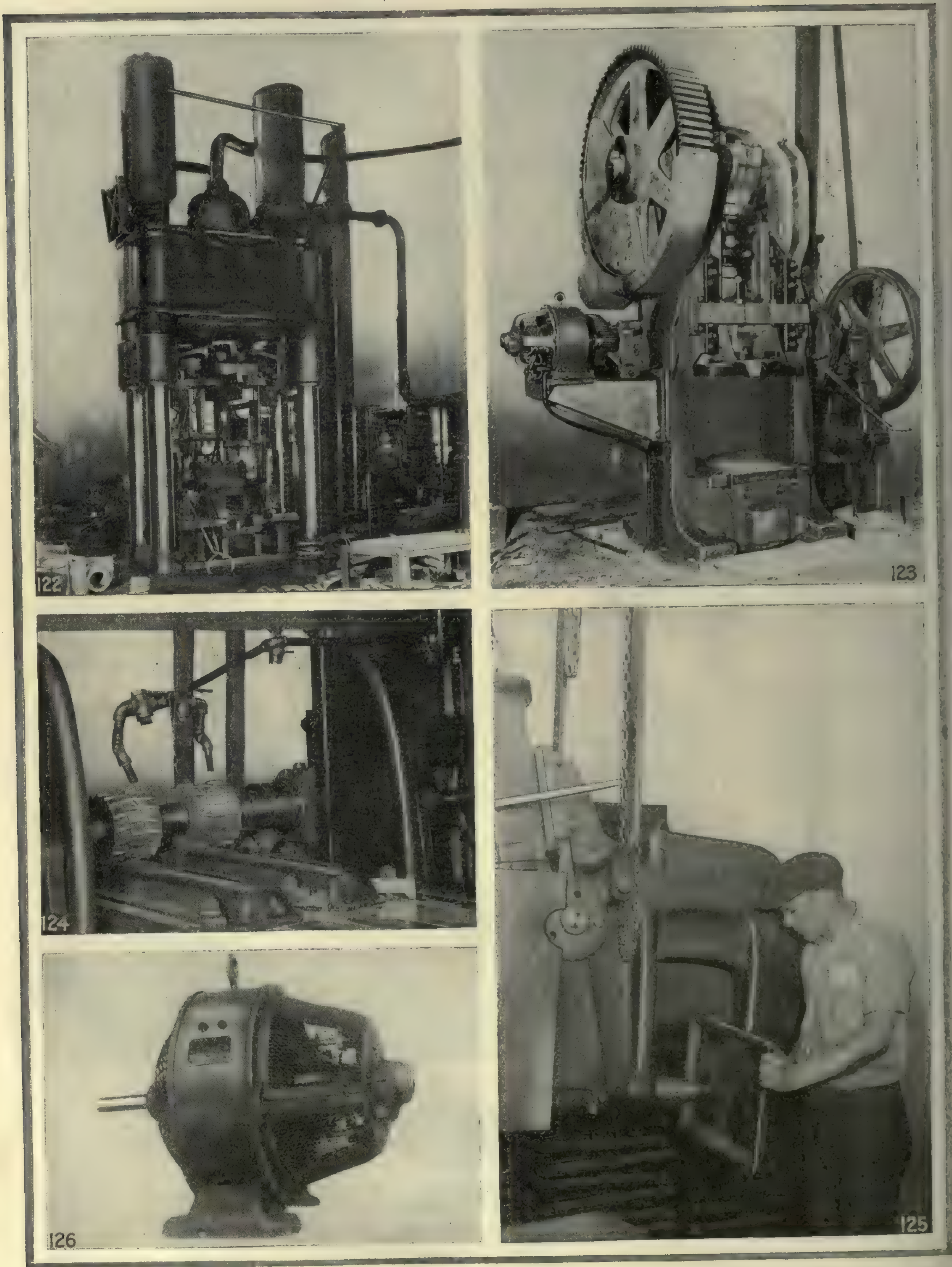
Sides and box are electrically spot-welded or riveted together by large rivets. The spot-welder and holder are shown in Fig. 115. This construction gives a particularly strong beam section, and in manufacture makes it possible to use the same sides in the many different boxes required for the different carbon sizes. The spring is a flat, steel coil of few turns, and is protected by a baked-on, rustproofing enamel. A tension key for adjusting the spring pressure, and a sheet-steel guide for definitely locating the pressure point on the carbon, are provided. The holder is assembled in a fixture. After assembling, it is checked up very carefully in a suitable fixture, Fig. 116, to insure a free fit for the carbon and the accurate location of the carbon on the commutator.

Manufacturing variations of plus 0.001 in. to plus 0.003 in. from nominal width, and plus 0.002 in. to plus 0.010 in. in length, are allowed in the box. A maximum, permissible variation for copper-plated carbon brushes has been adopted jointly by the motor manufacturers and the carbon makers which shall allow the carbons to pass through a gage 0.001 in. larger, but not to pass through a gage 0.004 in. smaller than the nominal thickness of the carbon. The length of the carbon is limited by passing a gage of exact dimensions and not passing a gage 0.016 in. undersize. These close manufacturing limits strictly observed, insur

FIGS. 113 AND 114. PRESSED-STEEL BRUSHHOLDER FOR DIRECT-CURRENT MOTORS, AND DOUBLE HOLDER FOR ALTERNATING-CURRENT MOTORS

FIGS. 115 TO 121. SOME OF THE OPERATIONS AND PARTS

Fig. 115—Spot-welder and fixture for welding brush-holders. Fig. 116—Checking fixture for brush-holders. Fig. 117—Carbons and shunts, soldered cap, tube and washer construction. Fig. 118—Laminated main poles, solid interpole with and without tip. Laminated interpole. Fig. 119—Building and pressing of laminated poles. Fig. 120—Machining interpoles from bar stock. Fig. 121—Pressed steel slide rails and bedplates



FIGS. 122 TO 126. PUNCHING AND MILLING OPERATIONS

Fig. 122—500-ton hydraulic forging press. Fig. 123—Motor-driven punch press. Fig. 124—Milling slide rails. Fig. 125—Air-operated toggle riveter. Fig. 126—Expanded metal covers for motors

free sliding of the carbon in the box and at the same time prevent undue looseness. These limits should be specified by operators who purchase carbons from other than the motor manufacturer.

Lugs and screws for clamping the carbon shunts are provided on the holder, that the current need not pass through the spring and guide. An excellent rust protection is provided by a special chemical treatment, and in this process the outer stratum of the iron undergoes a chemical change. In coal mining work, in chemical plants and on shipboard a pressed-brass holder with phosphor-bronze springs is provided. At the end next to the brush-holder rod, the holder is slit and provided with a substantial, easily accessible screw for clamping on the rod. On industrial motors, spring pressures of $1\frac{1}{4}$ to $1\frac{1}{2}$ lb. per sq.in. have been found most suitable. In modern motors it is the practice to use a relatively large number of small carbons in preference to few carbons of large cross-section, as in older motors. This practice unless carried to the extreme where carbons and springs become too small and therefore unserviceable, has the advantage of utilizing more fully the contact area between carbon and commutator; reducing the liability of the carbon to jump under vibration due to uneven commutator surface; also the wear on the commutator is further reduced.

Qualities of Carbons

The opinions of operators differ greatly in regard to desirable hardness, resistance and composition of carbons. In fact, various grades of carbons give different results under different conditions, hence it is difficult to make a general rule. However, as all operators are vitally interested in this subject we venture the following statement: Before interpole motors came into use, it was the practice to employ three different grades of carbons; namely, soft, for 115 volts, medium for 230 volts and hard for 550 volts. With interpole motors of industrial type it is possible to use the same grade of carbons for all voltages. One prime requisite often overlooked in a carbon is that it shall always be uniform. The manufacture of carbons is a long and delicate process, and a lack of uniformity in the product easily creeps in. This often explains seemingly contradictory experiences with the same make and grade of carbon.

In regard to carbon shunts, a definite standard between all manufacturers has not yet been established, except that uniform practice is now being followed in regard to the size of terminals at the end of the shunt. There are many different and successful types of shunts, and two of the preferred constructions are shown in Fig. 117. In one, a sheet-copper cap is soldered to the top of the carbon; in the other the strands of the shunt cable are clamped under a washer.

In the manufacture of pole pieces for direct-current motors and generators, there are two different types to be described; both may be seen in Fig. 118. The main poles are laminated; built-up from $\frac{1}{16}$-in. sheet steel, pressed and riveted together in a fixture on a hydraulic press, as shown in Fig. 119. The fixture gives accuracy in the alignment of the individual punchings, hence no machining operations are required aside from jig-drilling and tapping of holes for mounting bolts. Interpoles are made solid, machined from bar stock, Fig. 120, after cutting off on Newton saws. Where electrical conditions require a pole-face wider than the body of the pole, the bar stock is upset in an Ajax forging machine and both ends of the pole, faced off. For motor characteristics where a quick building up of the flux is particularly essential, laminated interpoles are used which are manufactured along the same lines as the main poles described previously.

Particularly interesting from a manufacturing standpoint are the pressed-steel, slide rails and bedplates, Fig. 121, used on industrial motors for adjusting the belt tensions. Pressed steel is used on all sizes to advantage so long as the quantities to be manufactured annually justify the outlay in dies and presses, and permit production on a scale essential to economical manufacture. Steel plate $\frac{1}{4}$- to $\frac{1}{2}$-in. thick is used, pressed into particularly stiff sections on the 500-ton hydraulic press shown in Fig. 122. For blanking, trimming and punching of slots and foundation holes, smaller, motor-driven, punch presses, Fig. 123, are used. Compared with cast iron, which was formerly used, these rails are much stronger, less bulky and require very little machining. They are unbreakable, a point of particular importance when motors are suspended from the ceiling. The foot of the motor has a milled groove in the bottom which engages a machined tongue, Fig. 124, in the rail, to facilitate shifting of the motor in tightening the belt. The tension screw goes through a drilled hole in the motor foot and engages a malleable-iron lug on the side of the rail or on top of the bedplate, which is riveted to the pressed-steel part, this riveting being accomplished on the compressed-air-operated toggle riveter, Fig. 125.

In view of safety requirements, industrial motors are now frequently protected by covers, as shown in Fig. 126. Solid covers obstruct the ventilation of the motor to such an extent that with the same motor temperature, only 50 to 60 per cent. of the open rating would be obtained. Expanded metal covers such as shown in Fig. 126, protect the motor from flying chips, etc., and also protect the operator from coming in contact inadvertently with current-carrying parts. The expanded metal permits the use of comparatively small openings, and at the same time limits an obstructed ventilation to a minimum, which makes it possible to obtain the same, or practically the same, motor temperature as with an entirely open motor. The expanded metal is spot-welded to a framework of sheet steel by means of which a sufficiently strong cover is obtained, and at the same time its flexibility permits the fitting of it to the bracket castings. The expanded metal covers are readily attached to a motor either before or after shipment from the manufacturer's works.

Knocking the Government

By E. A. Dixie

Intelligent constructive criticism of the administration, or of anything else for that matter, is usually justifiable, but there is no excuse except that of ignorance for carping critics and common knockers.

For some time I have been working in one of the big Government plants. In spite of thirty-seven years spent in machine shops I find many things here that are new to me.

This factory is under the supervision of a Colonel of the Regular Army who has spent many years in this work, and in its broader sense he understands it thoroughly. Under him is a corps of experts, Regular and Reserve officers, foremen and operators of wide experience.

There may be those who think that the directors of a concern like this should take the gateman and the floor sweepers into their confidence and tell them just why certain things are made in one way; why certain other things are not made in another way; and just why further things, that do not in the least concern them, are done or not done in still a different way. It is true that this method might forestall a lot of knocking, but it would take a lot of time; besides, it is not yet common practice except among the Bolsheviki and I. W. W.

There are knockers in this shop just as there are in all shops, and as with other knockers, their knockings are usually the result of ignorance—not necessarily ignorance of their own work but of some essential.

Knowing the Reasons

A certain type of war material is being altered here. Before being in the shop two days I heard the Government knocked for allowing these things to be altered at this time. To the outsider it did look foolish to do this work now in wartime, and I myself, could offer no reasonable excuse why it was being done. Of course, it was not my business to offer excuses nor criticism, neither was it the business of the knockers. They and I were on a par in this: neither of us knew the reasons, nor indeed that there were any reasons for altering those things at this time. There was however, one apparently reasonable objection: the knockers were more or less skilled at this kind of work, and their criticism with the weight of their skill added, did affect or rather *infect* me so that I became annoyed at the inefficiency of a Government that would allow work of this character to go on at an inopportune time.

My irritation against the Government grew as the days went by, and each time I overheard another knock my grievance became greater.

Some of the knockers went so far as to say that there must be evil influences high up in the War Department, which secured the doing of such foolish things to delay production; and I in my ignorance (which was also their's although they did not know it) almost believed what they said.

In this same factory there are a number of men who are being trained to be inspectors. They come from all walks of life. There are mechanics, near-mechanics, college boys and others. Some of them are old, some young, some sincerely believe that they can thus best serve their country, others frankly admit that they have taken the job to escape the trenches.

Taking them "by and large," they know less about the job than I do, but you should hear them criticise the Government, the methods employed in teaching them, the subjects taught, the men instructing them.

Without any encouragement from me, I have been buttonholed and given their views on how things should be done.

I saw one of them push a 12-in. micrometer over a piece of work that was 0.013 in. larger than the size to which the micrometer was set. He told me that the man who instructed him how to use the micrometer did not know how to use it: "he sets it so light you don't get a bearing on the work." Thirteen thousandths is a "bearing" with a vengeance.

But to get back to knockers and knocking: a few days ago I had business in the department in Washington, where all work for this factory is originated. I know a number of men there, some of them are near to the ultimate source of information, and I know that they know they can trust me. After my business was settled I went to one of them to repeat the grave suspicions in order that he could take some action to bring the matter to the attention of his superiors, and what do you think I found out?—that of all the work being done at the factory, the alterations of those particular pieces were of the utmost importance to the conduct of the war; and being told the reason, even I could see that this was so.

In the conduct of the war of the country and of everything else, there are a number of elements that on the surface look dead wrong. The bulk of them look wrong either because we don't know what they are for, or because we don't know why they are done; the fact that it is none of our business, does not deter us from passing an opinion, and our knowledge of something, perhaps far different, gives us sufficient assurance to cause us to believe that our opinion is worth while.

Here in the shop there are a number of things that this kind of assurance tells us are obviously wrong.

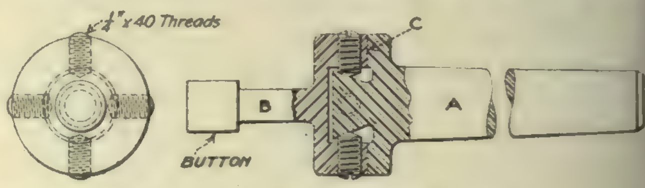
It is poor practice to bore or turn steel at a surface speed of 16 ft. per min., but there are different kinds of steel—3 to 4 per cent. nickel and heat treatment, do have some influence in reducing speeds. Cutting speed also has in some cases an influence on the accuracy of the work.

Skilled men have for years been trying to increase production and maintain the high quality of the work at this factory, but about 20 ft. per min. surface speed is the best that they have so far been able to attain. The next time you are in a Government (or any other) shop, before you start to knock pause long enough to ask yourself how much more you really know about the job than the men who have spent their lives at it.

Adjustable Locating Button

By William C. Betz

A button or locating bar that can be adjusted to run dead true, is an exceptionally handy article on a milling machine or boring mill where accurate center distances are to be located. The bar is made in two parts con-



ADJUSTABLE LOCATING BUTTON

sisting of shank A and button B. The part A is hardened all over and is ground square with the axis of A at C, and the button is ground and lapped to size. In use, the button is adjusted to run true by means of the four screws on the periphery.

Emergency Methods of Cutting and Drilling Glass Disks

By J. A. Lucas

A brief description of tools and methods that can be easily and quickly made and applied in the average small shop for cutting and drilling for emergency-repair replacement of glass covers on steam gages, recording instruments, etc.

IN APPLYING the methods described in this article the operator must, to be sure, have consideration for the brittle and refractory nature of the material operated upon and should not bank upon success every time, but with patience and a little practice, the loss by breakage will be surprisingly small. Perhaps the simplest way of cutting a plain disk is to take a sheet of metal a little larger than the required disk, and about $\frac{3}{32}$ in. thick, swing it up in the lathe and with a parting tool cut out the center as at *A*, Fig. 1, leaving a hole that is larger than the required glass disk by an amount equal to the thickness of a common glass cutter at the point where in use this cutter would come in contact with the templet.

Now lay upon a smooth board a pane of glass, the narrowest dimension of which is not less than $\frac{1}{2}$ in. greater than the diameter of the required disk, and lay the templet over it. Run an ordinary glass cutter around the inner edge of the templet, making sure that

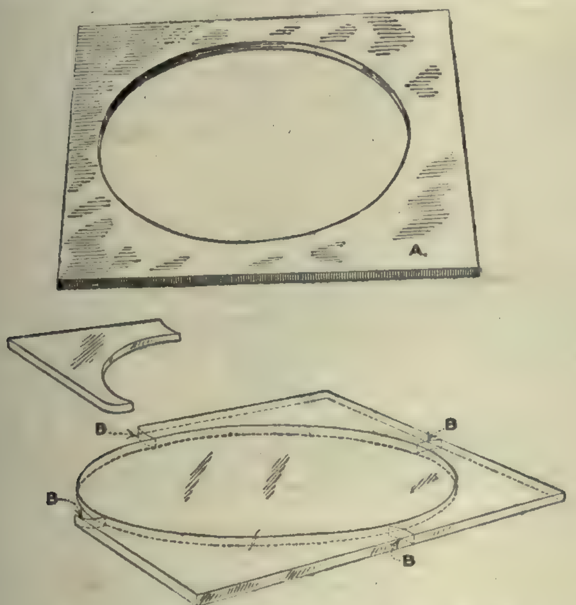


FIG. 1. THE TEMPLET AND THE WORK

the glass is scored clear around the circle without any little switch tracks or sidings leading toward the center. If only one or two disks are required, a thin piece of hard wood may be substituted for the metal, in making the templet.

Remove the glass, and with the cutter make four cuts as shown at *B*. This is important as without these cuts it will be found to be practically impossible to remove the disk from the square without breakage.

A modification of this method, which does away with the necessity for a templet, is shown in Fig. 2 wherein the glass, suitably fastened to the board either by wooden clamps or with glue, is chucked in a lathe, and the glass cutter held by hand upon a rest, properly located and held in the toolpost. It is well in either case to interpose a piece of blotting paper between the glass and its supporting board, to cushion the slight irregularities in both glass and board.

Where the demand for these disks is likely to be continued at intervals, the handy fixture shown in Fig. 3 may be made and disks can then be cut at a moment's notice without trouble or loss of time. The figure is

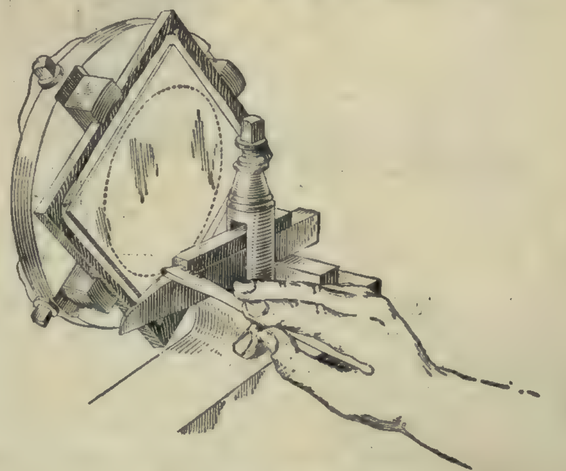


FIG. 2. ANOTHER METHOD

self-explanatory; the cutter being the sawed-off end of a common glass cutter, as shown at the right, and held in position at the end of graduated bar *A*, by the set-screw at *B*, the brace *C* is necessary to secure the rigidity of the fixture. Pressure is applied to the cutter by bearing down with the hand upon the central spindle.

This form may be used also in a drilling machine by substituting a taper shank for the central spindle and omitting the frame. The drilling machine should, of course, be turned slowly by hand, the operator taking care that the cutter makes but one revolution when in contact with the glass, as it will ruin the cutter to run it over an already scored surface.

Forms of Drills

Anyone who has tried to make holes in a sheet of glass, as is sometimes desirable on instruments where it is required to make or break an electric circuit, will appreciate the difficulty of performing this operation by any ordinary form of tool, and a few hints as to how it may be quickly accomplished are appended.

There are various forms of drills used for this work, the one with which the writer has had the greatest success being a piece broken from an old round file and the end ground to a diamond point as shown at *A*, Fig. 4. This tool should be hardened in mercury, sulphuric acid, or a solution of salt water, ammonia and ice, and should never be ground after hardening. When

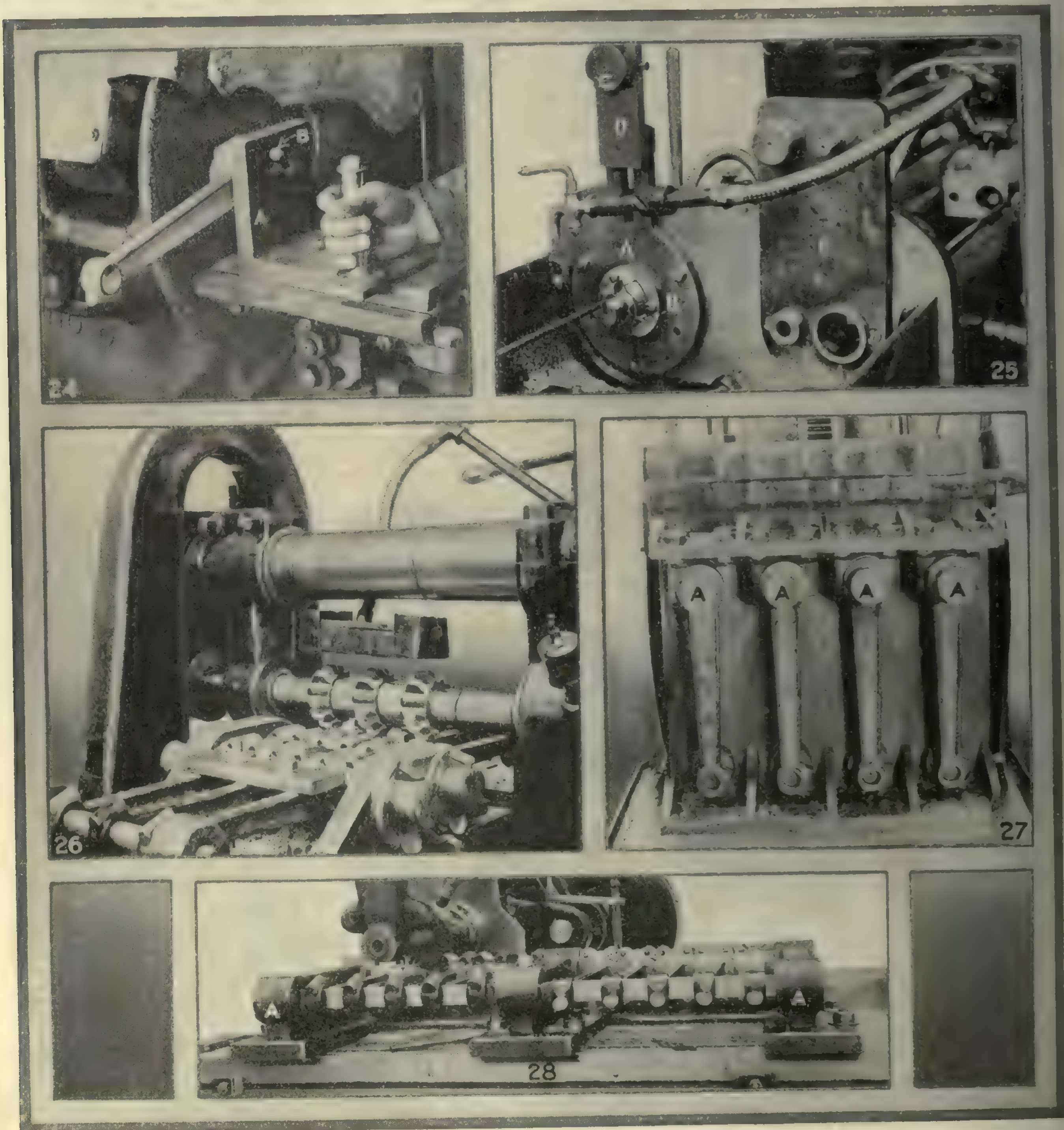
end supports *A* are removed to load the fixture and, when bolted down to the machine table, support the outer ends of the bars and clamp the work firmly in place.

When the five rods on the left half of the fixture have been milled and sawed they are removed and replaced with new ones; then when the cutters have finished the five rods on the right half, the table is lowered and run back to starting position. This permits the five finished rods on the right half to be removed and replaced with others, while the machine is working on the rods on the left half. This gives practically a continuous milling operation.

The remaining operations are not of an unusual nature and are handled with jigs and fixtures very similar to those already described.

The piston work is handled in much the same general way as in other shops, but there are a few special fixtures in use which are interesting.

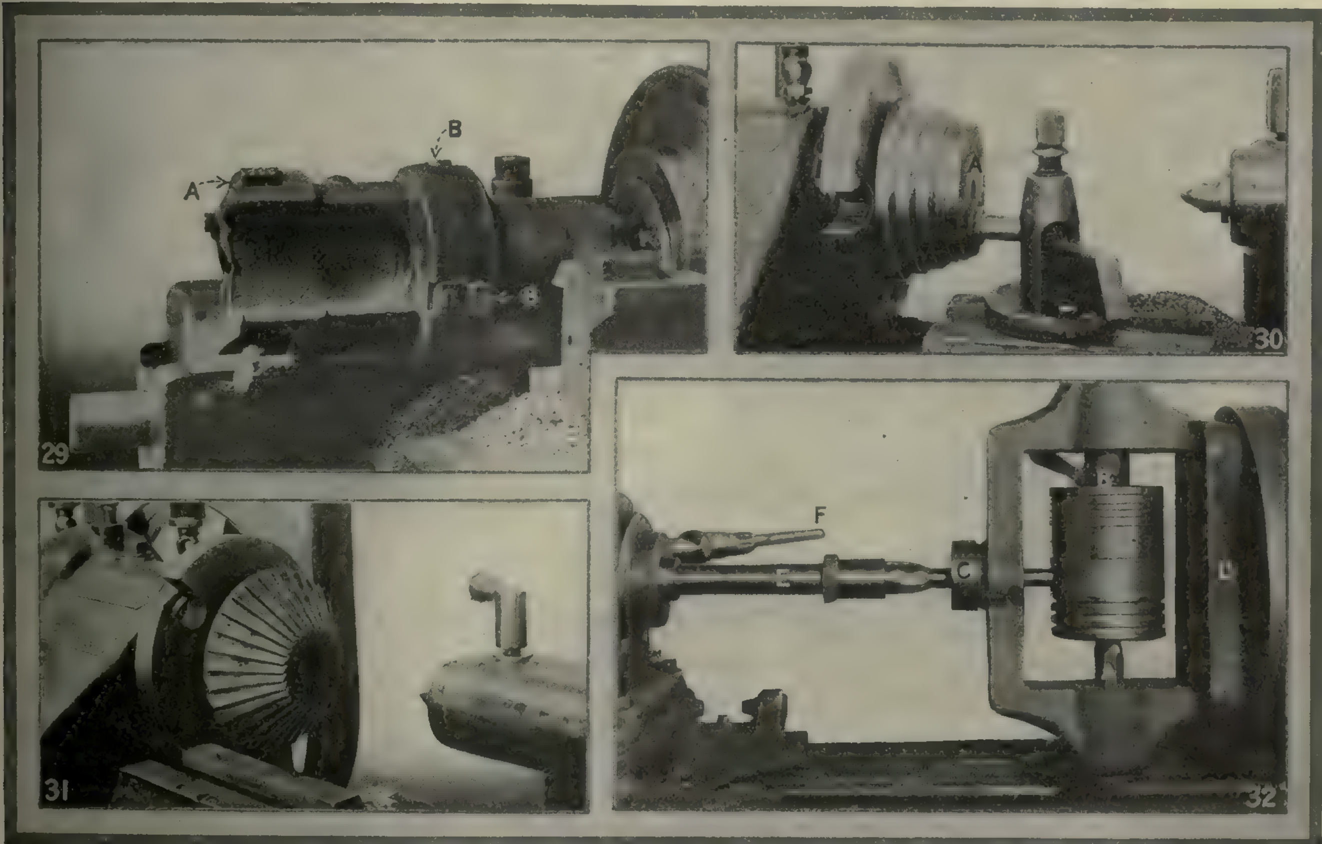
The rough turning of the pistons is handled on Bardons & Oliver lathes, the air chuck shown in Fig. 29 being used to hold them. The two serrated jaws *A* grip the outer end of the piston, and three grooved studs *B* engage the flange inside the open end. The finish-turning, facing, centering and grooving, are handled on Potter & Johnston automatics as is the general practice in many shops.



FIGS. 24 TO 28. VARIOUS OPERATIONS ON CONNECTING RODS
Fig. 24—Facing connecting rods on disk grinding machine. Fig. 25—Broaching keyways. Fig. 26—Milling bolt lugs. Fig. 27—Drilling bolt holes. Fig. 28—Milling and slitting crankpin ends

The pin holes are rough drilled in a simple jig before the finish-turning and grooving operation, after which the pistons are recessed on a Porter-Cable lathe, shown in Fig. 30. The plug arbor *A* has several steps turned on it and is used for various sized pistons. The pin engages the pin bosses inside the piston and drives the work which is supported at the outer end by the tail center.

The inside of the piston opening is beveled on the Porter-Cable lathe with the bevel cutter shown in Fig. 31. For handling this rather heavy work the small drive pulley is removed and replaced with a large one which reduces the speed of the cutter and gives ample power. In performing this operation a steel bar is passed through the pin hole in the piston and rested against the tool slide to prevent the work from turning when it is forced against the cutter by the tail-center. A rather unique device is used for boring the pin holes true with the ground portion of the piston. This is shown in Fig. 32.



FIGS. 29 TO 32. SOME OF THE OPERATIONS INVOLVED IN THE MANUFACTURE OF PISTONS

Fig. 29—Air chuck for turning pistons. Fig. 30—Piston arbor on Porter-Cable lathe. Fig. 31—Cutter for beveling inside of pistons. Fig. 32—Jig for boring pin holes.

Two cup centers *A* engage the face of the finished upper end of the piston. A pointed center between them is held in place by a heavy spring, and recedes as the work is clamped down by the large center *B*. This center enters the bevel formed in the mouth of the piston and holds it central. As the center *B* is being brought down on the work, a plug is pushed through the bushing *C* and locates the rough pin hole fairly true with the bushing.

A bushing in the plate *D* supports the pilot of the boring tool *E* and of the reamer *F*. Both of these tools are supported in the bushing *C* by slip bushing.

Slackers in the Shop

By H. D. Murphy

On page 51 of the *American Machinist* Mr. Baker makes an earnest appeal to the workman not to be a slacker, which cannot be read without feeling that everyone in this country should respond to it unreservedly.

In reference to the last part of his article, however, I think Mr. Baker will find most of the men consider that the golden opportunity consists in sticking to their bench or machine. Two instances which have recently come under my observation bear out this conclusion.

A certain employer, in coaxing from another shop a man who is an expert on automatics, offered him 20c. an hour more than he was getting, full pay for all time off, including holidays, and at least one dollar and a half an hour for Sunday work. Another man some time ago gave up his position as foreman to work at a machine for 75c. an hour, which with overtime is netting him $70 a week. Both of these men state that the fact that they have no responsibility is almost as great an attraction for them as the pay.

It may be said that large earnings are all very well if the men can stand the strain; but on the other hand the men will tell you they are under no strain as they work along from day to day at "just a comfortable gait."

Does anyone hear of correspondingly lucrative offers being made to foremen, who must assume the responsibilities of the position they hold?

Alignment Chart for Feeds, Speeds and Power of Lathe Tools

By A. Lewis Jenkins
Associate Professor of Mechanical Engineering, University of Cincinnati.

THE five fundamental considerations involved in the economical operation of lathe tools are as follows: (a) The relation of cutting speed to diameter and revolutions per minute of the work. (b) Effect of feed and depth of cut on the cutting speed. (c) The kind of material cut. (d) Power required to remove a given amount of metal in a given time. (e) The speeds and powers obtainable on the machine.

Other variables such as the shape of the tool and rigidity of the work and tool, have become so nearly the same for all shops that they may be generally neglected as such.

The accompanying chart was designed to cover these five variables.

Relation of Cutting Speed to Diameter and Revolutions per Minute of the Work

The relation of cutting speed in feet per minute, V, the diameter of the work D, and the revolutions per minute, N, of the work as expressed by the well-known formula $V = \frac{\pi DN}{12}$ is represented on the chart by the three axes, V, D and N. For example: To find the required revolutions per minute for a cutting speed of 80 ft. per min. on a piece of work 8 in. in diameter, a line is drawn through 80 on the V-axis and 6 on the D-axis, cutting the N-axis at 51, which is the required revolutions per minute.

To make the chart particularly adapted to any one machine, its speeds may be indicated on the left side of the N-axis.

Relation of Cutting Speed to Size of Cut

The cutting speed of a given lathe tool for a given material depends upon the feed and depth of cut. This relation, as given by Dr. Taylor's, "Practical Table of Cutting Speeds" in the "Art of Cutting Metals" for a $\frac{5}{8}$-in. tool, is closely represented on the chart by the axes marked: "Depth of Cut, d," "Feed for Cutting Speed, f," and "Cutting Speed, V." A straight line drawn through the values for depth of cut and feed will intersect the axis for cutting speed at a value very close to that given by the original table.

For example: The cutting speed for a depth of cut of $\frac{1}{4}$ in. and a feed of $\frac{1}{16}$ in. for medium steel is found by drawing a line through $\frac{1}{4}$ on the d-axis, and through $\frac{1}{16}$ in. on the f-axis for medium steel, and this cuts the V-axis at 70 ft. per minute.

The $\frac{5}{8}$-in. tool was selected for use on this chart after consulting several lathe builders and sets of data taken from the actual practices of shops. These speeds seem to be more in accordance with the practice of the average shop than the speeds given for the larger tools, even when the larger tools are used.

The kind of material cut is represented by the axes for feeds marked "hard," "medium," and "soft," for both steel and cast iron.

Calculations for the power required to remove metal in a lathe are based on the cubic inches of metal removed per minute. This, of course, varies with the toughness of the material—which is a variable difficult to measure in terms that may be used for purposes of calculation. Under ordinary circumstances, however, 1 hp. will remove 2 cu.in. of cast iron and 1.5 cu.in. of steel per min. If the tool is dull or the metal extra tough, the values of these constants are high, but in the actual operation of the machines there is usually sufficient overload capacity of the motor or belt to take care of this variation.

The actual volume of metal removed in cubic inches per minute is

$$Q = \frac{\pi}{4}(D^2 - D_1^2)Nf$$

where D is the diameter of the work in front and D_1 the diameter of the work behind the tool.

Assuming that the center of pressure of the chip acts at a distance from the surface of the work equal to half the depth of cut, the mean velocity of the chip is $V' = \frac{\pi}{12}\left(\frac{D - D_1}{2}\right) N$ or $N = \frac{24V'}{\pi(D - D_1)}$. The depth of cut is $d = \frac{D - D_1}{2}$ or $D - D_1 = 2d$. Substituting these values of N and $D - D_1$

$$Q = \frac{\pi}{4}(D - D_1)(D - D_1)\frac{24V'}{\pi(D - D_1)}f = 12V'df$$

For ordinary cuts V' is practically equal to V and $Q = 12Vdf$, and the horsepower is

$$H = \frac{12Vfd}{2} = 6Vfd \textit{ for steel}$$

and

$$H = \frac{12Vfd}{1.5} = 8Vfd \textit{ for cast iron}$$

These equations are solved by using the axes for V, d, H, the axis marked "feed for power, f," and the "pivot axis." For example: The power required to remove a cut in cast iron $\frac{1}{4}$ in. deep, $\frac{1}{16}$ in. feed at a cutting speed of 60 ft. per min. is found by drawing a line through 60 on the V-axis and $\frac{1}{4}$ on the d-axis cutting the "pivot axis" at some point P, and through this point and $\frac{1}{16}$ on the left side of the axis marked "feed for power" a line is drawn cutting the H-axis at 7.5, which is the desired value for the power.

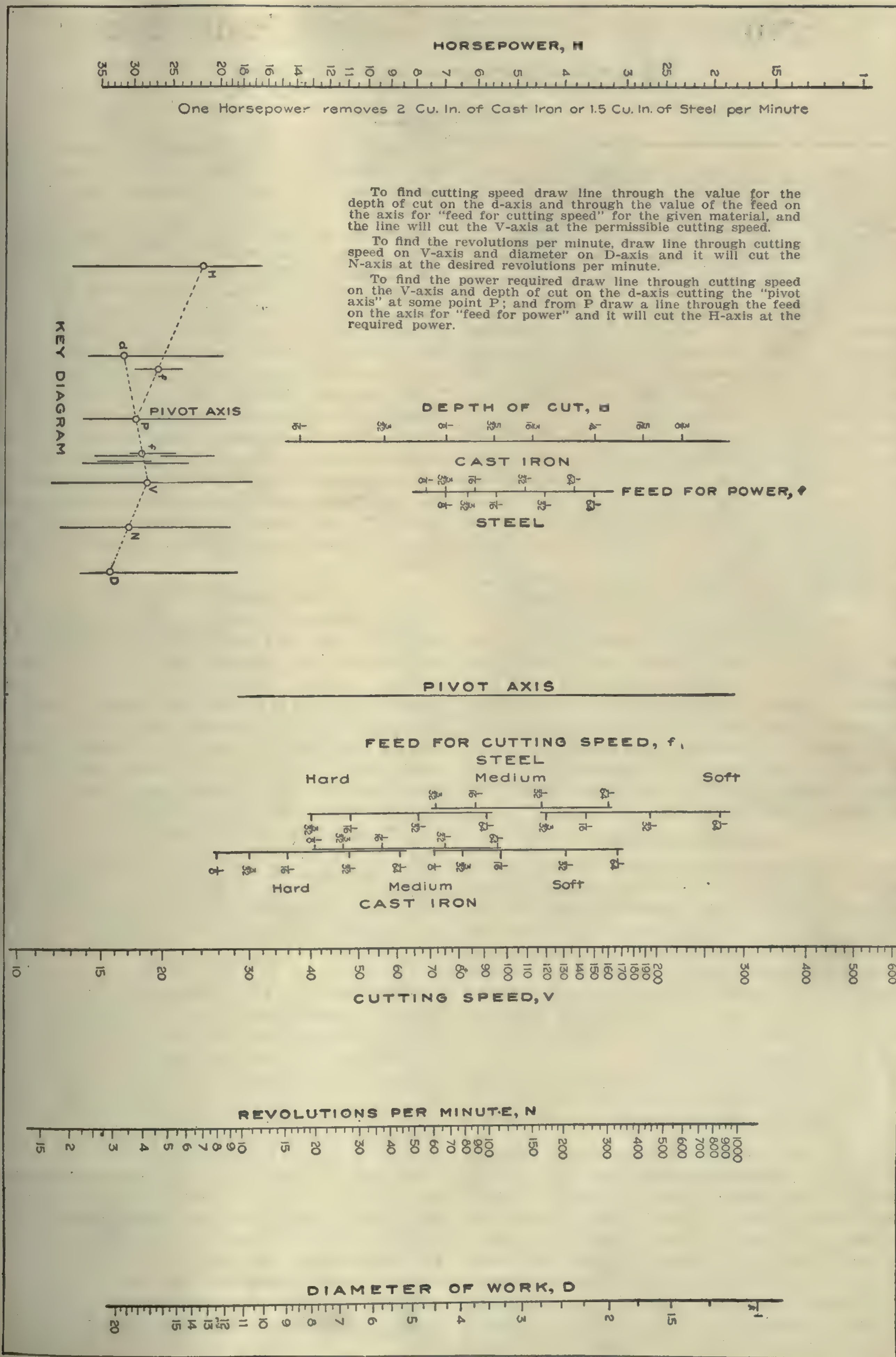
By using Barth's notation, $1AS$ for the slowest spindle speed, where the numerals 1, 2, 3, etc., denote the positions of the belt, A, B, C, etc., the gear reductions and S, M and F, the slow, medium and fast countershaft speeds; the N and H axes may be graduated for any particular machine. The speed notation is placed opposite a special graduation on the H-axis representing the power available at that speed.

By means of these special graduations the chart may be used in finding the most desirable feed and depth of cut in much the same way as found by the special slide shown in the "Art of Cutting Metals."

To find cutting speed draw line through the value for the depth of cut on the d-axis and through the value of the feed on the axis for "feed for cutting speed" for the given material, and the line will cut the V-axis at the permissible cutting speed.

To find the revolutions per minute, draw line through cutting speed on V-axis and diameter on D-axis and it will cut the N-axis at the desired revolutions per minute.

To find the power required draw line through cutting speed on the V-axis and depth of cut on the d-axis cutting the "pivot axis" at some point P; and from P draw a line through the feed on the axis for "feed for power" and it will cut the H-axis at the required power.



ALIGNMENT CHART FOR FEEDS, SPEEDS AND POWER OF LATHE TOOLS

Notes on General Gaging and the Manufacture of Gages

By H. James

Accurate gaging systems are essential to a quantity production of interchangeable parts, and this article points out many pitfalls found in inspection departments, and gives remedies for the same. The benefits derived from progressive inspection are also pointed out.

THE inspection of fuse parts has confronted many manufacturers very formidably, inasmuch as there are some 300 odd gages used and a set will cost approximately $8000 when made according to the specified and approved designs.

Even after the long endurance of the war, which has given us exhaustive opportunity to improve, there remains much to be done. In the first place the gaging of the time fuse is done from the two ends instead of from the base, whether on semi-automatics, hand-screw or special machines. In all cases work should be gaged from one end.

In designing, not enough practical thought has been applied to the essentials: ease of operation, adjustment after wear, first cost and method of manufacture.

The highly skilled artisans necessary for this accurate work have not been available, since in addition to gage work there has been a large number of men required for machine construction and the manufacture of tools. We rarely hear of a machinist today—they are all toolmakers; and although not so efficient as some who have made this branch of the mechanical arts their life-work, they must be given credit for meeting the emergency, for such it has been.

Designing of Gages

The designing of gages has taxed the resources of those not familiar with them; but the results have been gratifying withal. A few outstanding features are:

Nearly all plug gages have been double ended and the wearing surfaces are solid with the shank instead of using a reversible bush. The go end can be made longer, that it may be ground back as wear occurs: *A*, Fig. 1. Ring gages, *B*, are employed where adjustable block gages *C* would do. The latter allow for wear and give greater efficiency.

Thin plate-box gages *D* do not permit of finishing on machines but necessitate a lot of hand work, whereas a built-up box or a bar-type gage *E* and *F* would give better results.

Bar-type gages permit of greater gaging accuracy, as the parts lie flat and parallel to the gaging surfaces, whereas a thin gage is liable to be canted. Heights of projections or bosses are best gaged by having the high and low limits on the one side of the gage *G* and *H;* by moving the gage from one side to the other, the speed of the operation is greatly increased.

On account of the poor deliveries of ground, flat stock, some manufacturers have made use of cold-rolled sheet-steel, casehardening it by packing it in bone dust and heating it to about 1700 deg. F., keeping it at this temperature for about six hours, then water-quenching it. The results obtained have been entirely satisfactory.

Inspection costs and systems, when accurate examination is made, are necessarily elaborate and expensive; when if more judgment and coöperation were used by the representatives of those governments requiring the material, there would be greater conservation of natural resources. There are a great many details for which extreme accuracy is required, and even though great production is demanded, a manufacturer has no leeway.

The principal difficulty which arises in inspection systems is to insure this work being carried out correctly and not slurred over. A plan for achieving this purpose is to have a separate gaging department working in conjunction with the main inspection system; this department should have only two or three inspectors, they being required to change the gages every two or three hours with a view to checking any oversights.

Work Done by Operations

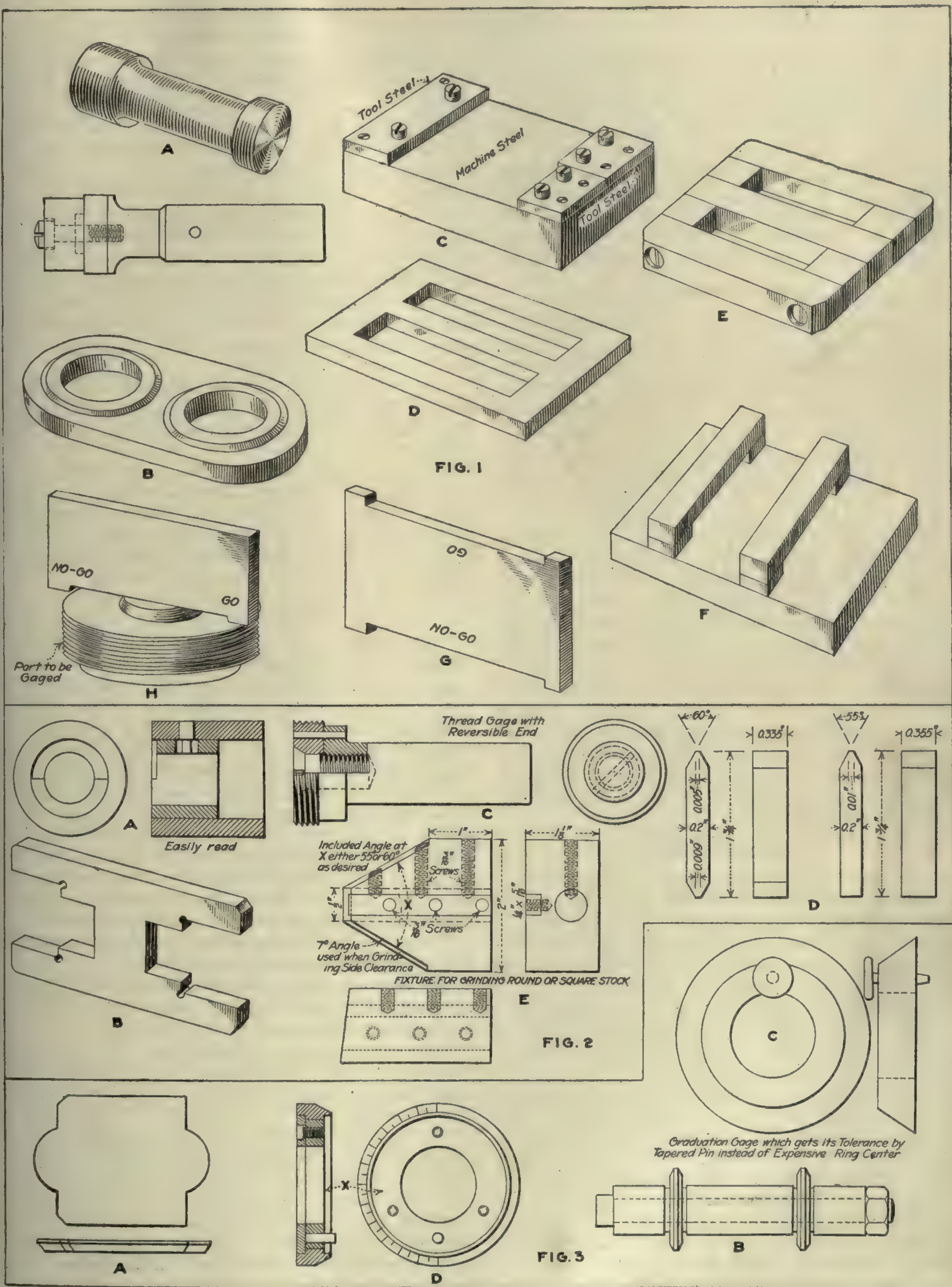
Generally work is done by operations, and as each operation is completed the operator's number is marked on the lot of parts, consequently it is an easy matter to trace trouble. Operations incorrectly performed should be returned to the negligent operator to be rectified so far as this is possible; or when this is not possible they should be sent to a specially equipped department. Another plan is to have samples taken every hour and put through each operation; this method, however, only gives a general idea of results.

Speed in gaging is an important factor and should be considered. By suitably designing gages or by using appliances, very great efficiency can be obtained. Gages requiring an operator to detect light underneath, etc., *A*, Fig. 2, are uncertain; and a design can be developed which permits of feeling, as shown at *B*.

Knowing How

Thread gages *C*, Fig. 2, have possibly given more trouble to manufacturers than any others, since considerable *knowing how* is requisite: gages must be held to 0.0003-in. limit including the lead, and when the shape of thread is examined by projecting it on a screen by means of a lantern the difficulties of manufacture are increased. Consequently as much life must be obtained from a gage as possible, and a good plan is to make them with reversible ends.

The writer believes that Ketos nonshrinking steel can be used to greater advantage than any other in this respect. Experience with several brands of non-shrinking steel has shown that on quenching, the lead has lengthened at least 0.0025 to 0.0035 in.; whereas the Ketos brand distorts less than half this amount—and so much is claimed to be excessive. Why a gage should lengthen instead of shrink is difficult to understand; but one theory is that the gage when heated,



FIGS. 1 TO 3. VARIOUS TOOLS, APPLIANCES, AND METHODS USED IN GAGE WORK

Fig. 1—A, plug gage. B, ring gage. C, adjustable-block gage. D, plate-box gage. E, built-up box gage. F, bar-type gage. G and H, height gage for bosses or projections. Fig. 2—A poor form of gage. B, a better form. C, a thread gage. D, block for thread gaging. E, fixture for grinding a thread gage. Fig. 3—A, a difficult gage to make. B, the imposed design. C, a graduation gage which makes use of a taper pin to determine tolerance. D, a more expensive gage for the same work

expands; and as the outside must necessarily be cooled very quickly in order to harden, the outside does not get a chance to shrink, even though the inside, which cools slower, may be tending toward shrinkage.

An accompanying illustration *D*, Fig. 2, shows a convenient block which can be used in conjunction with the Johansson blocks for testing the accuracy of the lead. These blocks are used by inserting them in the regular holder the correct distances apart; then holding the blocks tight up to the gage and making observations with a magnifying glass. After a little use one is able to judge by former practice how much the gages are out, and not many trials with the blocks are necessary.

Special Treatment

In using this steel, new taps should be cut from the same steel, hardened and new laps made. The gages should be made from annealed stock and 0.002 in. left for lapping. To anneal, a special treatment should be used. The steel should be packed in charcoal, heated to a temperature of 1450 deg. F., held there for 1½ hours, allowed to cool slowly to 1350 deg., then held for another hour and allowed completely to cool very slowly. If this practice is not adhered to, difficulty due to toughness will be experienced in machining.

The tool for cutting the thread should be ground in a fixture *E*, Fig. 2, to insure getting the correct angle.

Four sizes of laps are sufficient. In the case of large size gages, say 2 in. diameter, 0.005 in. should be left for lapping, although some say to leave less; but then there is the possibility of trouble in the hardening which will not permit of cleaning up. It is the general practice in this country to cut a clearance or dirt groove in the bottom of the thread in the case of ring gages, which permits the gage to be closed in and still maintain the effective size of the pitch diameter. Grade FF emery is sufficiently fine and makes a better job than a finer variety, although the final polishing should be done with grade FFFF.

An Efficient Process

Some manufacturers grind their threads, and it is an efficient process which resolves itself into how to shape the grinding wheel and how to get the wheel to hold its shape. There is no difficulty, since a number 120 to a number 150 grade-M wheel will hold up the cutting edge, and it should be wide enough and the fixture heavy enough to take care of vibration. A ¼-in. width wheel as large in diameter as the fixture will swing, should be used, as the larger the diameter the better will the cutting edge hold.

The examiners of the British fuse require standard designs of gages to be used. Sketch *A*, Fig. 3, illustrates a gage which it is not possible to make accurately without first making a master; and to make a master we must make a gage. The imposed design is all straight grinding work, as shown at *B*. This first gage however, may not be used because it is unofficial. A similar condition exists in the case of the graduation gage. A graduation gage which gets its tolerance by means of a tapered pin *C*, Fig. 3, instead of the expensive ring center, is shown in *D*, Fig. 3. Generally speaking there has been a lot of lost motion and material lost on war contracts—far more than is good for the country.

An Outside-Man's Job

By W. Osborne

Shrub wondered if the strange dog that had shown up would tackle the other two or whether he was only bluffing. As he looked out of the window he was also thinking about his job, and wondering whether it would not be best for him to drop it some pay day and go where it would be worth while.

What was the use of spending years of his life in such a place. The town was a dead one, and the shop was like it. The men there were just like the town and the shop. They were all back numbers. He had been here eighteen months and had known all that there was to know when he had been there less than half that time. He had done some work on every machine, almost, in the place, or at least he had worked on every kind of machine in the place.

The old codgers had the good machines with the easy work and the good pay, and the foreman did not respond to an invitation to let a meritorous young man have a look in.

Shrub had been busy near the front of the shop, and so he saw the man who came in, and was near enough to hear what he had to say to the foreman.

"I want a man, and I want him right away. Men are loafing around at my expense until I get going again." This man was evidently in a hurry.

The Foreman's Reply

"Our outside man is on another job and will not be back before the middle of the afternoon," said the foreman, "and I will send him as soon as he comes in."

"Let me have one of your other men. This is your own stuff that has let me down. Any man with a head on him can fix it. Our engineer is away to a funeral and one of the other men got too smart." The man had been looking around and had seen Shrub. This man had a daughter and Shrub had called there, and in a casual way had told the girl, in the hearing of the father, something of how he had already absorbed all that there was to know at his present source of supply, etc. As Shrub was a fine-looking young fellow and a good talker he had made an impression.

"There is a wide-awake fellow; can't you spare him long enough to go out there and back?"

The foreman acted as though he was going to object and cut Shrub out of another chance, but seeing that the request had been overheard he only said:

"You seem to know this chap, and if you want him we can spare him"; and turning to Shrub he said, "Get what you need and go." And with that he hurried away to other things.

The turn of affairs was very pleasing. Shrub gathered some tools together, rolled them up in his overalls and announced that he was ready.

As the buggy rolled along Mr. Dayton did some growling about the machinery in general, the inferior class of men who made it and the important and disobliging attitude of the foreman. Shrub agreed with everything and added a number of observations of his own along the same and similar lines.

Bobbie Jones was the regular outside man, and Bobbie was a joke. He couldn't dance or play ball, and didn't know enough to tell one card from another.

If you asked him a question he had to get the answer out of a book. He even kept a number of them at the shop, and at that Bobbie had the very nicest job that there was, and got lots of nice trips, like this one, and had a general good time, with lots of variety, and very little work.

Shrub did not know where they were going or what was to be done when they got there, and he was too busy to think of it.

They stopped before a country gristmill and found everybody in the neighborhood clustered around a gas engine. Shrub had just come from the shop that had made it, and was quickly informed that this engine refused to run, and it was plainly to be seen that everyone looked to him to perform the magic rites that would cause it to work.

Shrub's Feelings

One short hour ago Shrub had been thinking of such an engine as being beneath one of his talents, and had been sighing for something of man size to work on, and here suddenly the thing had become a malignant thing of mystery. Shrub realized that bluffing would not make the engine go but he did not see any immediate way to escape with any dignity so he removed his coat, rolled up his sleeves, tried to look important and think at the same time, and began looking the engine over.

"What have you fellows been doing with it anyhow?" —more to kill time than to get information.

"She's all there, mister, and not a thing broke. All she needs is to go through the hands of the inspection officer and to get the order to march."

"Seems like, maybe, she haint just got all of her kit in the right place."

This came from a man who seemed to be a person of some moment for all of the others laughed, and Shrub could feel the sweat breaking out all over his back. He had helped to put up and take down such an engine many times.

He had pulled on the wheel helping to start them. He had worked on some of the parts.

Not knowing what else to do he began looking at the places he had seen others look at when an engine gave trouble on the testing block, but while he was doing it he realized that he did not know how things should look when they were in their proper place. Strange as it may seem he did not know what conditions were necessary to make a gas engine run.

Talking vs. Doing

He could talk of compression, and ignition, and revolutions per minute, and gas per horsepower, and give the impression that he knew what he was talking about, but, like many other folks, he had not realized the wide difference between talking and doing something.

As he could not see anything wrong he proceeded to take down a valve. He had seen this done often, for it was a common thing for a heedless helper to leave enough dirt in some part to have it draw in and hold a valve open. He had received more than one blessing from an angry machinist for doing that very thing. The information that the valve had been out and examined did not stop him, for just then he could not think of anything else to do. The valve seemed all right, but as he was putting it into place again he saw that there were two ways that it would go in and that it had been bruised enough to remove any marks that might have been put on to show how it should go. A port indicated that it should register with another one in the cylinder and Shrub began putting it in so that it would do so when he was stopped by a man who was evidently the engineer for the day and who had been watching every move.

"Say, mister, that was in the other way. There is the mark where you hit it with the hammer when you were taking it out."

There was the mark sure enough. Shrub stared at it. Suddenly an idea struck him. These men had taken things apart. Perhaps they had put it in wrong. He examined the ports and could not see any way to get the charge into the cylinder if they did not match, and so proceeded to put the valve in as he had started to do. A glimmer of hope held out the possibility that he could get the engine running.

"How many other things did you fellows monkey with?" he demanded. To his relief he found that the valve was the only thing that had been taken off that could be put on wrong.

It was fortunate for him that the ignition was by means of a hot tube. Had it been by an electric spark and the adjustments been changed he would have been entirely at sea. Some time later he found that an ignoramus who meddles with machinery always tackles the parts that he knows least about, and seems to think that as long as two pieces of such parts are left together he has not done his duty. That is one of the things that makes it interesting for the man who goes out from the shop.

Encouraged by what he had found Shrub risked trying to start the engine. He got some real help here from the men who worked in the mill, for they had been used to pulling on it. To his joy and relief it started and pulled the mill, and as that seemed to be what they wanted most of all he rolled up his tools.

The Result

Not much was said as Mr. Dayton drove them back to the shop. Shrub felt that it was best for him to say nothing, and Mr. Dayton did not comment on the job.

Perhaps it was his imagination, but it did seem to Shrub that the foreman was a little bit surprised to hear that he had got away with the job.

He learned afterward that Bobbie Jones had gone out the next day, at the request of Mr. Dayton, and looked things over and made some adjustments and minor repairs, but he was so glad to have got back with any shred of his mechanical self-respect left that he did not feel any resentment.

This experience set Shrub to doing some thinking and observing and gave him a different opinion of the shop and his shopmates and of their ability. He has gone out to many other jobs since that first one, but never has he gone out with the important, carefree feeling with which he started to that one.

He has several books of his own now, and is surprised to find how many perplexing combinations a seemingly simple piece of machinery can get into when it is at the mercy, or lack of mercy, of an ignorant man.

Sidelights

EDITED BY E. C. PORTER

Canada produced $200,000,000 worth of minerals last year, $23,000,000 more than in 1916 and $63,000,000 more than two years ago. The Dominion's iron and steel production was the largest in its history.

* * *

According to the reports of R. G. Dun & Co. for 1917, there were fewer commercial failures in the United States in that year than in any of the three years previous. The total liabilities last year were $183,441,371, which is smaller than the corresponding figures for nearly ten years.

* * *

The debt-making "habit" among nations has grown apace within comparatively recent time. The total world's debt in 1714 was less than one billion dollars, in 1814 seven billion, in 1914 forty-five billion and at the beginning of 1918 it had reached the stupendous sum of more than one hundred billion dollars.

* * *

Secretary McAdoo announces that based on official information received the American Army is at least 90 per cent. insured. The total amount of insurance now on the books of the Bureau of War Risk Insurance is $8,879,104,000. This represents 1,082,099 applications actually on file. The average amount applied for is $8,205.

* * *

The War Department now permits women to qualify as inspectors of small arms, according to announcement made by the United States Civil Service Commission. The examination for which the commission is receiving applications to secure persons equipped to serve as inspectors and assistant inspectors of small arms in the plants filling contracts for the army is the first of its kind opened to women, it is stated.

* * *

Secretary McAdoo announces that every officer and cadet at the Ground School at Princeton, N. J., has taken out the maximum amount of insurance permitted under the war-risk insurance act, or insurance of $10,000 apiece. The total amount of insurance subscribed for by the officers and cadets at the Ground School is $1,864,000. As far as is known the Princeton Aviation School is the first camp of either the army or navy to set a 100 per cent. war-risk insurance record.

* * *

Provision has been made by the War Trade Board by which any person in the United States who holds a power of attorney for a patentee in an enemy country or country allied with an enemy country may pay such fees as are necessary for the filing in our Patent Office of trade-marks, prints, labels or copyrights. Such fees must be paid from the enemy's funds, however, and the payments be made subject to the approval of the alien-property custodian. Full information as to the processes surrounding the preservation of an enemy's patent rights in this country may be had from the War Trade Board.

Of all workers who can most righteously claim exemption from carrying a gun, the agriculturalists have filed the greatest number of exemption claims. The man at the lathe and the man with the hoe are absolutely necessary to be retained in their respective jobs, if the war is to be carried to a successful issue for the Allies, but it is the agriculturalist alone, who has hastened to act in the matter. The man at the lathe should lose no time in getting out of the draft. He is needed most where he is.

* * *

The War Department has approved the publication of a weekly newspaper behind the American lines somewhere in France. This paper which will be devoted entirely to American news, will be known as "Stars and Stripes" and will be published every Friday under the direction of the Intelligence Section of the American forces. A feature service of the "Stars and Stripes" will be furnished by the Committee on Public Information, and arrangements have been made with a syndicate for a weekly cable service. Advertising contracts are already being made in this country.

* * *

The demands of the Government for certain tools and handles are creating an unprecedented scarcity in some lines of hardware. The latest development is the enormous demand for Governmental uses for axe, sledge and many other tool handles. Shipbuilding is also creating an unusual demand for certain kinds of styles of adzes and carpenters' slicks. The call for plates for ships has caused a famine in crosscut saws, as the various saw works are giving a large percentage of their output of plates and sheets to the Government. The construction work at cantonments, camps and new factories for the Government takes a large proportion of the output of the country of such articles as tackle blocks, steel rules, hacksaw blades and a lot of other tools.

* * *

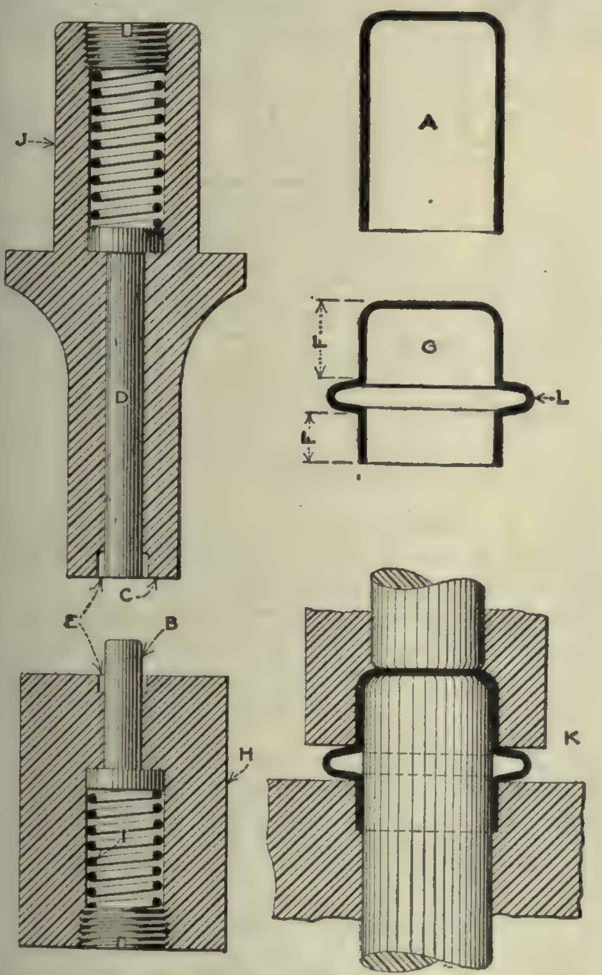
Though more than 20,000 binoculars, spyglasses, telescopes, sextants and chronometers have been received by the navy as a result of the appeal sent out by Assistant Secretary Roosevelt for these necessary articles as "eyes" for the watch officers serving on vessels in the war zone this generous response, however, does not meet the demand, and many more will be needed. No more can be obtained from foreign makers and the Government must depend to a large extent upon those who will loan these articles to the service. It should be distinctly understood, that opera and theater glasses are not suitable for this work. What is needed are binoculars, field and spyglasses, telescopes, sextants and chronometers. The owner's name and address should be placed on each article so that a record may be kept in order that they may be returned after the war. Articles for this service should be sent to Franklin D. Roosevelt, Assistant Secretary of the Navy, care of the Naval Observatory, Washington, D. C.

Producing a Bulge in Tubing

By O. P. Yost

In reading the article by W. S. Quimby, page 860, on producing a bulge in brass tubing, would say that the old style of rubber compression plan used similarly to Mr. Quimby's lead trick was considered good, but I think it rather expensive.

Also there is the oil-pressure die used on shapes similar to iron-bed trimmings. The die is similar to a mold that is ready to receive the molten metal. The deep drawn shell is annealed, placed in the die; a pipe connection is made on the end of the die and oil is forced into the shell under pressure. After the pressure is withdrawn the die is opened, the tube removed and found to be the shape of the die.



PRODUCING A BULGE IN TUBING

In the accompanying illustrations is shown another method of obtaining a bulge on a 22-gage drawn shell 3/8 in. diameter by 3/8 in. long.

The previously drawn shell *A* is placed on the pin *B* which is located in the die *H* and is pressed upward by a spring *I* held in place by a setscrew. The die *H* has the seat *E* as shown, to receive lower end of the shell *A*.

The punch shank *J* has the spring-operated pin *D* and a seat or recess *E* to receive the upper end of the shell *A*. The recesses *E* should be the same in depth as the dimensions desired at *F* on the completed cap *G*.

In operation, the previously drawn shell is placed on the pin *B*, in the die, and the punch *C* is brought down sufficiently to produce the desired bulge, but not to a hard stop, as that would form a collar or flange. When the punch leaves the die, the spring pins *B* and *D* will force the cap out of the punch and die. The die *H* can be made to suit any standard die block, and punch shank *J* can be made to fit any punch holder or ram.

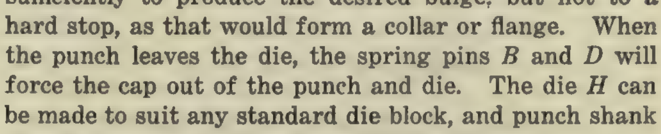
At *K* is shown the action of the die and punch on the shell when they are closed. The pin *B* prevents the sheel from collapsing, while the walls of the seats *E* will prevent expansion. The bulge shown at *L* may be varied to suit conditions.

Economical High-Speed Steel Counterbore

By Walter Nemo

In view of the present high price and the difficulty of obtaining high-speed steel, it behooves both designer and shop man to exercise their brains in the interest of conservation.

The accompanying sketch shows a method of making high-speed steel counterbores with a minimum of this expensive material.



ECONOMICAL HIGH-SPEED COUNTERBORE

The counterbore *A* is made double-ended with a center hole of suitable size passing clear through, and is tapped at the side, midway of its length, for a headless setscrew. The driver *B* is made of mild steel with same sized center hole as the counterbore; it is tapped on the side for the setscrew, and has teeth cut the same as in the counterbore, in order that the two parts will

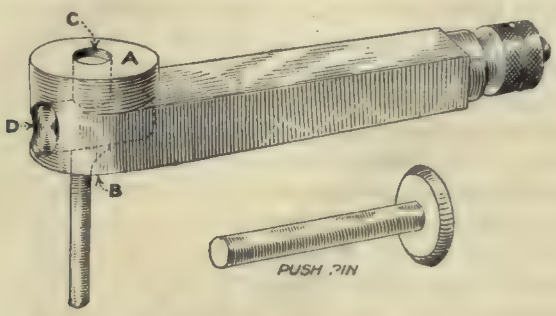
interlock when they are placed together. The pilot passes through the counterbore and is fastened by the setscrew in the driver. The setscrew in the counterbore is to prevent the latter slipping off when pilots of the same size, or smaller, than the center hole are used.

A Special Depth Gage

By Gustave Ramacle

In the accompanying illustration is shown a very handy depth gage, which is very useful when a hole or slot is to be measured for depth and may be too small or narrow to admit the entrance of ordinary depth gages.

The body of the gage is hardened and ground at *A* and *B*. Hole *C* is lapped to 0.125-in. diameter. The binding stud *D* is closely fitted so that the needle will not



DETAILS OF DEPTH GAGE

shift in the locking. The value of the gage lies in the fact that when special needles are needed to enter a hole or slot too narrow or small for the employment of other depth gages, a piece of 0.125-in. drill rod may readily be turned or filed to size and applied.

In applying the gage, the needle is pushed to the bottom of the hole or slot by means of the pushpin shown, and then locked by means of the knurled nut. The distance is then measured from the point of the needle to the surface *A* by means of the micrometer. The figure thus obtained, minus the dimension *AB*, leaves the depth of hole or slot.

Grinding Snap Gages

By Matthew Harris

Mr. Darling's article on page 31, in which he illustrates an abrasive wheel for grinding snap gages, calls to the writer's mind wheels of this kind he used for

WHEEL FOR GRINDING SNAP GAGES

the same purpose, about 40 years ago. Of course, no wheels of this shape were on the market at that time, neither were there any saucer-shaped wheels.

An ordinary wheel of the proper width was dressed with a diamond to a shape about as shown in the illustration, cutting the recess *A* only far enough toward the center to clear the points of the snap gage. This saved time, wear on the diamond, and left the wheel stronger than if the recess were cut further down.

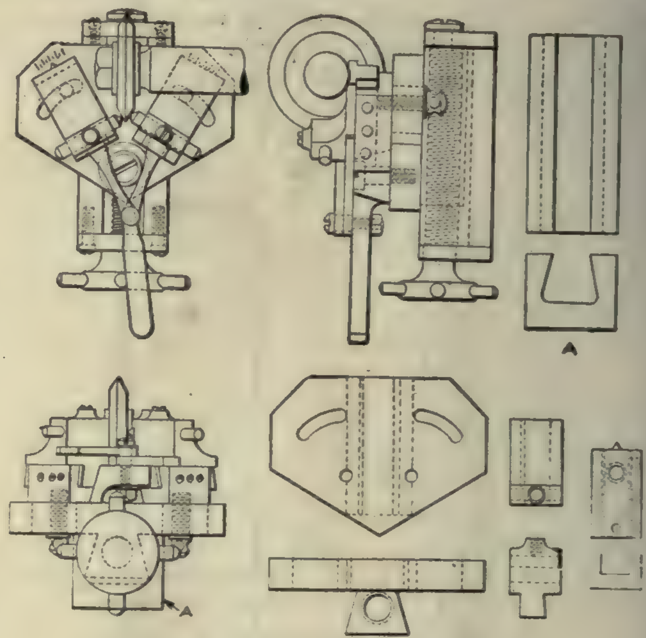
The writer found that by cutting a series of grooves in the sides of the cutting faces of the wheel, as shown at *B*, that the wheel cut very much freer, heated the work less and required very much less pressure. With wheels dressed in this manner, the grinding was done faster and with much greater accuracy.

Wheel-Dressing Fixture

By James W. Collins

The wheel-dressing fixture here shown and described is about to be installed in a plant where thread grinding was adopted twenty-five years ago. Its recognition by this pioneer concern surely proves its practicability.

It is adapted to any make of thread-grinding machine,



WHEEL-DRESSING FIXTURE

and when properly attached will overcome the many difficulties in truing formerly looked upon as necessary evils by the grinding-machine operator.

The initial precaution to observe in installing the fixture is to make certain that the base *A* be so attached to the machine as to move with the grinding wheel. The design of the fixture is such as to prevent the wheel leaving the center of the thread, and dressing may even be accomplished during the grinding of work. The drawing is more easily understood than a comment on the workings of the fixture, and any thread grinder will readily grasp and appreciate its merits.

A Cylinder Boring Jig

By M. E. Hoag

The cylinder boring jig shown in Figs. 1 and 2 was designed and built by Briegle & Hagius, Rock Island, Ill., for the Root & Van Dervoort Engineering Co., and is used for boring cylinders on a Moline cylinder boring machine.

Ordinarily no jigs are used with Moline cylinder boring machines, but on account of the depth of bore (10

in.) and certain cored pockets in the cylinders, it was deemed advisable in this case to use a jig with bushings to support and guide the tool spindles and prevent any possibility of their springing, or of irregularity in the finished work.

A front view of the jig is shown in Fig. 1. The base, which is very heavy and bolts to the machine bed, carries a sliding table *A* which is fitted with hardened-steel member *F*. If further adjustment of the bushings is required, steel shims of the required thickness are placed between the bottom of the milled slots in the bushings and the clamps. This method of adjustment avoids the possibility of the bushings being clamped down too far and binding the machine spindles.

The boring heads are larger than the machine spindles and do not pass through the bushings but enter

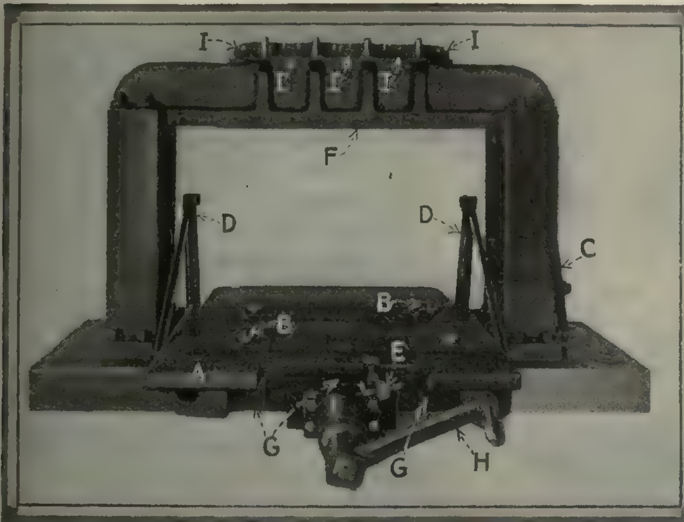


FIG. 1. CYLINDER BORING JIG

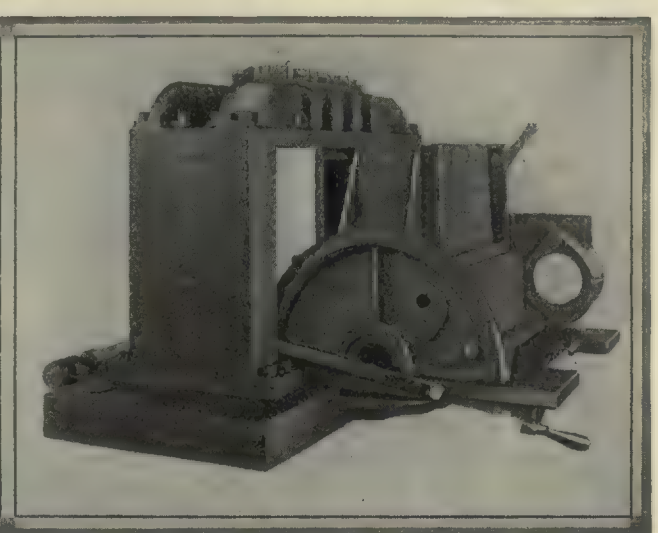


FIG. 2. JIG WITH CYLINDERS IN POSITION

locating stops and pins *B*, which enter drilled holes on the underside of the cylinder casting.

The table is moved out for loading by the lever *C* at the right of the jig, suitable ways being provided to insure alignment of the table in all positions. The arms *D* are connected to the lever *C* by a shaft at the back of the jig and give the table enough movement so that when in the extreme forward position the castings may be removed without striking the bushing supports.

Positive stops at the back of the table insure proper location of the cylinders when in working position. The screw and stud *E* are removed in order to slide the table forward, and are replaced and tightened against it when in working position, thus clamping it firmly against the locating stops.

The under side of the bushing plate *F* is planed parallel with the table, which latter is raised by a plate which carries three sliding wedges *G*. When the table and cylinders have been brought to their proper location for boring, the wedges are forced in by turning the handle *H*, thus raising the table so that the cylinders are clamped firmly between it and the underside of the bushing plate *F*, thereby preventing any possible chance of their cocking up on the locating pins, and also doing away with clamping bolts and straps

The plate, or member, *F* carries four bronze double bushings. The outer set are fixed in the member and are bored taper on the inside. The inner bushings protrude some distance above the tops of the outer ones and are tapered on the outside to fit them in practically the same manner as the bearings of a milling machine. They are split so that they may be adjusted to fit the spindles of the boring machine, and to take up for wear.

The tops of the inner bushings are heavy and have slots milled on four sides as far down as the member *F*. Hardened-steel fingers or clamps *I* enter these slots and are bolted down tight against the upper surface of the recesses bored in the underside of the member *F*. To protect the bronze bushings from damage through contact with the revolving heads, the hardened steel rings are pressed into these recesses.

This jig is so easy to operate that with an air or chain hoist for lifting the cylinder castings, that one man can easily handle the work.

Chart for Determining Approach for Milling Cutters

By W. H. Volkmar

The accompanying chart is very simple and is used for the same purpose as the one suggested by A. W. Hinkel and published under the same title in the *American Machinist* on page 910, Vol. 47.

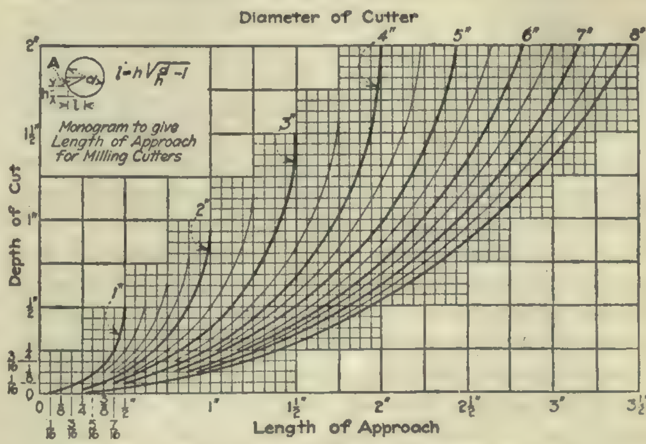


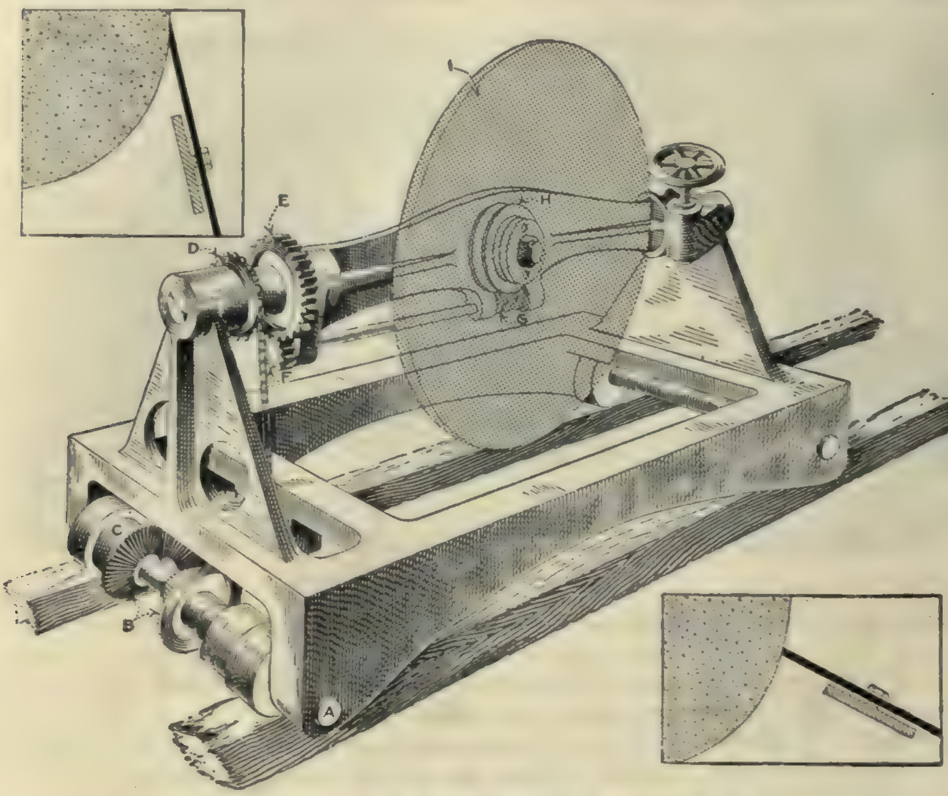
CHART FOR DETERMINING APPROACH FOR MILLING CUTTERS

[The formula at the top of the chart can be more simply expressed by $l =$ cosine $A \times \frac{d}{2}$.—Editor]

Shaping Edges of Circular Plates

By N. V. Christensen

A unique method of revolving a circular plate during grinding operations on its edges, is shown by the accompanying sketch of a device which takes its power from the traction of the wheels upon which the carriage runs



CARRIAGE FOR DISK-GRINDING OPERATION

while traveling back and forth past the surface of the grindstone.

The usual custom is to accomplish this movement by means of a countershaft and belt, the tendency of the latter being to lift the carriage away from the grinding medium, thereby causing a variation of pressure with resultant unevenness of work.

Two miter gears *B* mounted upon axle *A*, carry four pawls in their respective hubs; one set being operated by a right-hand, the other by a left-hand ratchet; these pawls and their springs are retained by the steel ring *C* which slips over the hub. The third miter, meshing with the two gears upon the axle, is mounted on the end of a short shaft lying parallel with the line of travel of the carriage; this shaft carries a sprocket which drives by means of the chain, the sprocket wheel *D* mounted upon a sleeve with the gear *E*.

This gear through the medium of the pinion *F*, the worm *G* and the wormwheel *H*, turns the disk *I* with a powerful and uniform movement in one direction regardless of the direction of movement of the carriage.

The transmission of power through the sleeve, gear and pinion allows the bar carrying the disk, to be turned upon its own axis for the purpose of tilting the disk to whatever angle may be required; this turning being accomplished by the worm and handwheel shown at the right.

This latter feature has been found to be very convenient in a number of instances.

Relation of Press Stroke to the Life of a Die

By A. P. F.

On page 485, Vol. 47, C. T. Creager has an interesting article on the above subject, in which he gives some figures showing conclusively from actual results that, "all other things being equal," a short stroke is of distinct advantage in prolonging the life of the tools. It is not my intention to convert either premises or the fact, but to show the reasons for results obtained, and also to suggest that while the various foremen interrogated by Mr. Creager were quite correct in their statements, he and they were thinking of two distinct matters when they said, "If the presses are run at the same speed." I suggest that the foremen meant by this expression "mean linear speed" of the ram, while Mr. Creagor referred to the "number of strokes per minute."

Now a moment's consideration will show that if the stroke is reduced 50 per cent., and the number of strokes per minute remain constant, the mean linear speed of the ram will also be reduced 50 per cent. The result will be not only a great reduction in the wear of tools, due to abrasion, but the cutting action will be greatly improved owing to the slow displacement of the molecules of the metal. This is verified by the three examples given, the relative mean linear speeds of the presses being as follows:

Stroke, In.	R.p.m.	Mean Linear Speed, Ft. per Minute	Per Cent of Increase
1½	80	10	.....
3	65	16.25	62.5
2½	90	18.75	87.5

This shows the 1½-in. press to be much superior from the point of view of cutting speed and is in agreement with Mr. Creager's results, but it also indicates that the 3-in. press is better than the 2½-in. press, which is the reverse of Mr. Creager's claims. If Mr. Creager investigates the matter carefully these figures will be shown to be correct, although the difference in the life of the tools would be very slight as the percentage of variation is small.

The output per unit of time from the 3-in. press, however, would be much lower than from the 2½-in. press, therefore, in the long run the result per tool unit would be about equal, which is practically the conclusion reached by Mr. Creager.

On the basis of hourly production, however, the 2½-in. press would have the advantage over the others inasmuch as its production would amount to an increase of 12½ per cent. over its nearest competitor, and a correspondingly greater increase over the press with the 3-in. stroke.

Editorials

Maintaining Continuous Production

THE great problem of the machine shops in the effort to do their full duty at this time is production, and yet more production; while one of the most difficult problems of production consists of the human element: the securing of labor and its coöperation, which is so necessary to success.

The necessity for production is so great that nothing must be allowed to interfere with or hinder it. No past prejudices, no old notions either of rights or privileges of either side must be permitted to slacken the pace. Neither employer nor employee may use the present crisis to secure what seem to be advantages for his own side. Differences of opinion as to the merits or demerits, of unions, of open or closed shops, or of hours to be worked, must not stand in the way of continued production. No dispute must come to the point of shutting down the shop or even slowing down the output. The individual on either side must sink his demand for personal recognition or advantage, and work only for the one object: the winning of the war!

We can study the trend of labor activities and their treatment in Great Britain to advantage, carefully noting both sides of the question in every case. The unions conceded the abrogation of the closed shop in many places and helped to train unskilled labor. There, the railroads deal with the men through their unions as we do, and by these means serious friction is avoided. Shirkers are tried by a board which comprises one labor man, and are fined when the case warrants it. In every way the relations of employer and employed have been strengthened by contact with and appreciation of each others capacity, and an understanding of each others point of view. The British mission in this country freely predicted that such methods would result in closer and more amicable relations after the war; that collective bargaining was likely entirely to replace the dealing with individual workmen. The effect of complete harmony between the men and their employers, is sure to be a factor in future trade relation and competition, and should be carefully noted.

One of the great difficulties at present is the great discrepancy in hours and wages in different localities and in different shops. Men naturally seek the highest remuneration and the shortest hours, and the discrepancy between these things made possible in many cases by the abuse of "cost-plus" contracts, causes dissatisfaction, constant changing of men from one shop to another, or from one locality to another; and such unnecessary labor turnover is distinctly detrimental to production in every case.

This difference in wage is particularly hard on the builder of machine tools, as his price-advances have in most cases not been sufficient to allow the payment of any such rates as prevail in some of the distinctly classified war contracts. With the Government hounding the machine-tool builder for increased output and more rapid deliveries, and at the same time protesting prices which are modesty itself in comparison with those of almost any other line, it is but fair that some steps be taken to see that other government-contract manufacturers do not and cannot interfere with the machine-tool shops in their efforts to secure labor at a fair price. It may even become necessary to establish priority in labor as in material and machines—always bearing in mind that absolute justice must be done in all cases, and that the term labor implies all men who aid in production, no matter whether they work with their hands or head.

That some kind of regulation may become necessary is more than a possibility, and we may as well prepare ourselves for it. It is not a question of price or of personal preference, but of getting production out of the shops; and if we all realize the necessity of coöperation, and bear it in mind in all our dealings, the time of such regulation may be postponed, perhaps indefinitely.

Maintaining a Working Force

AMONG the many phases of the problem of production is that of maintaining a constant supply of suitable labor, and no phase of the problem is more trying; it is made more difficult by the lack of uniformity in the number of hours which constitute a day's work in different shops and in varying localities, as well as by the different rates of wage which prevail not only in certain localities, but in certain branches of the machine industry.

The problem of maintaining a constant labor supply is particularly trying in the neighborhood of some of the large munition workshops, where the selection of men is not always of the best, and high wages naturally loom up as a factor in determining a man's choice of job.

With orders filling the books, each of them with a priority certificate, with every mail bringing vain pleadings for impossible deliveries, the shop managers naturally look to longer hours as the only way of increasing the output. This is the more naturally and easily understandable when we know that every shop manager and every responsible executive is working longer hours than ever before, and see no way of avoiding it.

We must not overlook England's experience in this matter, nor make her mistake in regard to the hours of labor. Every report from the other side—from employers, from labor leaders and from those high in the councils of the country—points to the same conclusion: long hours and overtime work are to be avoided if real progress in production is to be maintained.

Long continued efforts such as are required in many shop operations, coupled with the monotony of con-

stant repetition, result in a fatigue which is responsible for accidents, for spoiled work and for a lowering of the stamina of the worker. Worst of all they are responsible for a discontent which urges the workman to try some other shop or some other occupation.

Again: we must not overlook the fact that labor has been guaranteed a maintenance of its pre-war standards; and when this labor situation coincides with that of Great Britain, when its representatives in this country agree that this is the wisest method from all points of view, we cannot expect good rèsults by running counter to the opinion.

The Government expects to pay for its purchases on the basis of an eight-hour day. The Ordnance and other departments recommend this as a basis for work, and outline other conditions which it is advisable to follow. Knowing the tendency of labor to shift in these uncertain days, the course adopted seems the wiser one to follow at present.

Increased output for the present at least, must come from improved methods and the employment of more labor in either single, double or triple shifts. This may or may not represent our best ideas of the subject, but we are faced by a condition and not a theory: a condition which puts every shop manager on his mettle and challenges him to make good under adverse conditions.

We know the difficulty of securing trained men in the present unsettled conditions and we believe the time is coming when the difficulty must be controlled or guided in some way, as we may all be controlled to some extent, for the public good. The new United States Employment Service is a step in this direction, and properly handled, should prove of great value in many ways.

Utilizing Older Men

THIS is a good time to revise some of our deluded notions regarding the usefulness of men who are no longer young, and for which Dr. Osler of forty-years-old-and-chloroform fame is largely responsible. Few fallacies have had wider credence than his famous statement regarding the desirability of chloroforming or otherwise disposing of all who allow themselves to be convicted of the crime of reaching the age of forty years.

In all probability Dr. Olser never intended this statement to be taken so literally, but he has much to answer for, as the epidemic of literality which followed worked much sorrow and hardship throughout the land. Fortunately the tide has turned, but we are not yet utilizing the experience and judgment which only comes with years, nearly so extensively as we should.

Age is scarcely more of an index of a man's ability to give useful service, than is the color or shape of his eyebrows—and not nearly so much so as his habits! There are many men of sixty-five years who have at least ten years of active service in many lines ahead of them and who can be depended on to give an excellent account of themselves in productive work.

The present emergency, wherein skill and experience are of so much greater value than mere man power, affords us an opportunity of using every man who can give even a few hours per day to the cause. At the drawing board, in planning work, in making calculations, in teaching learners in our factories, in the toolroom, and in many other lines where brain rather than brawn is the main consideration, many men of sixty and seventy years of age can give an excellent account of themselves. And there are many kinds of manual work at which they can give good service for a few hours if not for a full day. Every hour counts and should be utilized for the country's good.

The country has, owing to some of the army regulations, been deprived of the services of valuable men because they could not pass the physical examinations applied to the reserve officers. The reason of course is to avoid saddling pensions on the country and from that point of view is commendable. But equitable arrangement can be made to avoid this and to secure the services we need so much. If a man can give but six months of service, the country is that much better off, and means should be provided to enable him to serve in some capacity for as long or short a time as he may be able.

The idea of raising the ban against a still useful and active age is also true in its application to industry. We should not forget that the man with years of experience requires less supervision than the younger man and that he has an added value on that account. It is well to forget all about age and judge only by the value of the work, not forgetting that tool breakage and supervision must also count for or against a man in considering his real worth.

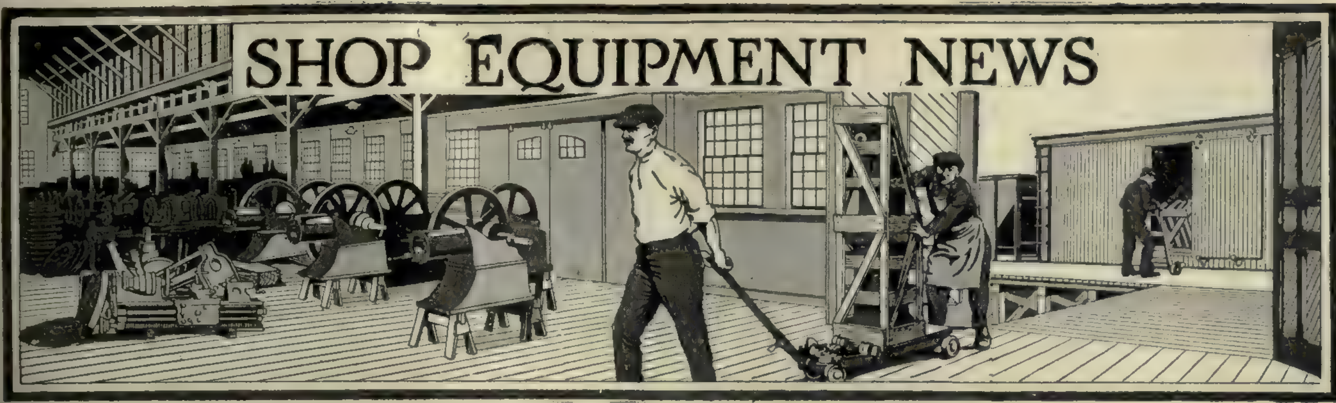
It may be well worth while for manufacturing concerns to take an inventory or census of the men in their vicinity who have been considered as past the desirable age. The chances are that a considerable contingent can be rounded up which could add a great many man-hours to the productiveness of your shop. It would be a source of genuine gratification to many to feel that they are rendering a service to the country in its hour of need.

Illogical Aircraft Turnbuckle Standards

THE accepted practice of designing engineers is to make new designs and standards conform to existing practice wherever possible, as is the rational and thoroughly sensible procedure; because of this it is somewhat of a surprise to note the departure from this practice in the specifications for turnbuckles issued and which are being adopted by the International Aircraft Standards Board, through the Department of Commerce.

The specifications give the dimensions both in inches and in millimeters, but the very objectionable feature is the establishment of new sizes for diameters, and also of the number of threads per inch, which conform neither to the A. S. M. E. or to the S. A. E. standards. In some cases the difference in diameter is only a few thousandths of an inch, and in the threads only two per inch, so that the differences seem to have no logical reason for existence.

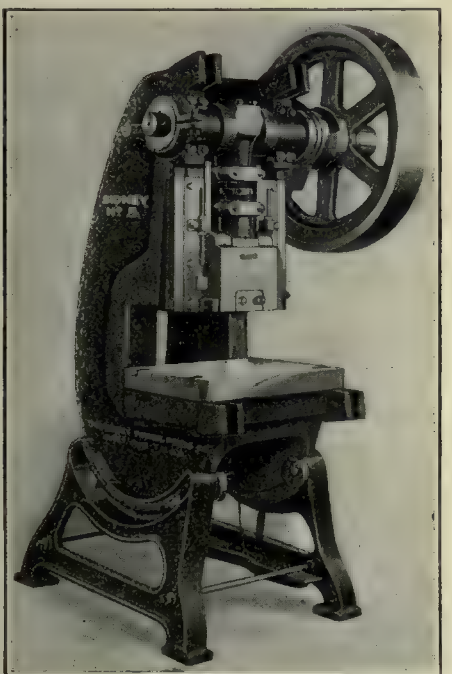
We are surprised that the engineers of the aircraft industry, representing as they do the newest industry of the country, should have suggested such a set of standards, and we trust they will soon reconsider it that specifications may conform to modern practice.



This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Sidney Power Presses

The Sidney Power Press Co., Sidney, Ohio, is now marketing a line of power presses, one of which is shown in the illustration. It is claimed that the presses are very sturdy in construction and that they will stand up under rough usage. They are equipped with an automatic safety clutch which makes it impossible for the press to repeat if the treadle is held down. To make a second stroke the treadle has to be released and depressed a second time. The slide is kept in alignment by means of three adjusting screws in each gib. The hole in the slide for the shank of the punch is round and room is provided for adjustment of the side clamp. The machines are built in six sizes, Nos. 1 to 6, and range in weight from 1000 to 6000 lb.

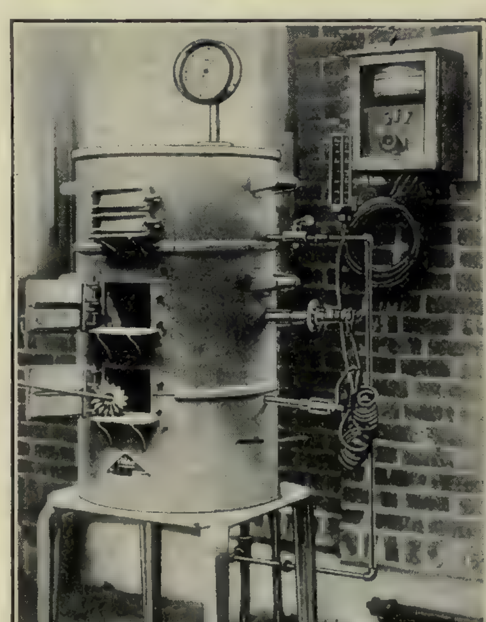


SIDNEY NO. 3 OPEN BACK INCLINABLE POWER PRESS

Weight, 2600 lb.; weight of flywheel, 450 lb.; size of flywheel, 28 x 4½ in.; speed of flywheel, 110 r.p.m.; approximate hp. required, 2; standard opening in bed, 8 in.; distance from column to center of slide, 10 in.; distance from bed to slide, with stroke down and adjustment up, 7 in.; width of opening back of frame, 9 in.; width between gibs, 8 in.; standard stroke of slide, 2 in.; maximum stroke of slide, 6 in.; hole in slide for shank of punch, 2 in.; bolster plate, 21½ in. wide by 14 in. deep; thickenss of bolster plate, 2½ in.; height to center of shaft, 62½ in.; floor space, 26 x 36 in.

"Triad" Heat-Treating Furnace

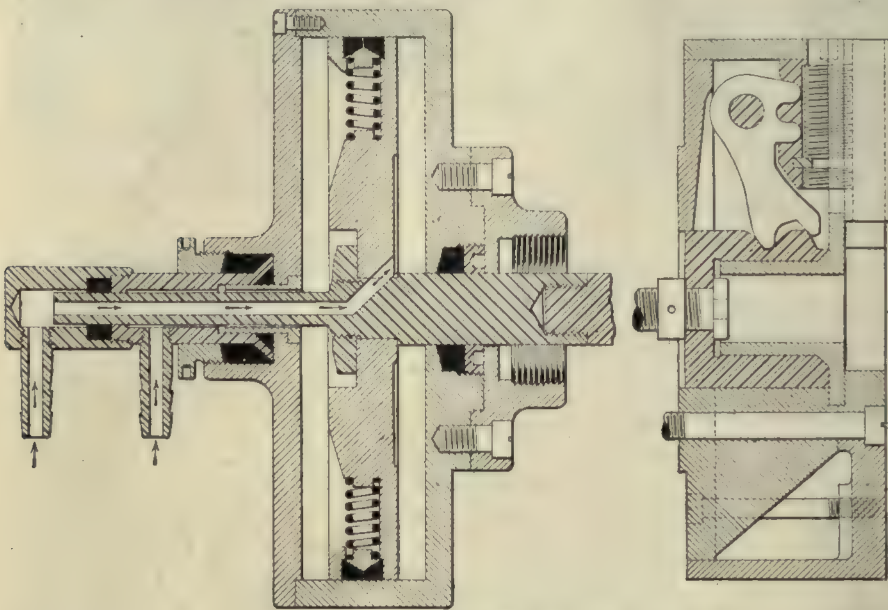
The Bennett Metal Treating Co., Elmwood, Conn., is now marketing a new "Triad" furnace which is designed for the heat treatment of carbon, tungsten or high-speed steel tools. This furnace is operated by a single burner, but is so constructed that the three steps—preheating, high heating and tempering—can be accomplished simultaneously. This renders the installation of three furnaces for these different steps unnecessary. The furnace burns either fuel oil or gas and occupies a floor space of 4 sq.ft. The temperatures in both the intermediate and lower compartments are determined by means of pyrometers, while the temperature in the tempering compartment at the top is determined by a thermometer and is controlled by an air inlet from the main air line operated by a valve and a mercury air gage. It is claimed that the atmospheric conditions in the intermediate and lower chambers are reducing.



"TRIAD" HEAT-TREATING FURNACE

"American" Air-Operated Chuck

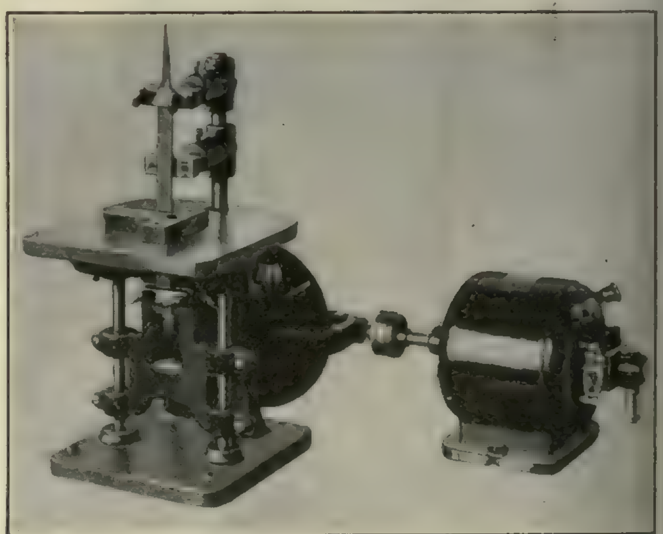
The American Pneumatic Chuck Co., 9 South Clinton St., Chicago, Ill., is now marketing the pneumatic chuck shown in the illustration. The Neidow & Payson Co. is the selling agent. The body of the chuck is made in two pieces, which are forced together and held in place by screws, this construction eliminating open space around the inner part of the chuck-jaw slide. It is claimed that this construction removes one of the causes for chattering and gives greater strength to the seat of the jaw slide. The housing is made from a steel or semi-steel casting, as desired, and the jaws are furnished either solid or with screws for independent adjustment and are reversible. The jaw slide is in the back plate only, and does not project through into the chuck housing. The adjusting screw is supported in bearings at both ends of the slide. The universal feature of the chuck is secured through the movement of the sector being forced by air pressure up the incline of the cam bushing. The air cylinder is attached to the rear end of the machine spindle, and is connected by a draw rod through the spindle to the cam bushing in the chuck. When the air is applied, the cam bushing and sector lever are drawn back, and the sector lever travels up the incline of the cam to its fixed point and thus operates the three jaws universally. It is claimed that the cam construction and the three-to-one increase in power secured by means of the sector lever greatly increase the gripping power secured. When the chuck jaws are properly adjusted for the diameter of the work the sector lever will be forced up the face of the cam until it reaches the straight-line portion of the cam, when the jaws become locked upon the work, and it will remain in this position even though the air pressure may be released. If desired the chuck may be operated by a hand device on the back plate. The chuck is made in ether the two- or three-jaw type in $6\frac{1}{2}$-, 8-, 10-, 12- and 15-in. sizes. The double-acting air cylinder has been designed for light weight so as to reduce the wear on the machine spindle. The illustration shows the construction.



"AMERICAN" AIR-OPERATED CHUCK

Holmes Filing Machine

The Holmes Manufacturing Co., of Shelton, Conn., has improved its filing machine by an addition of metal which makes the machine stronger and more rigid, and gives it larger bearing surfaces than before. As will be seen from the illustration the machine is motor driven through the medium of an adjustable friction disk which permits a speed range from 200 to 800 r.p.m. An Oldham coupling is interposed between the motor and the driving disk to provide a certain amount of flexibility in the connection. The driven disk is of cast iron 7 in. in diameter, with a plain, smoothly finished surface. The driver is built up of leather rings clamped firmly together and finished to a diameter of $1\frac{3}{8}$ in. by grinding. The main bearing of the machine is a bronze bushing, the head of which sustains the thrust of the driving disk. This bushing is threaded into the casting and has a clamping screw to hold it in whatever position required, thereby furnishing a ready means of adjustment to compensate for wear of the driving mechanism. The sliding head takes its movement from the regular form of slotted yoke and pin, allowing adjustment of the stroke from 0 to 2 in. The head has bearing surfaces at widely separated points, to insure smoothness of movement and freedom from vibration.



HOLMES DIE-FILING MACHINE

Size of wood base, 13 x 20 in.; machine table, 8 in. square; height of table, 9 in.; stroke, 0 to 2 in.; speed, 200 to 800 r.p.m.; motor, $\frac{1}{10}$ hp., either a.c. or d.c.; weight assembled, about 40 lb

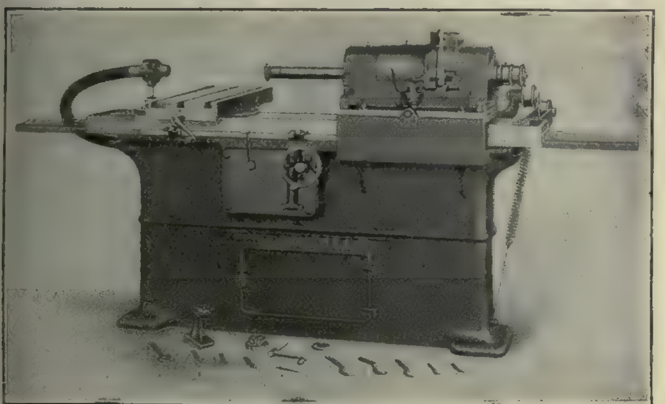
A clamp, with two clamping screws, permits the use of files of any kind, or of oil-stone slips if it is desired to use the machine for this purpose. There are two top supports provided, so that a short section of file may be held entirely above the table, a feature

of value in filing punches and pieces of similar nature where a shoulder prevents the use of a full-length file. The top supports are independently adjustable, and the post may be removed entirely by unscrewing it from the sliding head, leaving unrestricted space for the manipulation of large dies. The table may be tilted to provide for draft.

The machine and motor are mounted upon a substantial wood base, the combined weight being about 40 pounds.

Whitney No. 23 Cylinder-Grinding Machine

Baxter D. Whitney & Son, Winchendon, Mass., has purchased from the Brown & Sharpe Manufacturing Co., the rights, design, tools, etc., for its No. 23 cylinder-grinding machine and will continue to manufacture it. The machine is for the purpose of grinding gasoline-engine cylinders where the work is such that



WHITNEY NO. 23 CYLINDER-GRINDING MACHINE

Capacity, grinds holes 3 to 7 in. in diameter up to 14 in. deep; maximum radius described by wheel spindle, 1½ in.; maximum wheel size, 4½ in.; speed, 5500 r.p.m.; speeds of wheel-spindle revolving drum, six, 66 to 146 r.p.m.; automatic travel of sliding table, 25 in.; feeds of sliding table, eight, slow series 7 to 21 in. per minute, fast series 18 to 55 in. per minute; distance to top of table from center of wheel spindle with spindle at center of revolving drum, 10 in.; T-slot in sliding table, ⅝ in., working surface of cross table, 13 x 30 in.; cross movement of cross table, 15 in.; T-slots in cross table, three, ⅝ in.; floor space, 44 x 144 in.; net weight, 4700 lb.

it is impracticable to revolve it. The work to be ground is mounted either upon a sliding table or upon a cross table, being held in a suitable jig or fixture. All wearing surfaces are protected from grit and oil holes are also protected. The wheel spindle is mounted in a sleeve that furnishes a support close to the wheel and is made of chrome vanadium steel, heat treated, ground and lapped. It runs in phosphor-bronze boxes provided with means for compensation for wear. The spindle-revolving drum carries the spindle sleeve and revolves it eccentrically within any radius that the capacity of the machine admits. The drum is driven from above through cones that provide for various spindle speeds. The wheel spindle has both quick and fine adjustments, the quick adjustment being operated by a crank inserted in the head while the fine adjustment is by a lever at the front of the spindle head. The wheel can be fed to or withdrawn from the work without stopping the mechanism. The wheel spindle is driven by a belt passing under two idler pulleys at the rear of the machine, one of these idlers being equipped with a spring takeup for regulating the tension of the belt. The wheel-spindle head is provided with means for vertical and transverse adjustments, which enable the spindle to be set in alignment to compensate for any irregularity in the work.

The sliding table is equipped for fast roughing feeds and slow finishing feeds, the travel being automatic and controlled by adjustable dogs which are provided with screws for fine adjustments. If desired the dogs can be raised and the table run beyond the reversing points without disturbing the adjustment. After being raised the dogs drop back into place automatically, which prevents the table accidentally running beyond the reversing point a second time. The cross table is provided with dust-proof bearings and adjustable taper gibs. The cross movement is obtained by a crank and screw mechanism, and four adjustable stops are provided on the edge of the table. An exhaust fan is attached to the rear of the machine and draws the dust away from the work and into a tank partly filled with water. If desired a wet-grinding attachment can be furnished, water guards, pans, settling tank, pump, piping, etc., being included.

Clark Adjustable-Limit Snap Gages

The J. M. Clark Co., Bridgeport, Conn., is now marketing a line of adjustable-limit snap gages, one of which is shown in the illustration. It is claimed that the construction is such that the measuring plugs are positively clamped in position against the adjusting

ADJUSTABLE-LIMIT SNAP GAGE

screw and that the adjustment can be quickly made. The construction also allows the holes for the adjusting screws to be tapped out for a larger size in case they should become worn. The gages are made in 18 sizes varying in steps of ½ in. up to and including 6 in., and in steps of 1 in. for work from 6 to 12 in. in size. Measuring plugs for threads and other special shapes can be furnished if desired.

Seaboldt Thread-Measuring Wires

Realizing the difficulty to be met under average conditions by the toolmaker who wishes to use the three-wire system of testing thread plug gages and threaded parts, in procuring three pieces of wire that are round and true to size within the very narrow limits demanded by modern toolmaking methods, the B. Seaboldt Corporation of 25 West Broadway, New York City, has placed such wires upon the market in sets of three wires each, hardened and lapped by special processes and guaranteed by them to meet the required conditions.

The sets are made in sizes varying from 0.010 to 0.150 in. in diameter and from 1½ to 3 in. long respectively. A short section in the middle of each wire,

varying from $\frac{5}{8}$ to $1\frac{1}{4}$ in. long, according to the size, is finished to the required degree of accuracy, the remainder of the length being reduced to about 0.002 in. under the nominal size.

Modern Motor-Driven Scraper

The Modern Manufacturing Co., Bridgeport, Conn., has placed on the market a new device for obviating hand-scraping work on aluminum and brass castings,

FIG. 1. MOTOR-DRIVEN SCRAPER

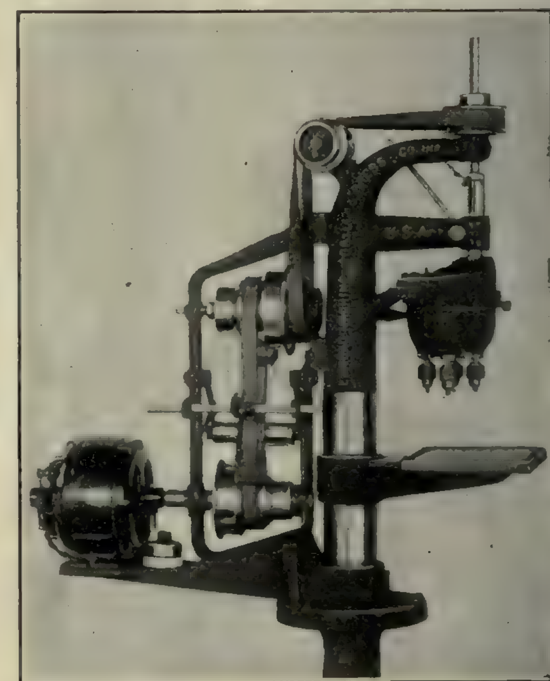
such as motor crankcases and similar work. The device consists of an electric motor and a flexible shaft, as shown in Fig. 1, which may be used to drive burrs of various sizes and styles, as illustrated in Fig. 2. The

FIG. 2. SOME OF THE BURRS USED ON BRASS AND ALUMINUM CASTINGS

motor is ball bearing and is suspended above the work by means of a universal joint. The flexible-shaft casing is attached to a cone holding lubricant for the shaft, and a hand piece is provided at the lower end which takes the different burrs. These are readily interchangeable.

Landau Drilling Machine

The Landau Machine and Drill Press Co., 368-370 Broome St., New York City, is now marketing the drilling machine illustrated. The machine includes a multiple-spindle drilling head composed of a stationary upper member fixed to the drilling-machine standard and a movable lower member carrying four drilling spindles, each with an independent adjustment for depth of feed. The movable bonnet is rotated by means of a collar and handle so that any desired spindle can be brought into position for work; the main drive spindle has a positive clutch and locking device which engages with the working spindle. Each spindle is automatically locked in place when in proper alignment, and a centering device inside of the head prevents the feed lever from being operated until both spindles are in alignment. The clutch is automatically released when the operation of each spindle is finished and the feed lever is back in its original position. All spindles except the one in working position remain idle at all times. The machine can be furnished for either belt or motor drive. If desired it can be furnished with one spindle arranged for tapping, the reversing being done by means



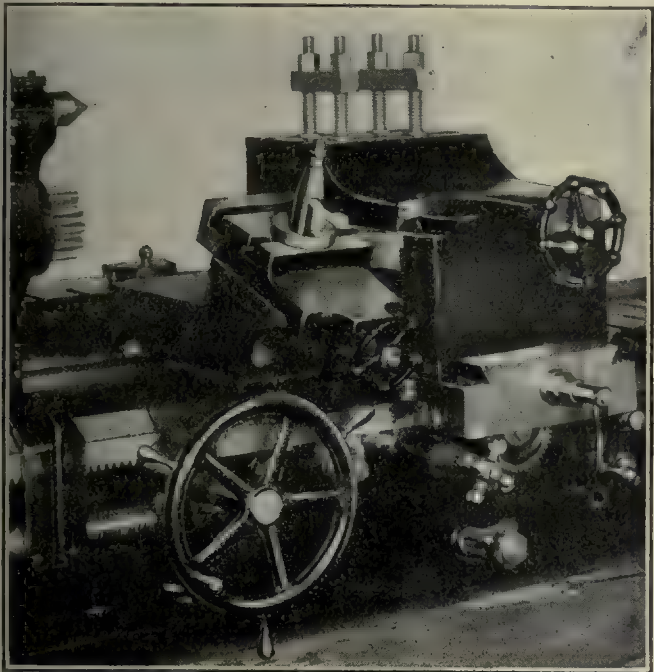
LANDAU DRILLING AND TAPPING MACHINE

Speeds, three, 650, 1100 and 1800 r.p.m.; height with column, 64 in.; height without column, 30 in.; floor space, 12 x 28 in.; weight with column, 250 lb.; weight without column, 190 lb.; number of spindles, 4; travel of spindles, $2\frac{1}{2}$ in.; travel of tapping spindle, 1 in.; forward speeds of tap, three, 110, 190 and 310 r.p.m.; reverse speeds of tap, three, 165, 275 and 450 r.p.m.

of gears which also serve to reduce the speed to that desired. The gears are in mesh at all times. The main spindle has a ball thrust bearing and the upper cone pulley is mounted on an eccentric stud by means of which the top belt may be adjusted. The belt is shifted from one step to another by means of a double fork and lever controlled by means of a handle convenient to the operator. The machine is furnished in either bench or floor type, and for either belt or motor drive. The illustration shows the motor direct-connected to the lower cone shaft.

"Fifield" 60-In. Triple-Geared Engine Lathe

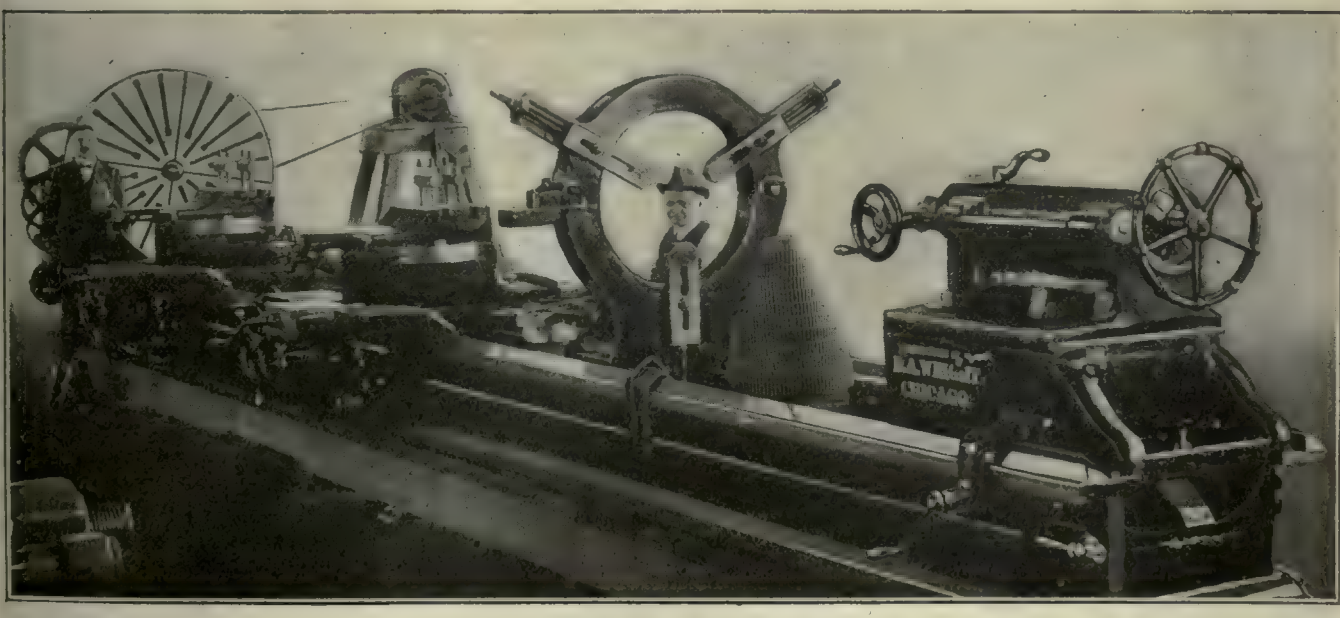
The illustrations show a 60-in. triple-geared engine lathe that is manufactured by David A. Wright, Chicago, Ill. It is made in two types—standard and heavy. All main and high-speed bearings are bushed with bronze and all gears are cut. Spindle centers are of tool steel, hardened and ground. The carriage slides on two Vs while the headstock, tailstock and steadyrest slide on flat ways. The bed is of box section with cross-ties and double ribs and has a cast rack 7 in. wide. The faceplate has 24 T-slots, and is either pressed or threaded on the main spindle as desired. Faceplate jaws are fitted if desired. The carriage is equipped with both power and hand feed. The tool slide is fitted with two straps and four bolts for securing tools. If furnished, the taper attachment is secured to the carriage and bolted by means of T-slots inside of the bed. The apron is furnished with a friction clutch for transverse feed and a lead screw nut for threading. Reverse is incorporated. The feed gears are driven by a spline in the lead screw, the threads being used only when thread cutting is being done. The steadyrest accommodates work up to 30 in. in diameter. The tailstock is of box section and is secured to the bed by means of six bolts and three clamps, the upper part being fitted with cross adjustment. It is moved by means of a crank wrench and gearing engaging the feed rack. Change gears are furnished for cutting threads from 1 to 12 and are of 5 pitch. Regular equipment includes compound rest, large and small faceplates, steadyrest, change gears, wrenches and double friction countershaft.



THE CARRIAGE OF THE "FIFIELD" LATHE

Bureau of Standards' Table of Wire Sizes

The Bureau of Standards has issued a circular containing complete tables of wire sizes. This is a combined table which includes the principal wire gages. It comprises the American or B. & S. steel, Birmingham (Stubbs), British standard and metric wire gages, giving all their diameters in mils, circular mils, square inches and square millimeters. This makes it particularly useful in determining the nearest equivalent to American or British gages in millimeters or square millimeters. Copies may be had by addressing the Bureau of Standards, Washington, D. C.



TRIPLE-GEARED 60-IN. ENGINE LATHE

Distance between centers with 14 ft. bed, 5 ft.; swing over carriage, 45 in.; carriage bearing on ways, 58 in.; ratio of back gearing, 13 to 1; ratio of triple gearing, 42 to 1; threads cut, 1 to 12; front-spindle bearing, standard type, 7 x 10½ in., heavy type, 8 x 12 in.; rear spindle bearing, standard type, 4¾ x 8¾ in., heavy type, 6 x 10½ in.; diameter of tailstock spindle, standard type, 5⅝ in. heavy type, 6 in.; weight with 14-ft. bed, standard type, 24,000 lb., heavy type, 30,000 lb.; extra weight per extra foot of bed, standard type, 1000 lb., heavy type, 1500 lb.; feeds of toolpost, 0.050, 0.096 and 0.137 in.; spindle speeds, nine, 1.48 to 120 r.p.m.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., March 9, 1918—The most important thing in any crisis is to get the necessary things done. Just how they are done or just what they cost is a secondary matter. No one of ordinary intelligence expects anything to be perfect. If it is good enough to answer its purpose everyone should be satisfied for the time being, although it is always in order to experiment for better things. But it is criminal to wait for new developments instead of using the best we have at hand.

Having started to supply the things we need, the next step is to see that they are produced efficiently and economically; to see that no undue profits are being made; to coördinate the resources, both large and small, so as to secure a widespread interest and an unfailing source of supply. This can be done only by centralizing the control of and placing the responsibility for securing war material. In no other way can we prevent the overlapping of activities and the inefficiency due to different departments competing for the same products; in no other way can the information regarding any product be made available for all departments.

To obtain this desideratum it would be necessary to pass the Overman Bill, which gives the President power to redistribute the functions of the executive agencies, to transfer duties, powers, records and personnel of one executive agency to another, and to employ such additional agencies as he may see fit.

In this way the President could consolidate buying to such an extent as would be necessary instead of leaving it to the several scattered departments as at present. He could thus place the duties of buying under the control of some central agency and invest some others with power to make decisions and to determine the important questions which affect more than one department.

In the same way he could prevent the duplication of efforts, which conflicting activities have developed in connection with the war. He might, for example, form a central secret service for the United States during the war by transferring to one central agency all activities of this kind, which are now scattered among many departments. This centralization of power is along the line of the resolution adopted at the war convention of American business men held at Atlantic City last September by the United States Chamber of Commerce. The Overman Bill, carrying out as it does the spirit and purpose of this resolution, has been indorsed by the United States Chamber of Commerce, which is working for its adoption.

It is interesting to note that the United States Public Health Service of the Treasury Department has begun to collect and disseminate information for the purpose of protecting the wives of those engaged in war industries.

One of the worst dangers to those dealing with explosives is from the nitro and amido compound of benzol and toluol. One of these compounds, trinitrotoluol, is of very general use in high-explosive shells and bombs, and all workers in shell loading are exposed to its dangers. The poison is readily absorbed through the skin and the respiratory tract, and while such absorption cannot be entirely prevented it can be made so bland that only those who are especially susceptible will succumb to its poisonous effects.

A practical article has been published by the Public Health Service on the safe handling of trinitrotoluol as applied to the shell-loading processes. It covers the two methods used in loading, both the pressing of the explosive in powder form and the pouring of it when melted. The former method is used only in the case of large shells, and comparatively simple methods will prevent injury to the worker. The melting process, however, requires more caution, and this is given careful discussion. The article recommends complete segregation at each stage of the loading process, long, narrow, one-story buildings with a conveyor system to avoid unnecessary handling of the substance being suggested. The worker should also be thoroughly instructed in the dangers of poisoning, and shown how to protect himself as well as possible by the use of overalls, cap and gloves. The use of alcoholic beverages makes a person more susceptible, while milk or milk products taken before beginning work tend to offset danger. Strange to say, young persons are more susceptible than old, and it is advised that the explosives be not handled by those under twenty-one years of age. It is further advised that men be employed for only eight hours a day when working with trinitrotoluol and that those employed in the most hazardous parts of the work be rotated to less dangerous processes at least every two weeks. In addition to all this, an efficient system of medical supervision is considered absolutely necessary.

It is gratifying to note that the great necessity for munitions does not blind us to the fact that it is even more necessary to preserve the health of those on whom we depend for its manufacture.

A Committee on Education and Special Training, composed of Col. Hugh S. Johnson, Deputy Provost

Marshal General; Lieut.-Col. Robert I. Rees of the General Staff, and Major Grenville Clark of the Adjutant General's Department, has been appointed by the War Department. As an advisory board the following gentlemen have been appointed. Dr. Charles R. Mann of the Carnegie Foundation for the Advancement of Teaching and the Massachusetts Institute of Technology; Dr. James R. Angell of Chicago, dean of the faculties of the University of Chicago; J. W. Dietz of Chicago, director of education Western Electric Co.; president of the National Association of Corporation Schools; James P. Munroe of Boston, a member of the Federal Board for Vocational Education (which appointment will include the interests of the trade schools and schools of secondary grade), and Dr. Samuel P. Capen of Washington, a specialist in higher education.

The functions of this committee will be to mobilize the country's schools and colleges behind the army. It will encourage and arrange for the technical education of men needed by the several branches of the army, particularly the Ordnance Bureau, the Signal Corps and the Engineers.

It is estimated that within the next six months 75,000 to 100,000 men will be given intensive training in schools and colleges. These men will be drawn from the armed forces of the nation, the men now in training camps or about to be called, and the registrants under the selective draft act.

Our Rifle Output

The following statement is authorized by the Secretary of War:

Rifle and cartridge production in the United States has developed in volume and in quality of product on a scale assuring the satisfactory equipment of the army. During the week ended Feb. 2, 1918, the daily production of rifles was as follows:

United States rifle, caliber 0.30, model of 1917, so-called modified Enfield	7805
United States rifle, model of 1903, so-called Springfield	1442
Total	9247

Total production for that week of such rifles was 50,872, or nearly enough for three army divisions.

In addition, during that week there were procured daily, either by manufacture or acceptance of rifles already made, 3868 Russian rifles, making a total daily production of 13,115. The weekly procurement for models of 1903 and 1917 and for Russian rifles was 72,152, which Ordnance Department officials believe was a greater number of rifles than any nation ever produced in equal time.

Our weekly production of rifles 10 months after war was declared was four times as great as the weekly production of rifles in Great Britain after 10 months of war (itself an excellent achievement) and twice as large as the production in Great Britain after two and one-half years of war.

Daily rifle production by the Ordnance Department for the week ended Feb. 9, 1918, was:

Model of 1917	7,491
Model of 1903	1,086
Russian rifles	4,435
Total	13,012

Production for that week was 46,792 of the models of 1917 and 1903, and 24,400 of Russian rifles, or a total of 71,192.

Since Apr. 6, 1917, the Ordnance Department has manufactured and procured more than 700,000 of the service rifles, model of 1903 and model of 1917. This is 100,000 more rifles than were available at the time of our declaration of war. We have today a total of 1,300,000 service rifles. Only about 50 per cent. of troops carry rifles. We have in addition 160,000 Krags, 100,000 Russian rifles and some 20,000 Ross rifles, or a total of about 280,000 training rifles.

Production has been hampered by the difficulty of procuring steel, especially receiver steel, caused by suspension of manufacturing due to coal shortage, and there also has been difficulty in obtaining skilled labor for rifle manufacture, the labor turnover experienced being heavy. Despite these handicaps production has often exceeded the estimates of ordnance officers charged with the work.

During January the production of ball cartridges, caliber 0.30, model of 1906, and of 8-mm. cartridges averaged 7,300,000 a day.

To achieve the rifle and ammunition production program the Government has expended or has obligated itself to expend during 10 months of war $400,000,000, and some 200 officers, 80,000 men and 10,000 women have been engaged exclusively in the manufacture of rifles and cartridges. Two Government plants and three privately owned plants are engaged in making rifles, and one Government plant and nine privately owned plants are engaged in cartridge manufacture. Ordnance experts in this country and in Europe are in agreement that the United States army is being equipped with two of the three best rifles in the world.

Fake Agents Abroad

Word has been received here from various points as far west as Oregon, and more recently from Ohio, that someone unauthorized is soliciting subscriptions for our periodicals. The work is plainly that of a fraud. He represents himself as a college man working for a special scholarship, and offers various combinations with other magazines and cut-price inducements. Should this individual approach any of our readers they will confer a favor upon us by telegraphing at once, at our expense, to H. K. Fisher, circulation manager, 36th St. and 10th Ave., New York City.

Our field subscription work is handled by a corps of experienced representatives, who devote their entire time to the interest of our 10 periodicals. These men carry order books and blanks bearing the imprint of this company, and will upon request show their card of authority indorsed by our circulation manager.

Our publications are never clubbed with other periodicals at a reduced price and are sold only at the regularly advertised subscription prices.

New Officers for American Institute of Consulting Engineers

The American Institute of Consulting Engineers, Inc., 35 Nassau St., New York City, on Feb. 19 elected the following officers for the coming year: Lewis B. Stillwell, president; Alexander C. Humphreys, vice president; and F. A. Molitor, secretary and treasurer.

Personals

C. E. Nutter has been appointed chief electrician of the Santa Fé R.R. at Topeka, Kan.

E. S. Pearce has been appointed mechanical engineer of the Big Four R.R., at Beech Grove, Ind.

L. F. Couch has been appointed master mechanic of the Memphis, Dallas & Gulf R.R., with office at Nashville, Tenn.

Wendell G. Wilcox has been appointed advisory engineer of the Powdered Coal Engineering and Equipment Co., Chicago.

R. C. Beaver has been appointed assistant mechanical engineer of the Bessemer & Lake Erie R.R., with office at Greenville, Penn.

W. W. Warner, formerly foreman of the car department of the Erie R.R., at Cleveland, Ohio, has been appointed shop superintendent at Kent, Ohio.

Fred E. Rogers, for many years editor-in-chief of "Machin. ry," has resigned to devote himself to developing a line of special machines for the power-transmission field.

F. M. Holden, formerly in the airplane-engineering department of the Signal Corps, Washington, D. C., is now research engineer of the Cadillac Motor Car Co., Detroit, Mich.

Wm. R. Gordon, formerly assistant consulting engineer of the Pierce-Arrow Motor Car Co., Buffalo, N. Y., is now on the engineering staff of the Willys-Overland Co., Toledo, Ohio.

L. E. Jolls, formerly factory superintendent of the Packard Motor Car Co., Detroit, has been appointed works manager of the Elizabeth, N. J., plant of the Duesenberg Motors Corporation.

H. S. Farish has resigned as secretary of the Founders' Association of Cleveland, to take charge of the stores at the Hog Island plant of the American International Shipbuilding Corporation.

C. E. MacConnell has joined the sales engineers' staff of the Hyatt Roller Bearing Co. Mr. MacConnell was formerly advertising manager of the Detroit branch of the Goodrich Rubber Co.

E. L. Maddox, formerly a manufacturer of chairs at Grand Rapids, Mich., and for the last four years a resident of Sacramento, Calif., has been appointed manager of the Liberty Iron Works, Sacramento, Calif.

Pope Yeatman, consulting engineer of New York, has been placed in charge of the nonferrous metals department of the War Industries Board, according to an announcement of the Council of National Defense.

William Burgess Nesbitt, who for five years has been advertising manager of the King Motor Car Co., Detroit, Mich., has been elected vice president of the company. His headquarters will be at 50 Union Sq., New York.

K. C. Miller, after six years' service in the ordnance department of the Root & Vandervoort Co., Rock Island, Ill., has resigned to become chief engineer of the Wright-Martin Aircraft Co., New Brunswick, N. J.

George S. Welker, formerly Pittsburgh representative of the Norton Co., Worcester, Mass., has resigned to become Pittsburgh representative of the Abrasive Co., Philadelphia, manufacturer of abrasive grinding wheels.

J. B. Siegfried has been appointed general manager of the King Motor Car Co., Detroit, Mich. He has been an executive of the company for several years, first as production manager and later as assistant general manager.

Edward P. Quinn has resigned as foundry superintendent of the Turner & Seymour Manufacturing Co., Torrington, Conn., and has been engaged as manager of the foundry department of the Bilton Machine Tool Co., Bridgeport, Conn.

Louis Schwitzer has been elected president of the Automotive Parts Co., Indianapolis, Ind., manufacturing cooling fans and other accessories. He was formerly vice president and chief engineer of the Oakes Co. in the same city.

J. A. Camm, formerly with the Cleveland Milling Machine Co. and the Davie Tool Co., Cleveland, Ohio, has become associated with the Kearney & Trecker Co., Milwaukee, Wis. Mr. Camm still retains an interest in the Davie Tool Co.

A. J. Klumb, formerly assistant master mechanic of the Milwaukee shops of the Chicago, Milwaukee & St. Paul R.R., has been appointed division master mechanic of the Prairie du Chien & Mineral Point division, with office at Milwaukee, Wis.

Harold G. Wilson, for seven years sales engineer of the automobile division of the Hyatt Roller Bearing Co., Detroit, Mich., and who left that position to join Holley Brothers, has returned to the Hyatt Co. to represent the tractor division in Detroit territory.

W. H. Thompson, for many years prominent in the heavy electric-traction work of the Westinghouse Electric and Manufacturing Co., has resigned to accept the position of works manager of the Fairmont Mining Machinery Co., Fairmont, W. Va., maker of coal-mining equipment.

S. W. Brainard, formerly mechanical engineer of the Cleveland Pneumatic Tool Co., superintendent of the Niagara Fire Extinguisher Co. and general superintendent of the Automatic Sprinkler Co. of America, has been appointed factory manager of the Borden Co., Warren, Ohio.

Loyall A. Osborne of New York, vice president of the Westinghouse Electric and Manufacturing Co. and chairman of the executive committee of the National Industrial Conference Board, has been appointed by the Secretary of Labor a member of a committee on industrial peace during the war.

Robert H. McMaster, assistant general manager of the Steel Co. of Canada, will leave shortly for Washington to act on the new Canadian War Mission, of which **Lloyd Harris** of Brantford, Ont., is to be the head. The commission about to be formed will handle Canadian affairs in the United States until the end of the war and Mr. McMaster's work will be principally in connection with the iron and steel industry, in which capacity he will be the buying agent for the Dominion of Canada.

Trade Catalogs

"Rimco" Rubber Insulated Pliers. Rubber Insulated Metals Corp., Plainfield, N. J. Circular. Illustrated.

National Chucks. Oneida National Chuck Co., Oneida, N. Y. 1918 Catalog and Price List. Pp. 28; 4 x 7 in.; illustrated.

Expanding Mandrels, Clamps, Lathe Dogs, Etc. Wm. G. LeCount, South Norwalk, Conn. Catalog No. 60. Pp. 20; 4½ x 6½ in.; illustrated.

Standardized Truscon Steel Buildings. Trussed Concrete Steel Co., Youngstown, Ohio. Catalog. Pp. 24; 8½ x 11 in.; illustrated.

Wood Screw Machinery, Single Blow Open and Solid Die Headers, Rivet Machines. The Asa S. Cook Co., Hartford, Conn. Catalog No. 25. Pp. 36; 6 x 9 in.; illustrated.

The Evolution of the Steel Ball Industry. Hoover Steel Ball Co., Ann Arbor, Mich. Treatise which tells how the steel ball industry came into existence and describes the methods of manufacture. Pp. 116; 6 x 9 in.; illustrated.

Bakelite Micarta-D Gears and Pinions. The Westinghouse Electric and Manufacturing Co., E. Pittsburgh, Penn. Bulletin C, 1579-A. Pp. 12; 8½ x 11 in.; illustrated. This contains technical information relating to these gears and pinions, including methods of attaching to the driving shaft, formulæ for horsepower rating, etc.

Business Items

The Ketzer Machinery Co. has consolidated with W. H. Robinson & Co. with offices in the Real Estate Trust Building, Philadelphia, Penn., exporters and importers of general material, and has added a machinery, engineering and hardware department with Paul R. Ketzer as manager.

Walter H. Wade, 311 Atlantic Ave., Boston, Mass., has purchased all the drawings, patterns, jigs and fixtures, special tools and master gages for the line of No. 2½, No. 3 and No. 4 bench lathes and all their attachments and the bench profiler formerly made by the American Watch Tool Co. of Waltham, Mass., and will manufacture and market them in the future.

Modern Tool Co., Erie, Penn.—A recent advertisement illustrated a die head in operation at the plant of the Stromberg-Carlson Telephone Manufacturing Co. This die head was wrongly credited by our Service Department, and should have been used in the advertising of Modern Tool Co., Erie, Penn. The mistake was inadvertent, and we regret its occurrence.

The Worthington Pump and Machinery Corporation made the following appointments on March 1: James E. Sague, vice president, in charge of engineering and manufacturing; Leon P. Feustman, vice president, in charge of general commercial affairs, including contracts, prices, purchases, traffic, etc.; Frank H. Jones, vice president, in charge of sales; William Goodman, assistant to vice-president; William Schwanhausser, chief engineer; Edward T. Fishwick, general sales manager; Charles E. Wilson, assistant general sales manager; all having offices at 115 Broadway, New York, and Neil C. Lamont, works manager Laidlaw Works, with office at the works, Elmwood Place, Cincinnati, Ohio.

Forthcoming Meetings

The American Gear Manufacturers' Association will hold its second annual convention at White Sulphur Springs, W. Va., Apr. 18, 19 and 20, with headquarters at the Green Brier Hotel. The secretary is F. D. Hamlin of the Earle Gear and Machine Co., 4701 Stenton Ave., Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

The sixth annual meeting of the Chamber of Commerce of the United States of America will be held in Chicago, Apr. 10, 11 and 12, 1918. Elliot H. Goodwin, Riggs Building, Washington, D. C., is general secretary.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

The National Metal Trades Association announces the following program of its forthcoming convention, which will be held at the Hotel Astor, New York City: Monday, Apr. 22, 10 a.m., executive committee meeting; 7 p.m., secretaries' dinner. Tuesday, Apr. 23, 10 a.m. to 5 p.m., council meeting; 10 a.m., meeting of local secretaries; 6:45 p.m., alumni dinner. Wednesday, Apr. 24, 9:30 a.m. and 2 p.m., convention; 12:30 p.m., buffet luncheon; 7 p.m., banquet. Thursday, Apr. 25. 9:30 a.m., and 2 p.m., convention and meeting of the incoming administrative council. Homer D. Sayre, People's Gas Building, Chicago, Ill., is the secretary.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine. Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Hardness Testing Machine, Brinell
Scientific Material Co., 711-719 Forbes St., Pittsburgh, Penn.

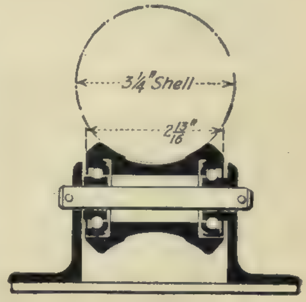
"American Machinist," Feb. 21, 1918

With this machine the depth instead of the area of the spherical indentation produced by the ball is measured. The machine is essentially a hydraulic press, the upper neck of which carries the hydraulic piston upon which is mounted the hardened-steel ball, 10 mm. in diameter. Two pressure gages are mounted at the top, one for regular use in measuring the pressure and the other reserved as a test gage to check the pressure readings. The indentation is measured by an instrument attached to the upper spindle which magnifies the depth fifty times

Conveyor, Shell
Lamson Co., 100 Boylston St., Boston, Mass.

"American Machinist," Feb. 28, 1918

A roller conveyor made especially for shell work, the rolls being of such shape as to prevent the shells from rolling off sideways. Where large shells are being handled, however, an angle iron guard rail is placed at each side. To insure ease of operation ball bearings are used on the roll spindles, and it is claimed that the conveyor will operate on grades not exceeding 3 or 4 per cent. The rolls and bearings are held in place by a split pin at each end of the spindle, this construction making all parts easily accessible.



Clamp, Drop Forged
William G. LeCount, South Norwalk, Conn.

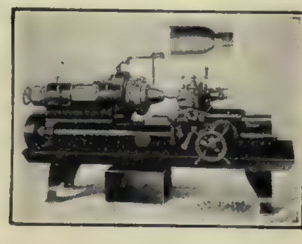
"American Machinist," Feb. 28, 1918

This line of clamps is made from drop-forged steel, the screw being cut with U. S. S. thread, hardened and tempered. Made in seven sizes, the lengths varying from 3 to 12 in.; all have 3 in. depth of throat and screws 13/16 in. in diameter by 5¾ in. long. The weights run from 6½ to 10¾ lb.

Lathes, 16 and 25-in. Shell
Gisholt Machine Co., Madison, Wis.

"American Machinist," Mar. 7, 1918

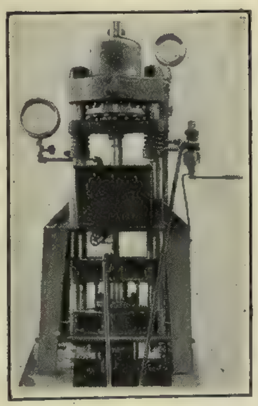
Designed to meet simplified-operation conditions in the manufacture of shrapnel and high-explosive shells or parts made up in large lots. As single-purpose machines they are simple in design and easy for women operators to handle. The illustration shows the lathe equipped with collet chuck and tools for boring and threading the nose end of 155-mm. shells. These machines are made in 16-in. and 25-in. swing, with 3¾ and 6¼ in. spindle bore in several models, embodying many combinations with different styles of chuck and carriage.



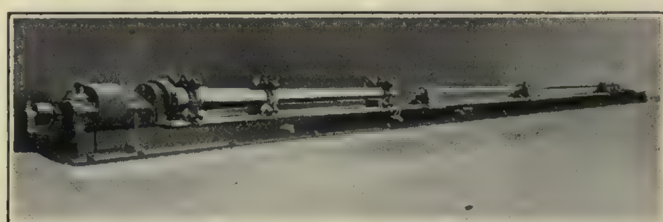
Press, Hydraulic Shell-Testing
Metalwood Manufacturing Co., Leib and Wight Sts., Detroit, Mich.

"American Machinist," Feb. 28, 1918

These hydraulic shell-testing presses are made in three sizes: No. 1 for 3-in. and 75-mm. shells, No. 2 for 4.7-in. shells and No. 3 for 6-in. shells. The illustration shows the No. 1 machine. Machines consist of an intensifying cylinder, a pull-back cylinder and a third cylinder of correct size to insure a fluid-tight joint between the shell nose and the resistance head. One gage is provided for recording line pressure and a second for recording the test pressure applied to the shell. The filling and emptying of the shells is done on the machine, this feature obviating the loss of water



Boring Machine, Gun
Amalgamated Machinery Corporation, Chicago, Ill.

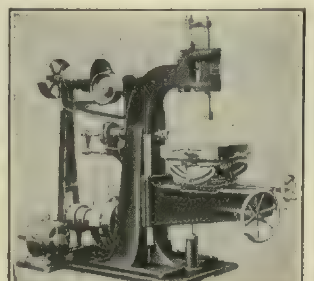


"American Machinist," Mar. 7, 1918

These machines are made with 27-, 39- and 48-in. swing with beds of any length desired. They are made especially for gun-boring work. The headstocks are cast solid with the first section of the bed, and all bearings are cast-iron shells lined with babbitt metal and fitted to their shafts, after which they are aligned by jigs and locked in place by a special fusible metal which expands on cooling. Motor drive is arranged as desired.

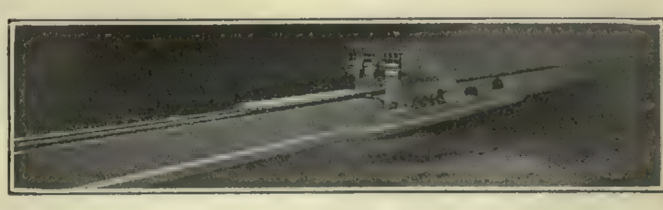
Milling Machine, Wood—No. 75
Oliver Machinery Co., Grand Rapids, Mich.

"American Machinist," Feb. 28, 1918



This company has recently added a number of improvements to its No. 75 wood-milling machine. The column has been broadened, and the base has been made considerably larger. Another new feature is the table. This will rotate in a plane at any angle, which makes the machine much more universal than those previously constructed. The compound cross-slides are located above the double swivel and tilting mechanism, so that these compound slides will operate in any position. It will be noticed that there are now two cross-slides instead of a single one as formerly. The top of the table is graduated with parallel cross lines 1 in. apart, which facilitate setting the work. Furnished either with variable-speed motor drive, constant-speed motor drive with four-step cone pulleys, or for belt drive with four-step cone pulleys.

Planing Machines, Reinforced Concrete
Amalgamated Machinery Corporation, Chicago, Ill.



"American Machinist," Mar. 7, 1918

Built especially for planing the beds of large gun-boring machines. Construction is of reinforced concrete with metal sections of the skeleton type. Specifications for this particular installation: Table, 90 ft. long, 13 in. thick; bed, 140 ft. long; width between housings, 72 in.; cross-rail, 4 ft. sq., concrete faced with cast iron.

Patent Applied For

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Mar. 7. 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$27.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	35.50
*Bessemer, Pittsburgh	37.25	37.25	36.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia................	33.75	33.75	34.75
*No. 2, Valley.......................	33.95	33.95	36.00
No. 2, Southern Cincinnati...........	35.90	35.90	29.90
Basic, Eastern Pennsylvania..........	33.75	30.75	30.50

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Mar. 7, 1918	One Month Ago	One Year Ago	Mar. 7, 1918	One Year Ago	Mar. 7, 1918	One Year Ago
Structural shapes ...	$4.20	$4.20	$4.10	$4-4.04	$4.10	$4.20	$3.75
Soft steel bars......	4.10	4.10	4.00	4-4.04	4.00	4.10	4.00
Soft steel bar shapes.	4.10	4.10	4.00	4.14	4.00	4.10	3.75
Plates, ¼ to 1 in. thick	4.45	4.45	5.15	4.39	5.00	4.45	4.75

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Mar. 7, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York..................	4.70	3.75
Warehouse, Cleveland	3.98½	3.95
Warehouse, Chicago	4.10	3.75

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Mar. 7, 1918	One Month Ago	One Year Ago	Mar. 7, 1918	One Year Ago	Mar. 7, 1918	One Year Ago
*No. 28 black.......	5.00	6.45	6.45	6.00	6.45	5.50	6.45	5.40
*No. 26 black.......	4.90	6.35	6.35	5.90	6.35	5.40	6.35	5.30
*Nos. 22 and 24 black	4.85	6.30	6.30	5.85	6.30	5.35	6.30	5.25
Nos. 18 and 26 black	4.80	6.25	6.25	5.80	6.25	5.30	6.25	5.20
No. 16 blue annealed.	4.45	5.65	6.65	5.45	5.65	5.20	5.65	5.45
No. 14 blue annealed.	4.35	5.55	5.55	5.35	5.55	5.10	5.55	5.35
No. 10 blue annealed.	4.25	5.45	5.45	5.30	5.45	5.05	5.45	5.30
*No. 28 galvanized..	6.25	7.70	7.70	5.25	7.70	5.00	7.70	5.20
*No. 26 galvanized..	5.95	7.40	7.40	8.00	7.40	7.25	7.40	7.50
No. 24 galvanized...	5.80	7.25	7.25	7.70	7.25	6.95	7.25	7.20

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Mar. 7, 1918	One Year Ago
New York	List plus 25%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Mar. 7, 1918	One Year Ago
New York	$15.00	$9.50
Cleveland	15.00	7.50
Chicago	15.00	6.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16..	
No. 18	
No. 20	

¹ Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38 00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Mar. 7, 1918	Cleveland Mar. 7, 1918	Chicago Mar. 7, 1918
Tire	4.10	4.00	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel..	7.50	8.00	8.50
Spring steel (crucible analysis)	11.00	11.25	12.00
Coppered bessemer rods..	9.00	8.00	7.50
Hoop steel	4.95	4.75	4.95
Cold-rolled strip steel....	9.00	8.25	8.50
Floor plates	6.19½	6.00	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4......	29%	17%
4½ to 6......	44%	32½%	4½ to 6......	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Mar. 7, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	37.00
Tin, in 5-ton lots..................	85.00	85.00	54.50
Lead	7.25	7.00	10.75
Spelter	8.00	8.00	11.00

*Government price.

ST. LOUIS

Lead	7.10	6.85	10.50
Spelter	7.75	7.87½	10.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Mar. 7, 1918	One Month Ago	One Year Ago	Mar. 7, 1918	One Year Ago	Mar. 7, 1918	One Year Ago
Copper sheets, base.	31.50-33.00	32.00	44.00	32.50	46.00	36.00	43.00
Copper wire (carload lots	32.00	32.00	39.50	28.50	44.00	34.50	39.00
Brass pipe base....	36.50	36.50	47.50	39.00	52.00	41.50	47.50
Brass sheets	30.75	30.75	45.50	32.50	45.00	35.50	43.50
Solder ½ and ½ (case lots)......	62.00	43.00	45.50	48.50	33.50	48.75	33.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

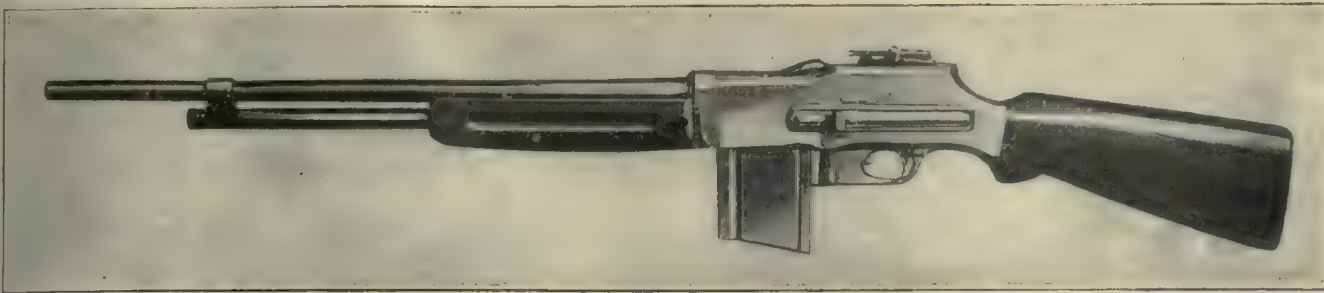
	Mar. 7, 1918	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail: Carload lots f.o.b. mill.. 19.00

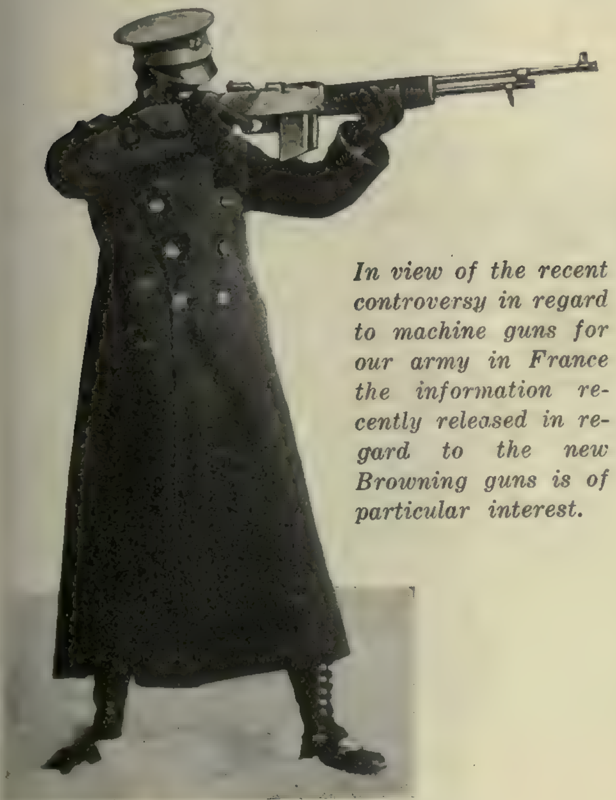
	In Casks		Broken Lots	
	Mar. 7, 1918	One Year Ago	Mar. 7, 1918	One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	20.00	23.00	20.50	23.25
Chicago	21.25	22.50	21.75	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Mar. 7, 1918	One Year Ago
New York	13.50	31.00
Cleveland	16.50	34.00
Chicago	16.00	32.00



The Browning Machine Rifle and Gun



In view of the recent controversy in regard to machine guns for our army in France the information recently released in regard to the new Browning guns is of particular interest.

THE Browning machine rifle, model 1918, Fig. 1 (so-called "light Browning rifle"), and the Browning machine gun, heavy type, model 1918, Fig. 2 (so-called "Browning heavy machine gun"), are the machine guns adopted for use by the United States army. They are the inventions of John M. Browning, distinguished firearm designer, inventor of several Winchester rifles, automatic pistols, repeating rifles, the Colt machine gun, which was adopted by the United States Army and Navy, and numerous other arms. The Colt automatic pistol is also his invention, this weapon having been adopted by the United States Army, Navy and National Guard in 1911.

The Browning machine rifle and the Browning machine gun came from the hands of the inventor coincidentally with the imperative war needs of the army for weapons of those respective types and uses.

The Browning machine rifle is an air-cooled, gas-operated gun weighing 15 lb. and resembling the ordinary service rifle. It may be fired from the shoulder, the rifleman finding his target over sights identical with those used on the new United States rifle, model 1917; or from the hip, the target in this case being found by the rifleman's general sense of direction—a knack quickly acquired by practice.

The principle of gas operation is simple. The gun is cocked with an easily operated handle for the first shot. The regulation 30-caliber service cartridge is used and the bullet is expelled by gases which exert a maximum pressure of 50,000 lb. to the square inch. A small portion of this powder gas is taken off by the gun mechanism to act as power to operate the gun automatically. This gun has approximately the same power as the United States rifle, model 1917, or the Springfield service rifle.

The cartridges are fired from a detachable magazine containing 20, or for special purposes 40, service cartridges. The magazine may be detached and a new magazine attached by one motion by merely pressing a button, this changing operation requiring about two and one-half seconds.

The gun may be operated as an automatic or as a semi-automatic arm and there is a lever at the easy disposal of the rifleman. Putting the lever in the first position the gun is made to fire single shots by trigger release; putting the lever in the second position the gun becomes automatic, and will fire 20 shots in from 2½ to 3 sec. The third lever position is the "safe," or locking, device. The designer intends the gun to be used more as a semi-automatic than as an automatic arm.

The powder gases create terrific heat, sometimes developing the destructive temperature of 4000 deg. F.; an air-cooled automatic gun, therefore, has its limitations. The Browning rifle, however, is of open and very simple construction and cools remarkably well, and the rifleman may fire 350 continuous shots without having to stop to cool it. The chief characteristic of the gun is its extreme simplicity of construction, rendering its manufacture correspondingly simple. It has fewer than 20 principal parts and possesses the great advantage of standardization, being easily and quickly taken apart and reassembled by the ordinary soldier. From the manufacturing viewpoint the gun has the important qualification of being produced in large numbers as shop machinery is multiplied and operating personnel developed.

Used cartridges are ejected from the side of the gun, never crossing the sight of the rifleman, and come with sufficient force to clear themselves from his view. Another of its features is that the cocking handle remains stationary while the gun is in operation, and is so arranged that it will in no way hamper the gunner, thus

Illustrations by permission of the Committee on Public Information.

eliminating a danger common to many guns. The gunner may operate the gun at all times without aid. Only one tool, a small wrench, is needed, as most of the operations of taking it down and reassembling may be performed by use of a cartridge as a tool.

The Browning rifle has met some remarkable tests by the War Department boards. A board test of a machine gun is more exacting than any test it might receive in service. Two features of a board test are: applying corroding chemical to the gun to effect a rusting condition which could not possibly obtain while in the hands of soldier, and the dust test, in which sharp, abrasive dust is blown into the mechanism from a bellows, creating a condition which would cause a soldier to meet court-martial charges were he to so neglect his weapon. Under these and other prescribed tests the Browning guns were successfully tried out.

In the official tests of the Browning rifle the individual members of the board fired a number of shots from the hip and shoulder, standing, and from the shoulder, prone and kneeling. The shots were fired without difficulty or malfunction of any kind, and the heat of the barrel did not interfere with the manipulation of the weapon. It was then put through an endurance test. In bursts of 500 or 1000 a total of 20,000 shots were fired, the gun being cooled between bursts. During the first 8000 rounds the cooling was performed by plunging the gun into a barrel of cold water. This caused the gas-cylinder tube to crack, due to the sudden contraction of the metal. The gas-cylinder tube was changed and thereafter cooling was effected by sponging off the barrel with cool water, no recurrence of a cracked tube taking place. The total number of malfunctions in the 20,000 rounds was 50, the majority of which were due to causes since remedied by the inventor.

The gunner carries approximately 120 rounds of ammunition in his belt, or bandoleer, and his two assistants carry 400 and 240 rounds respectively loaded in magazines. The loaded magazine weighs 1 lb. 7 oz. Thus it is possible for a gunner to go into battle with a supply of about 800 rounds of ammunition. The cartridges are stripped from clips into the magazines with ease, and require little time.

Because of its portability and its automatic and semi-automatic qualities the Browning rifle possesses important tactical possibilities. It permits troops to go forward in attack with tremendous advantage over adversaries who do not possess equally efficient automatic guns. When the gunner meets a detachment of the enemy he is able to take sure aim over the sights, and from his shoulder mow them down, expelling 20 to 40 shots almost instantly; or if there be but one soldier he may use only single shots and conserve his ammunition. Effective use may also be made of the gun in sweeping out trenches and in other ways. The tendency to demoralization among troops when they are confronted by automatic guns is well established. Reports received from observers abroad indicate that the trend in the French army is decidedly toward the use of automatic rifles of the more portable type, such as the Chauchat. According to army officials, the Browning rifle in many essential features, such as reliability of function, durability, lightness and handiness, is superior to any other light machine gun, and in particular it is supreme over any gun of similar type produced by the enemy.

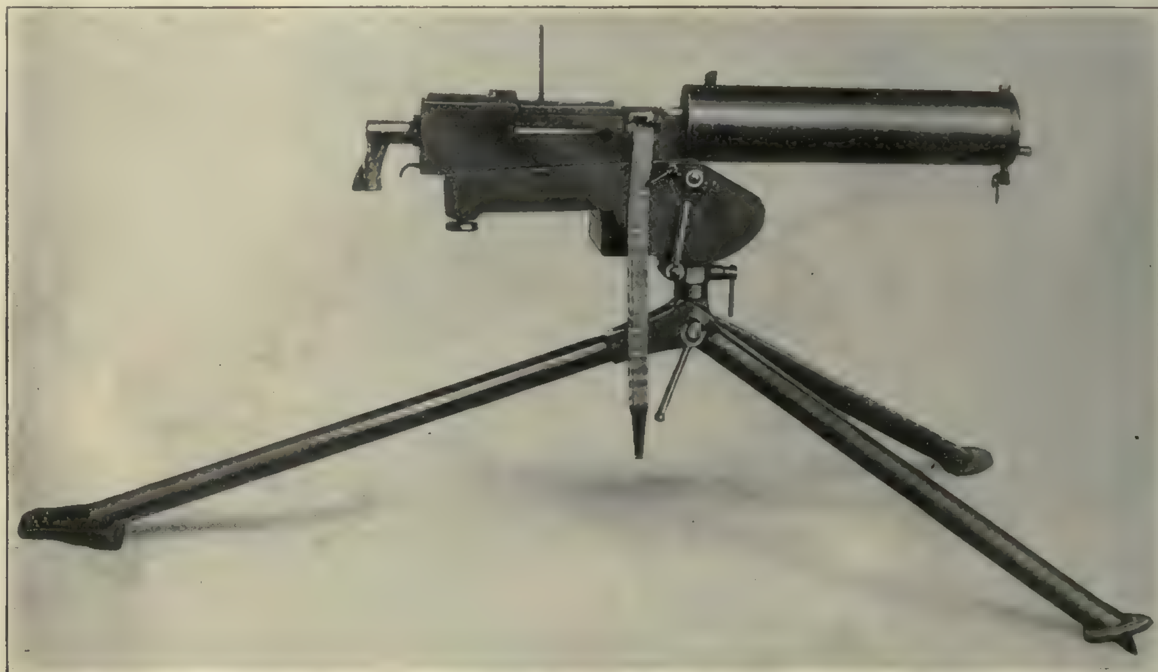


FIG. 2. BROWNING HEAVY-TYPE WATER-COOLED MACHINE GUN

The Browning machine gun, heavy type, model 1918, is water cooled and is operated by means of the power created by the recoil action. It is fed from a cotton belt which contains 250 rounds of service cartridges. The belts may be rapidly loaded by means of a machine which is a development of the one which Mr. Browning devised some 20 years ago in connection with the Colt gun.

The most remarkable features of this heavier type of Browning gun, as revealed by the official tests, are its simplicity of construction, rendering its manufac-

ture easy, and its great endurance. In the Government test 20,000 rounds were fired from this gun with only three stoppages, one due to a defective cartridge. In a further test firing was continued with the same gun to 39,500 shots when the sear gave way. A duplicate gun fired 20,000 shots in 48 min. and 16 sec., with a malfunction and with only three stoppages, these being due to defective cartridges.

The gun weighs 34½ lb., with the water jacket filled, and is fired from a tripod. It has great tactical value in such firing as overhead, indirect, barrage and defensive, besides other uses.

In passing on this gun the testing board reported as follows: "The board is of the opinion that its lightness, simplicity, reliability of function and endurance in action are such as to make it superior to any other of the so-called heavy water-cooled type known to the board."

With certain modifications it is applicable to aviation service, and when used for this purpose it is stripped of its water jacket and weighs 22½ lb.

Income-Tax Reports for Shop Employees

By Thomas J. Walsh

It is perhaps timely to suggest a method of meeting that requirement of the income-tax law which relates to the reporting of employees receiving $800 or more in the plant where I am employed.

Fortunately in our case, for this purpose at least, the payment of a monthly bonus to all employees necessitated devising some record which would expedite the compilation of the bonus. Figs. 1 and 2 are the result. Fig. 1 (buff color) is assigned to new employees, who receive a bonus of 5 per cent. At the expiration of six months they are given 10 per cent. and assigned a white card, Fig. 2. These bonus cards are then summarized on Fig. 3, from which is derived the information required to be furnished to the Collector of Internal Revenue for income-tax purposes.

In complying with this requirement one becomes aware of the amount of work that will have to be done by someone employed in plants having large payrolls and who have not kept bonus or individual records of employees, a contingency not met with ordinarily in the routine of business.

To digress a moment, I have suggested to the Collector of Internal Revenue that reports to his department be made on cards. This will eliminate the work of transcribing in his department, which would be necessary if the reports were made in blanket form, and reduces the work to the mere sorting of the cards. The fact that employees of a plant may reside in different internal-revenue districts makes this obvious. The little extra time taken to make reports in this manner will be more than compensated for by the resulting expedition of the returns and receipt of taxes. Personally I think great service could be rendered to the Government if men in the paymaster's division were given some incentive to assist the employees in their plants in preparing income-tax returns.

The spare time of many a man practised, if not expert, in the various lines of industrial endeavor incidental and essential to the prosecution of the war could be mobilized if some recognition was given thereto.

I have in mind a suggestion recently made to a Congressman, informing him that the reporting of men receiving $800 or over will affect "steady men," but will not affect transients or floaters, who are numerous in these times, and his reply that an efficient organization of revenue agents has been formed and will no doubt take care of this matter. His limited knowledge is so obvious that no comment is needed, though his reception of a practical suggestion is open to criticism.

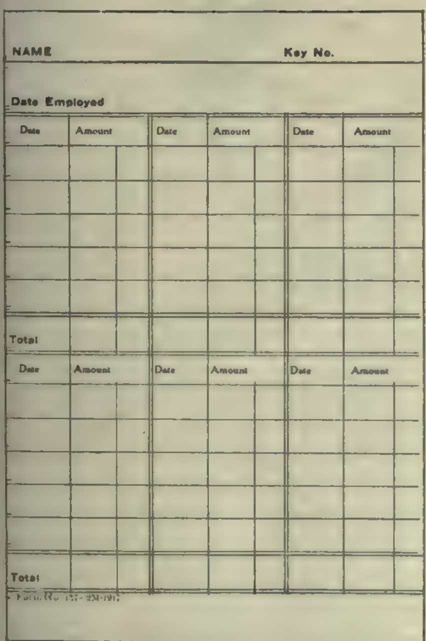

NAME Key No.
Date Employed
Date Amount Date Amount Date Amount
Total
Date Amount Date Amount Date Amount
Total
Form No. 137—2M-1917

FIG. 1

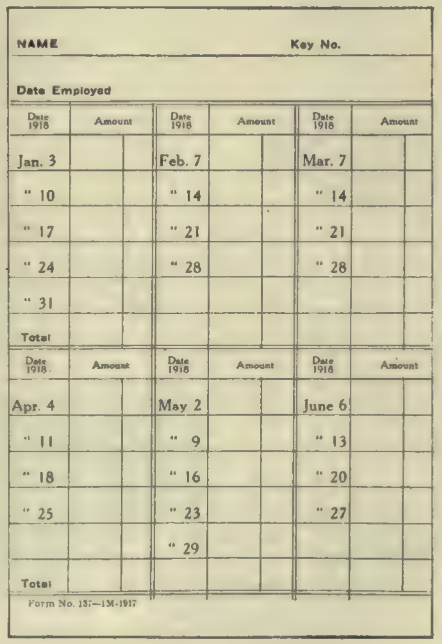

NAME Key No.
Date Employed
Date 1918 Amount Date 1918 Amount Date 1918 Amount
Jan. 3 Feb. 7 Mar. 7
" 10 " 14 " 14
" 17 " 21 " 21
" 24 " 28 " 28
" 31
Total
Date 1918 Amount Date 1918 Amount Date 1918 Amount
Apr. 4 May 2 June 6
" 11 " 9 " 13
" 18 " 16 " 20
" 25 " 23 " 27
" 29
Total
Form No. 137—1M-1917

FIG. 2

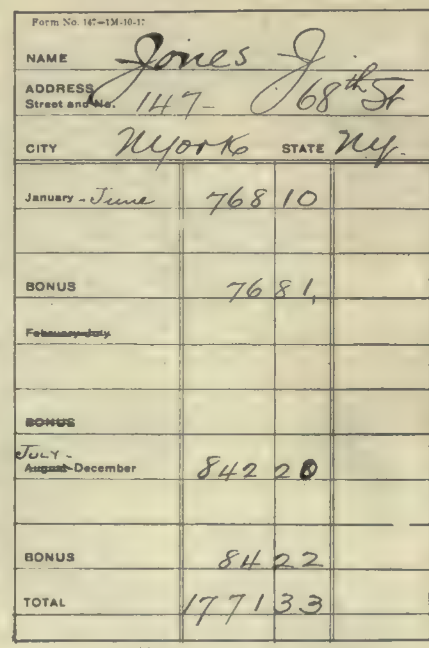

Form No. 147—1M-10-17
NAME Jones J.
ADDRESS Street and No. 147 - 68th St
CITY N York STATE N.Y.
January - June 768 10
BONUS 76 81
~~February-July~~
~~BONUS~~
July - ~~August~~ December 842 20
BONUS 84 22
TOTAL 1771 33

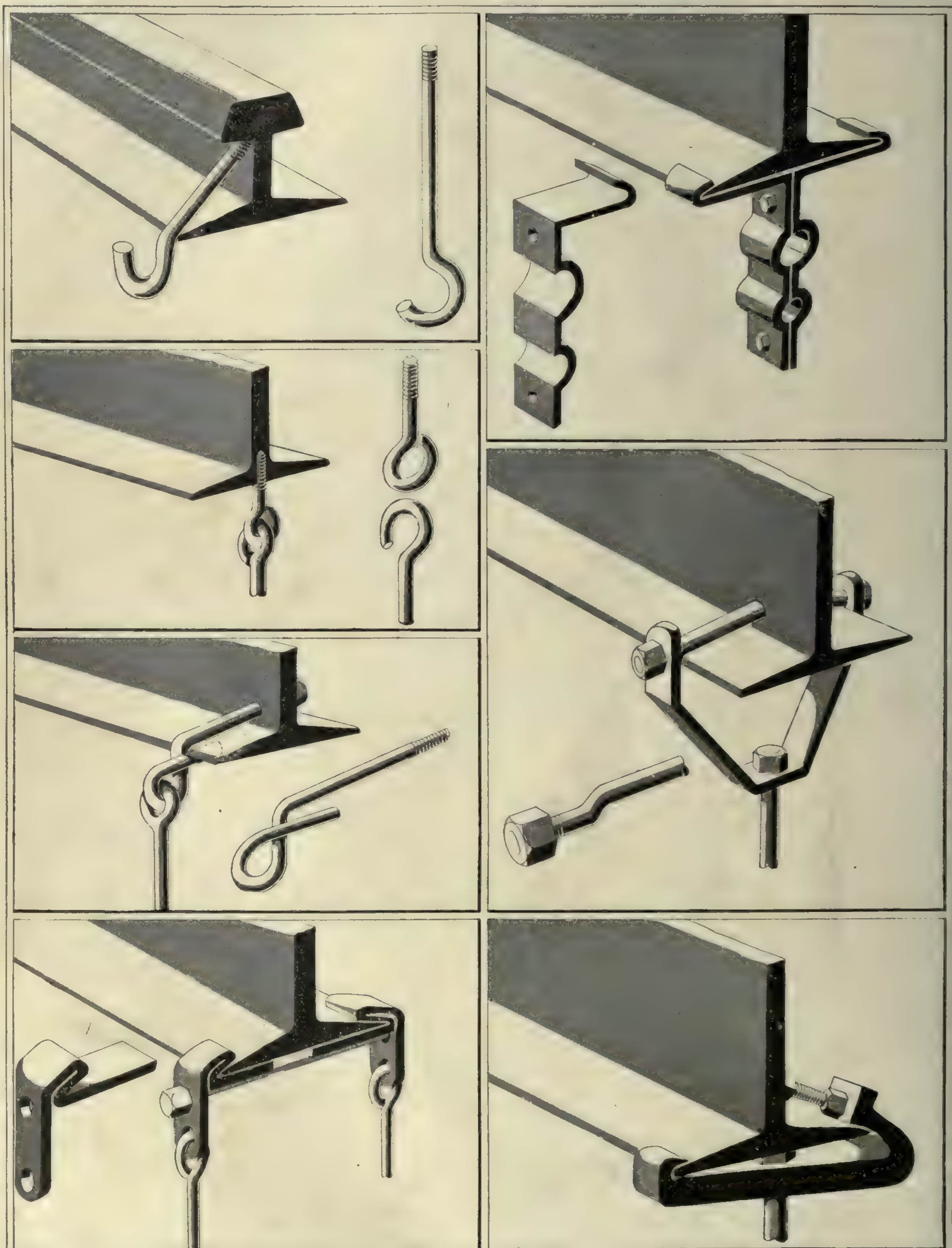
FIG. 3

FIGS. 1 TO 3. CARDS FOR INCOME-TAX REPORTS

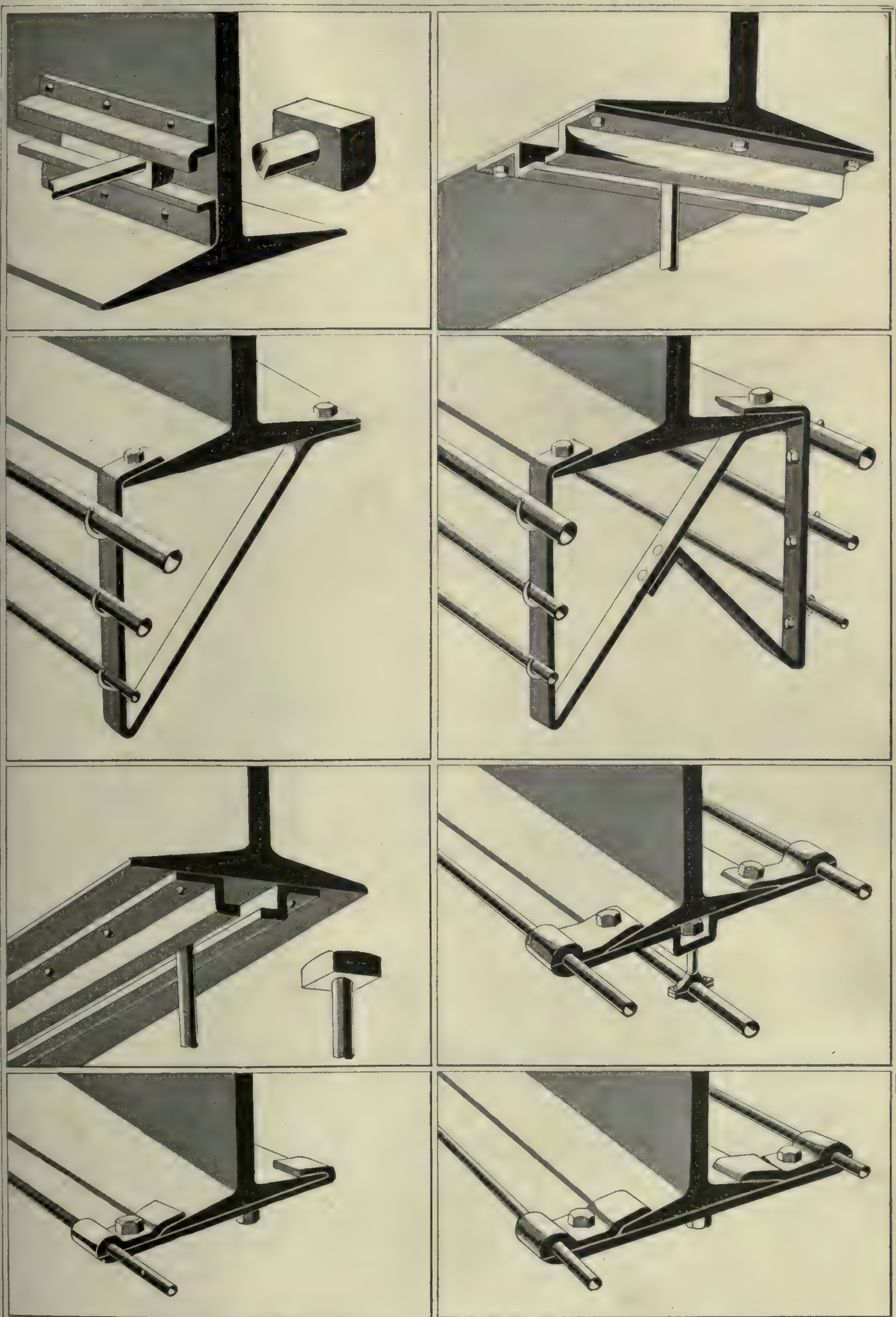
Fig. 1—Five per cent. bonus card. Fig. 2—Ten per cent. bonus card. Fig. 3—Summary card

From a Small-Shop Notebook

By J. A. Lucas



METHODS OF SUSPENDING OBJECTS FROM I-BEAMS



METHODS OF SUSPENDING OBJECTS FROM I-BEAMS

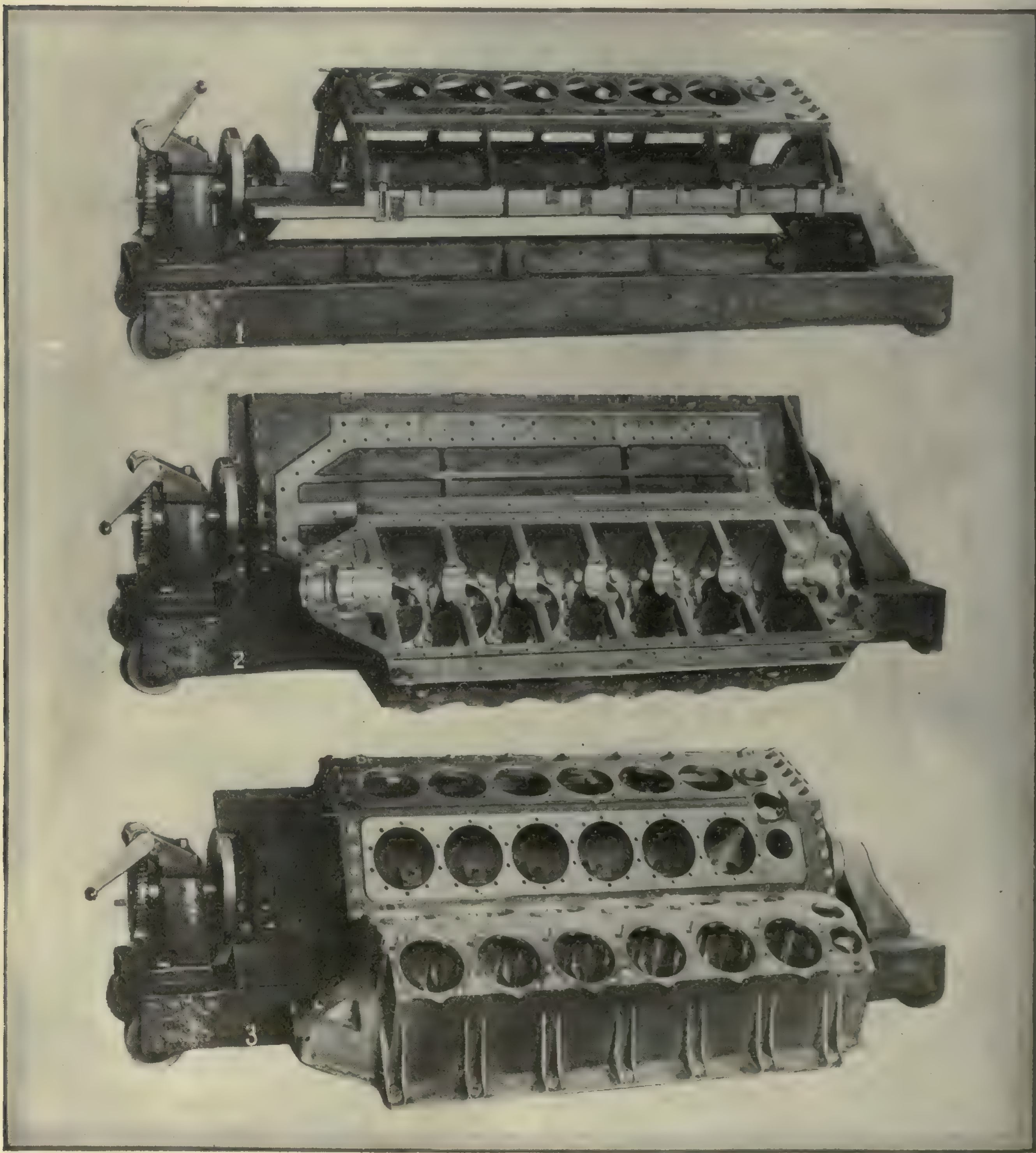
A Crank Case Trunnion Jig

SPECIAL CORRESPONDENCE

A JIG that is somewhat out of the ordinary, both as to size and design, has recently been completed at the shops of the Holmes Manufacturing Co. of Shelton, Conn., for the purpose of drilling the holes in both the upper and lower parts of the crank case of a 12-cylinder internal-combustion motor.

The base of the jig shown in the illustrations is in the form of a rectangular frame truck of heavy construction, mounted on four grooved wheels, which will run upon track rails of steel passing under three multiple-spindle drilling machines and extending into the central aisle of the shop for loading and unloading.

Triangular-shaped brackets are bolted to each end of the truck frame, having near their apex a bearing for supporting the working parts of the jig which are carried upon trunnions rotating in these bearings, the



FIGS. 1 TO 3. A TRUNNION JIG FOR OPERATIONS ON AN ENGINE CRANK CASE

axis of rotation thus being in a horizontal plane lying longitudinally parallel to the truck.

The main working part of the jig—the bottom plate as it is called by the makers—is a rectangular plate of cast iron $61\frac{3}{32}$ in. long, 23 in. wide and about $1\frac{1}{4}$ in. thick, having a cross rib on the under side near each end. Caps are bolted to the upper surface over these ribs, and in the bosses formed by these caps are bored the holes for the trunnions which are firmly clamped and keyed in place.

Two Index Plates

There are two index plates for locating the drilling positions of the jig, one being keyed to the trunnion at each end of the bottom plate. These index plates are disks of cast iron 11 in. in diameter and have four holes with hardened and ground bushings to receive the tapered ends of the locking pins, which latter work through the web of the main supporting brackets, being operated independently by suitable hand levers. The object of having this indexing mechanism in duplicate is to provide a rigid support at each end of the jig to prevent the distortion or wringing of the plate, which would probably follow heavy drilling pressure upon a far corner if supported at but one end.

The jig is turned to the various drilling positions by means of the worm and worm wheel which is mounted upon the end of one of the trunnions. The worm is cut with a single Acme thread of $\frac{1}{2}$-in. lead.

There are four drilling positions of the jig: (*a*) with the surface of plate horizontal, bottom side up, for the drilling of all holes in the flanges of both upper and lower parts of the crank case, and the six anchor holes for the bearings in the lower part; (*b*) with the plate horizontal, surface up, for drilling the hole for the intake manifold; and (*c*) and (*d*) two angular positions in which the surface of the plate is up, but stands at an angle of $22\frac{1}{2}$ deg. from the horizontal in either direction.

Operations on the Cylinder Faces

For performing the operations on the top or cylinder faces of the upper part of crank case, there is a cover carrying the necessary drill bushings, which bolts to the bottom plate after the work has been clamped to the latter. This cover is shown bolted in place in Figs. 1, 3 and 4, Fig. 1 showing four of the five holding bolts in the slots at the edge where the lower part of cover adjoins the edge of the bottom plate. In this illustration the jig is in position for drilling the hole for the intake manifold, but without the work in place. Fig. 2 shows the bottom plate swung to a nearly vertical position exposing the under side. A crank-case part is shown in front of the jig. Fig. 3 shows the jig with cover in place and the upper part of a crank case on the floor in front of the jig. Fig. 4 is an end view in same position as Fig. 1. The reader should understand that Figs. 2 and 3 do not show drilling positions, the object of positions shown being to give the observer a clear idea of the construction.

In operation, the bottom plate is set in the horizontal position, with the surface up; the cover, which incidentally weighs 300 lb., is lifted off and a section of the crank case set on the plate, being located by six blocks, the top surfaces of which are partially rounded to fit the bore of the crankshaft bearing seats in the work. These blocks can be seen plainly through the cylinder openings in the cover plate, Fig. 3. The work is held to the plate by eight clamps, the outer ends of four of these clamps being visible in Fig. 1.

If the piece being operated upon is the lower half of the case, the jig is turned 180 deg., locked in position and the holes drilled. If it is the top part of the case the cover is put on and clamped, and the vertical hole drilled. The jig then is turned to first one and then the other of the angular positions for drilling the cylinder faces. The bottom plate carries 84 bushings for holes from $\frac{3}{8}$ to $\frac{5}{8}$ in. in diameter. The cover has 12 bushings $5\frac{5}{16}$ in. inside diameter, for the cylinder openings; three bushings for $1\frac{5}{8}$-in. holes, and 120 bushings for small holes for bolting on the cylinders.

This jig takes care of all holes in the case except end holes, which of course it would be impracticable to accommodate in this design.

During the construction, the bushing-carrying plates were baked in a japanning oven four times between

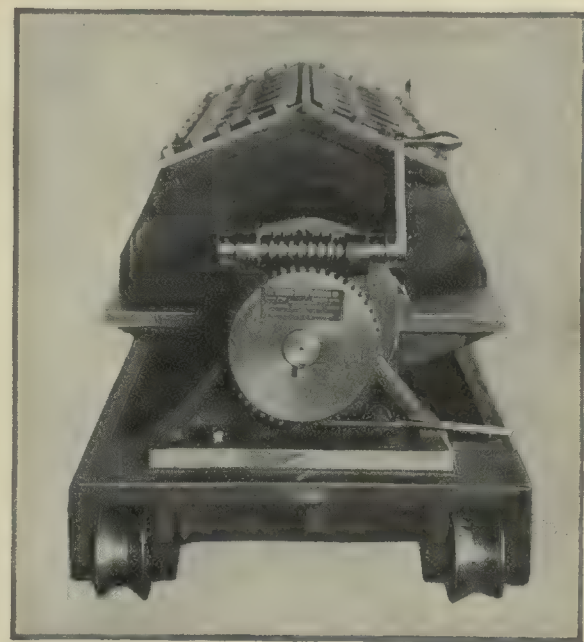


FIG. 4 END VIEW OF JIG

cuts to relieve internal strains in the casting, and to insure as far as possible a plate that would remain stable when put in operation.

In Fig. 1 will be noted two small projections at the apex of the cover plate: one standing vertically near the center and one projecting horizontally from the end. These are hardened and ground steel plugs put in for convenience in construction, to be removed when the jig goes into service. They are the points of departure from which all measurements were taken in laying out and testing the holes in the cover. The cover is located on the bottom plate by six hardened plugs of rectangular section, three of which are plainly seen, they being permanently located in the bottom plate and fitting into slots in the cover whose bearing surfaces are lined with steel, hardened and ground. To allow for expansion and contraction of the cover from temperature changes during operation, the middle pair of these plugs is closely fitted lengthwise of the cover, but left with

about $\frac{1}{16}$-in. clearance sidewise, while the two end pairs are closely fitted sidewise and given about $\frac{1}{32}$-in. clearance in either direction, endwise. This locates the cover from the center, allowing for movement in both directions, reducing the error from this cause to a minimum.

The jig complete, weighs approximately 3000 lb.; is 80 in. long, 24 in. high from the track rails, and 23 in. wide.

Sheet-Metal Work

By H. H. Armstrong

At the present time when sheet-metal production is being made to fit all kinds of stamping and drawing operations, it is advisable to use this metal in many cases where castings and drop-forgings are used, and by making good tools—tools that are designed properly to produce accurate and finished pieces—the factory cost of production can be cut appreciably.

We all know that patterns and castings are necessary in many cases, but there are cases where tools can be employed to produce punchings that will fit in and do the work of castings with a much lower factory cost. The snagging, drilling, planing and milling of the castings is thus done away with by die-blanking, drawing, forming and piercing operations of the tools done on the one press and by the same operator, thus saving the moving of parts from one machine to another.

In using sheet steel it is essential to have the bends and breaks made across and not with the grain of the metal. However, this is not taken into consideration with deep stamping and forming steel, as this steel is dead soft and can be put in the die with any angle of the grain. Still on hot-rolled steel and hard sheet steel the practice mentioned is essential. Bending with the grain on hard steel is liable to make cracks and splits.

Some manufacturers in their specifications will state that certain steel will bend at right angles across the grain; other steel (softer) will bend flat on itself across the grain, but only at right angles with the grain. When making bends with the grain, and not being familiar with the steel, a rounding bend is safer than a sharp bend.

A good feature of cold-rolled steel is the very smooth surface that can be obtained. Invariably pieces that are made from very smooth steel do not need any grinding to fit them for the plating bath, but a buffing- or soft-wheel operation is all that is required. This steel costs more to buy, but if these grinding operations are eliminated, then it is cheaper in the end to use a high-grade, smooth-surface steel.

Another thing to be reckoned with is the scarcity of copper and brass. Years ago sheet-metal articles were made of copper and brass for the reason that sheet steel would not do the work. Today, however, sheet steel can be obtained in almost any degree of softness, and this is largely taking the place of sheet brass and copper.

We have had complaints that steel would never fill the place of brass and copper, as the rust made it unfit for ornamental articles; even if nickeled it was not satisfactory, as when used in damp places the rust would work through the nickel plate and finally become very unsightly. To the manufacturer this need not be cause for worry, for if the steel parts are given a copper plating first, and then a nickel plating, the rust will never come through. Copper has better affinity for steel, or seems to hold better in solution than nickel. On the other hand, nickel will hold well on copper. Therefore, if the steel parts are given a copper-cyanide bath first, the nickel will hold and rusting will be overcome.

Castings that are used for heavy duty can be supplanted by steel stamping in some cases. We have used boiler plate for this work, and by heating it red hot it can be formed and drawn satisfactorily. Of course, this is for work where surface appearance does not count and where grinding and polishing are not necessary.

For marine work, steel fittings and punchings may be used satisfactorily, and if the parts are sherardized there is no chance of their rusting. While the war is going on, it is the duty of every manufacturer to use steel wherever possible, and steel can easily be substituted for the more expensive and envied materials, copper and brass.

Lastly, when using sheet metal, make stock layouts of the parts to be punched and determine the proper width before ordering. Then there will be a minimum of waste. Also by ordering multiples of the blank required, short ends are eliminated.

Civilian Workers Wanted for Ordnance Department

Men having a high-school education, some shop training and the natural ability to adapt themselves to new work may qualify for a Government appointment in which, under Government instructors, they will receive the necessary training for the positions described below. Those who have the required technical training will be placed and advanced as quickly as their ability justifies.

Men wanted are for: Inspectors and assistant inspectors of field-artillery ammunition steel; inspectors of artillery ammunition, cartridge cases, assembling, loading, forging, primers, detonators, shell and shrapnel machining; ballistic inspectors; metallurgical chemists and assistants; inspectors of powder and explosives; inspectors of cannon and forging operations; inspectors of gun carriages and parts; inspectors of gunfire-control instruments; assistant inspectors of motor vehicles and artillery wheels; engineers and assistant engineers for tests of ordnance materials; inspectors of ammunition packing boxes, and machinists accustomed to work to thousandths of an inch.

These positions are under civil-service regulations, but applicants will not be required to report for examination at any place. Applicant will be rated in accordance with education and general experience. No applications will be accepted from persons already in the Government service unless accompanied by the written assent of the head of the concern by which the applicant is employed. Papers will be rated promptly and certification made with least possible delay. Apply or write for further information to C. V. Meserole, special representative of the Ordnance Department, U. S. A., Room 800, 79 Wall St., New York City.

Manufacture of Machine Tools in Switzerland

By C. E. CARPENTER
President of the Allied Machinery Co.

The machine-tool industry of Switzerland has experienced a phenomenal growth since the beginning of the war. Tools of many types and sizes are being produced in large quantities, but the supply is not equal to the demand. In particular the exportation of machine tools has increased by leaps and bounds.

THE effects of the war on the Swiss metal-working industries are clearly set forth in the export statistics for the year 1916, recently published by the Swiss government. By far the most remarkable growth shown by these figures is that of the machine-tool industry, which before the war was confined principally to the manufacture of machines used by watchmakers. During the year 1916, Switzerland's exports of machine tools amounted to $9,750,000, an increase of 1400 per cent. over the year 1913. The exports were distributed among the following countries: France, $5,200,000; Italy, $3,117,000; Germany, $733,000; England $202,000; Austria, $189,000; Roumania, $120,000; Russia, $100,000; other countries, $89,000.

In connection with these figures it is interesting to note that during 1916 France imported forty times as many machine tools from Switzerland as in 1913, Italy approximately thirty times, while Germany increased its imports from Switzerland only 300 per cent. In the case of Germany the statistics show a decrease as compared with 1915, indicating that German imports of machine tools reached their high-water mark in the second year of the war. On the other hand more than half of Switzerland's total imports of $998,000 of machine tools in 1916 came from Germany, the share of the United States being only $293,000.

Exports in 1916

If to the nine and three-quarter millions of exports in 1916 is added the large domestic consumption of machine tools, stimulated by the great demand for war material that practically all Swiss machine shops have experienced, it will be seen that Swiss machine-tool builders have enjoyed exceptional prosperity. To what extent the impetus thus gained will be converted into a permanent industry, competing in the world's markets with the big machine-tool building countries, it is difficult to foresee. In a number of cases, however, evidence is to be found which indicates that substantial progress in design, workmanship and manufacturing methods has been made, and if the conditions of supply and demand should continue to remain favorable to Swiss industries it is safe to assume that after the war Switzerland will become a factor of no mean proportions in the machine-tool trade of the world.

The types of machines which have figured most prominently in Swiss exports during the war are engine lathes up to 24-in. swing and 12 to 15 ft. between centers, turret lathes up to 2-in. spindle capacity, bench precision lathes, thread-milling machines for fuse work and shells, universal milling machines, universal and wet tool-grinding machines, small drilling machines, and to a smaller extent horizontal boring, milling and drilling machines and radial drills.

One of the types of Swiss machines exported in considerable quantities during the year covered by the foregoing statistics was a thread-milling machine, with a hob form of cutter, specially designed for milling the threads on brass and aluminum fuses and in the nose of shrapnel and high-explosive shells. This machine, in various sizes, was in heavy demand both in Switzerland, where large contracts for fuses were taken by watchmaking factories, and in the countries at war. It is understood that several thousand machines of this type have been built and sold.

Building Engine and Turret Lathes

The building of engine and turret lathes likewise received stimulus from the insatiable demand for these machines that prevailed in all European countries after the first months of the war. To meet the demand, machine shops of all kinds, from builders of locomotives to makers of agricultural machinery, converted as much of their equipment as possible to the production of lathes until there was scarcely a shop in the country in which the building of lathes had not become an important part of its work.

Naturally, under such conditions, many machines of inferior design and workmanship were turned out. In general, however, the quality of the product was very good, and in some instances machines were built by plants not previously experienced in this kind of work which compare favorably with the product of some of the best known American machine-tool plants.

In the case of lathe builders whose business existed prior to the war, the progress made during the war has been quite marked, and it is the belief of lathe users in Switzerland that in the future Switzerland will be independent of foreign countries, except for special types of lathes, the designing and construction of which by local manufacturers have not been warranted during the past three years.

The manufacture of milling machines, except in a limited way, cannot be said to have fared so favorably as some of the other types of machines. While a number of plants have endeavored to take advantage of the tremendous demand for universal milling machines, the results in the majority of instances have been unsatisfactory. Only one factory has been notably successful, and its output has invariably been sold ahead for at least a year. Other plants whose reputation for accuracy of workmanship in unrelated products is world renowned have not been able to produce milling machines of sufficient power and accuracy to meet the conditions imposed by modern manufacturing requirements, and it is therefore unlikely that they will continue to be a factor in the trade when more normal conditions return.

The particular plant referred to has specialized on one size of horizontal machine comparable in dimen-

sions with the No. 3 machine of a prominent American make, and the machine has had a very favorable reception both in Switzerland and in some of the allied tcountries, where it is claimed to be as accurate and as productive as some of the best American machines. A No. 3 vertical milling machine with rotary table is being marketed with much success by the same concern, and it is understood that a smaller size of horizontal machine will shortly be put on the market by this manufacturer. All these machines have single-pulley drive and gear-feed changes.

Slab Milling Machines

The manufacture of slab milling machines with horizontal and vertical heads is also being undertaken in Switzerland, owing to the impossibility of procuring these machines from foreign countries, and it is therefore not unlikely that after the war American makers of such machines will find serious competition from Switzerland in this line.

Another machine of Swiss manufacture which deserves mention is a horizontal boring, milling and drilling machine embodying modern improvements, which is produced by the largest Swiss machine-tool plant. Many of these machines have been exported since the beginning of the war and are highly commended by users. The capacity of the plant is insufficient to keep pace with the demand, the product being constantly sold ahead at least 18 months. The machine is built in both column and table types and is furnished with single-pulley and motor drive.

Equally worthy of mention is a line of small universal grinding machines built by a manufacturer who was established for some time prior to the war, and whose business has since been developed to important dimensions. The factory has adopted American shop practice throughout; all work is done with jigs, and the design, accuracy and finish obtained will place the line in a strong competitive position for after-war trade. In the same plant a surface grinding machine, similar in capacity to the Brown & Sharpe No. 2, is built. The machine is equipped with magnetic chuck and exhaust for carrying away emery dust. Of less interest, but perhaps noteworthy in connection with the development of the machine-tool industry in Switzerland, is the line of wet tool grinding machines that form part of the product of this factory. These machines are built in lots of 50 to 100, and practically monopolize the Swiss market.

Swiss Progress

Last but not least in this brief mention of Swiss progress in machine-tool building is the manufacture of precision bench lathes, which has achieved especially marked development. Makers of these machines have had a steady demand for their product since the beginning of the war, and they have met the abnormal conditions not only by a large increase in their production but by steady improvement in design and workmanship. The incessant demand for fuse-making equipment and for machines for toolroom work has encouraged them to put forth unusual efforts, and has likewise enabled them to prepare to good advantage for future competition with builders of other countries. These manufacturers have also designed and built many special drilling and milling machines for fuse work, which have enabled Swiss makers of fuse parts to attract to Switzerland large munition orders.

In the manufacture of small tools, Swiss industry has also profited, especially by producing chucks, gages and measuring instruments of all kinds. The universal scarcity of lathe chucks induced many factories to undertake the manufacture of this line, and in all probability some of them will continue their product after the war.

The progress made by the Swiss machine-tool and small-tool industries in general is particularly noteworthy when the difficulties of obtaining raw materials (iron, steel and coal) are taken into consideration. Switzerland produces neither iron nor coal, and is therefore wholly dependent upon other countries for these commodities. To those who are familiar with the rigid restrictions governing the uses to which imported raw materials may be put, it is nothing short of astounding that such an important growth should have taken place. The spirit of patience and energy which Swiss manufacturers have shown in solving these knotty problems speaks favorably for the continuance of these industries when keener competitive conditions again prevail.

Growth of the Industry

In this connection it is interesting to note a statement of the Association of Swiss Machine Tool Builders contained in the official report accompanying the figures of exports given above: "The construction of machine tools, which in Switzerland was of secondary importance, has taken on an extraordinary development. The excessive growth of this industry, however, has not altogether benefited the factories which existed before the war and which constituted an old, established industry. If we deduct those machine shops which took up this line as an auxiliary product to compensate for a lack of orders for their regular product or for holding their organization together, and if we further deduct the special plants that were established prior to the beginning of the war, we find the industry composed of 'war creations' that, favored by circumstances, have grown up like mushrooms. It is evident that these machine-tool and munition plants lately organized not only diminish by disquieting proportions the amount of raw materials available for our normal industries, but contribute also to greatly increase the difficulties of the labor situation, without taking into consideration the fact that the development of a war industry has indirectly caused our normal industries numerous difficulties through the greater severity in the control exercised over the use of raw materials."

New Monthly Iron and Steel Publication

A new publication, *Iron and Steel of Canada*, is issued by the Industrial and Educational Press, Ltd., of Montreal, Canada. The first issue appeared in February, 1918, under the guidance of Alfred Stansfield, D.Sc., as editor in chief, and W. G. Dauncey, M.E. and C.E., as associate editor. It is a monthly publication, and the subscription price is $2 a year.

Interesting Examples of Gage Grinding

By S. A. Hand

At the shops of the Blair Tool and Machine Works, Inc., New York City, they are doing some very interesting gage grinding and have developed several novel and ingenious devices which have enabled them to successfully accomplish some unusual work in this line.

In the illustration at *A*, Fig. 1, is shown a receiving gage for the case of a cartridge used in the Model 1903, 15-lb. gun. The hole to be ground is about 3 in. in diameter, 23 in. long and slightly tapering. This is an unusual job, and is one which presents great difficulties to any shop not specially equipped for grinding. In this case the shop had no grinding machine capable of grinding so deep a hole, so that some special rigging had to be devised for doing the job.

FIG. 1. GRINDING CARTRIDGE-CASE GAGE

The gage was mounted in an engine lathe and held near the outer end by a steadyrest in the usual manner.

The steel bar *B*, 1¾ in. square and 40 in. long, was fitted to the tool block, as shown in the illustration, and the variable speed motor *C* was mounted on the right-front wing of the lathe carriage. Connection from the motor to the grinding wheel was made by the flexible shaft *D*. This shaft was provided with a long bearing at *E*, which was let into a groove in the bar *B* and securely clamped in place. It will be seen that with this rigging the length of the hole that can be ground is only limited by the overhang of the bar *B*. The grinding wheel *F* was 3 in. in diameter with ⅜-in. face and ran at a speed of 5000 r.p.m. when new. This was increased as the diameter of the wheel was lessened by wear.

Fig. 2 shows a Heald internal-grinding head rigged up on a Brown & Sharpe grinding machine. This was done for grinding a hole that was too large in diameter and too deep to be ground with the internal-grinding attachment furnished with the machine. This arrangement has proved so useful and economical that it is now well nigh a permanent fixture on the machine so far as internal grinding is concerned. Fig. 3 shows a special fixture for grinding thread gages, and as shown in the illustration it is mounted on an Ames precision lathe. The swivelling head *A* on which the grinding spindle is mounted is not centered by a stud, but is guided by a circular tongue which fits into a groove of the same shape and radius. The center of foci of this tongue and groove is at the exact location of the center of the grinding wheel *C;* thus it will be seen that no matter how much the plate *A* may be swivelled, the center of the wheel *C* remains in a fixed position.

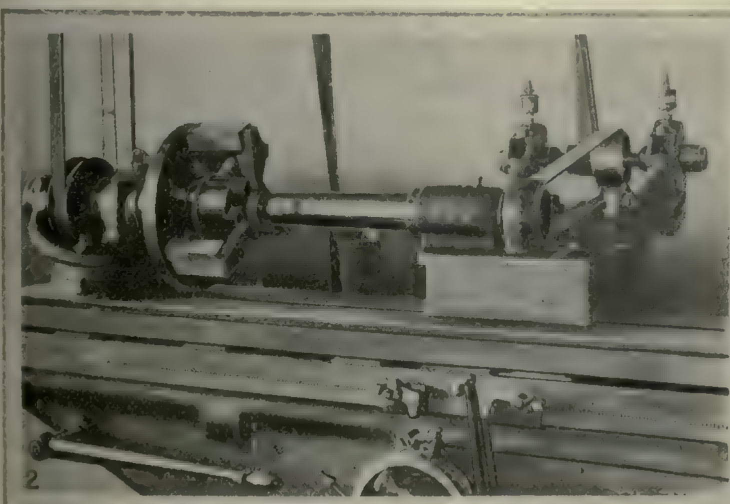


FIG. 2. HEALD INTERNAL-GRINDING HEAD ON BROWN & SHARPE GRINDING MACHINE

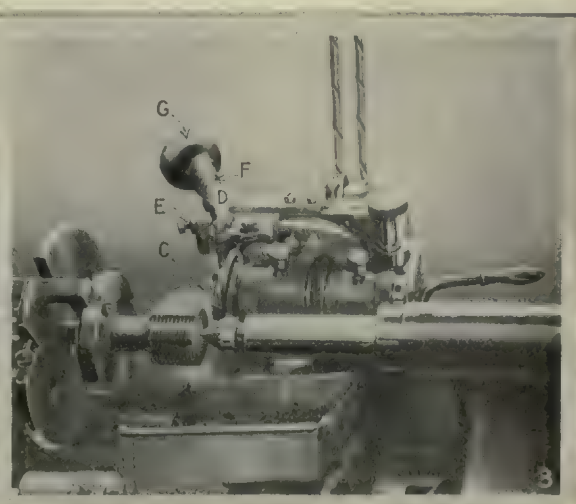


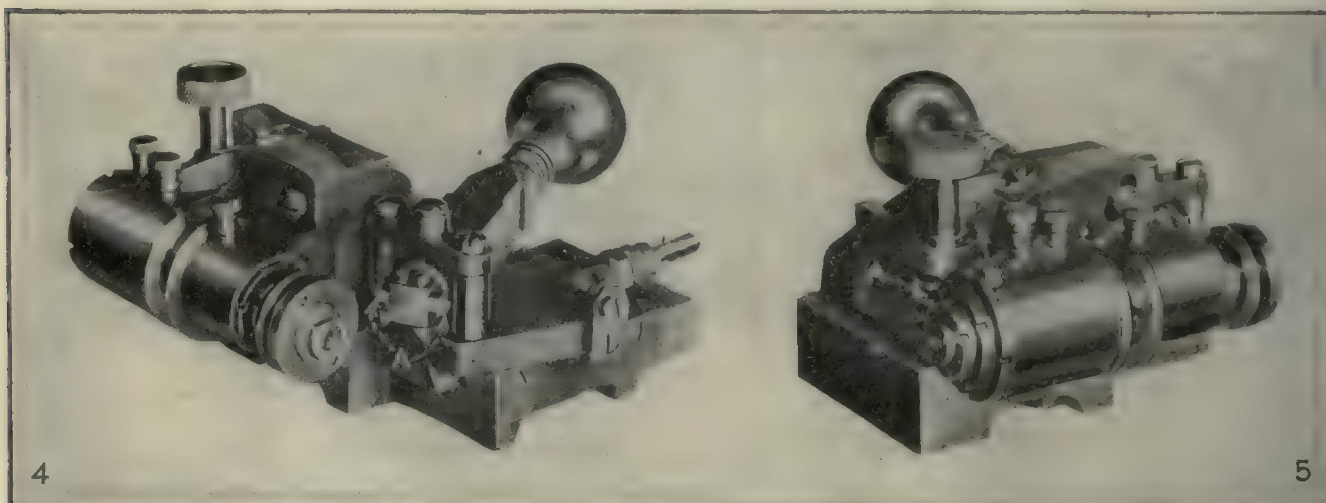
FIG. 3. GRINDING A THREAD GAGE ON AMES PRECISION LATHE

D is the diamond truing device, also used for forming the thread angle on the grinding wheel. The plane on which this device swivels is fixed, and the angularity of its motion is controlled, by adjustable stop screws, one of which may be seen at *E*.

The diamonds, of which there are two, are mounted at the end of a square sliding bar, and are normally kept away from the wheel by the spiral spring *F*, and are traversed over the wheel by pressing the handle *G* toward the wheel.

Keeping the truing device on a fixed plane permits the wheel to be shaped to the same angle as the thread to be ground after the wheel has been set to the proper helix angle. If the wheel was shaped to the same angle as the thread to be ground before being set to the helix angle, the resulting thread would not be of the proper shape; under these conditions it would reouire the angular limits of the device to be adjusted for every different lead and diameter of thread to be ground. This would involve some very close calculating and adjusting and would consume a great amount of the time allowable for the grinding operation.

The lead of the thread to be ground is controlled by a hardened and ground hob with buttressed threads, which insures accuracy for a long time. The hob is mounted on the rear of the lathe spindle, and longitudinal motion is conveyed to the slide which carries the grinding fixture by a rod parallel to the center line of the lathe.



FIGS. 4 AND 5. THREAD-GRINDING ATTACHMENT FOR ENGINE LATHE

The round driving belt is so guided by idler pulleys that it has a contact of 180 deg. on the driving pulley. This provides ample power and prevents the wheel from slipping when under pressure of the cut.

Figs. 4 and 5 illustrate two views of a grinding head or attachment similar to the one just described, but designed for use on an engine lathe and in front of the work instead of behind it, as in the case of the one on the precision lathe.

At *A*, Fig. 4, are shown the diamonds for dressing the grinding wheel, and at *A* and *B*, Fig. 5, are the worm and the wormwheel segments for adjusting the wheel spindle to the desired helix angle.

Engineering Council Holds Its First Annual Meeting

The first annual meeting of the Engineering Council was held Feb. 21. The following officers were elected: Chairman, J. Parke Channing; first vice chairman, Harold W. Buck; second vice chairman, George F. Swain; secretary, Alfred D. Flinn. Committees were appointed as follows: Executive committee, the chairman, the two vice chairmen and David S. Jacobus, Calvert Townley, George J. Foran; finance committee, E. Wilbur Rice, Jr., chairman, Charles F. Loweth, Sidney J. Jennings, David S. Jacobus; rules committee, J. Parke Channing, chairman, Clemens Herschel, Nathaniel A. Carle, Irving E. Moultrop; public affairs committee, Charles Whiting Baker, chairman, George F. Swain, Benjamin B. Thayer, E. W. Rice, Jr., Charles E. Skinner; American engineering service, George J. Foran, chairman, Edward B. Sturgis, secretary, George C. Stone, Alfred D. Flinn, Dr. Addams S. McAllister; war committee of technical societies, D. W. Bruntno, chairman, Arthur H. Storrs, secretary, James M. Boyle, Nelson P. Lewis (American Society of Civil Enginers), Edmund B. Kirby (American Institute of Mining Engineers), A. A. Greene, Jr., R. N. Inglis (American Society of Mechanical Engineers), Harold W. Buck, Dr. Addams S. McAllister (American Institute of Electrical Engineers), Dana D. Barnum, E. C. Uhlig (American Gas Institute), Joseph Bijur, Dr. Charles A. Doremus (American Electrochemical Society), Louis B. Marks, Preston S. Milar (Illuminating Engineering Society), Christopher R. Corning, George C. Stone (Mining and Metallurgical Society of America), Henry Torrance, F. E. Matthews (American Society of Refrigerating Engineers); fuel conservation committee, L. P. Breckenridge, chairman, Ozni P. Hood, secretary, Robert H. Fernald, Charles R. Richards, Charles L. Edgar, Carl Scholz, David Moffat Myers, Edwin Ludlow, Harold W. Buck.

The definition of the Engineering Council that was adopted declared that "the Engineering Council is an organization of national technical societies of America created to provide for consideration of matters of common concern to engineers, as well as those of public welfare in which the profession is interested, in order that united action may be made possible. The Engineering Council is now composed of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, having a membership of 33,000 and known as the 'Founder Societies.' "

The Government War-Labor Policy

The effect of the policy of the Government on labor matters is so important to the manufacturer that it ought to be part of his duties to familiarize himself with these policies. To make it easy to know just where the matter stands at present, the following outline of the Government war-labor policy has been prepared.

UP TO the present, each department of the Government has handled its own production program, leaving central supervision to only certain specified production problems of unusual difficulty. In general each production division has pursued its own policy and had different policies on labor problems. Each had of necessity set up in its own organization a section, either large or small, to handle the various phases of production that had to do with labor.

Efforts have been made to correlate these many agencies; but this was not successful, as there was no organization authorized to direct the whole labor field. During a strike last fall in a plant which was making munitions for the Army, the Navy, and the Shipping Board, mediators from four departments stepped in to try to reconcile the differences between the employer and the men. Each of these sets of mediators was acting under a different head, with different orders and a different policy. Confusion resulted, and it was only after the mediators themselves got together on a common program to handle the thing as it should be handled—as one problem—that any progress was made.

The Council of National Defense had discussed the proposals to establish a central war-labor administration, and such cases as the one described have helped to show the vital necessity for it. In November the council asked L. C. Marshall of the University of Chicago, an economist of note and a lifelong student of industrial problems, to take in hand the problem of working out some solution of the difficulty. As a result, the council late in December recommended a plan for a national war-labor administration. The President approved and asked the Secretary of Labor to undertake its administration, authorizing him to take whatever steps were necessary to bring it about.

Reasons for Action

Roughly, the reasons which underlay the decision, as seen by the interdepartmental conferees, were these:

1. At present each department of the Government is with a few exceptions dealing with its own labor problems irrespective of what is done by other departments. As a result, (a) there is much duplication of effort; (b) there is no uniformity of policy or procedure; (c) there is much conflicting action.

2. Each department competes against the other departments for essential skilled labor. Contractors and subcontractors engaged on Government work are using every means at their command to draw essential skilled labor away from each other. By this means the labor turn-over is multiplied and men are kept moving from job to job in certain industries for higher pay.

3. There is as yet no adequate system for dealing promptly and uniformly on a nation-wide basis with labor disputes affecting war work. The result is an increasing labor unrest.

4. To allow this situation to continue will, in our opinion, diminish the country's production and eventually paralyze industry.

On Jan. 15 the Secretary of Labor appointed an advisory council to outline a plan of action and assist him in the formulation of a program for the unified administration of all the Government's war-labor problems, including distribution, transportation, housing and training, and adjustment of disputes. The council consisted of John Lind, chairman; L. C. Marshall, who had already been working on plans at the request of the Council of National Defense; Waddill Catchings of the United States Chamber of Commerce, and A. A. Landon, general manager of the American Radiator Co. and vice chairman of the Aircraft Board, representing the employers; John B. Lennon and John J. Casey, representing labor, and Agnes Nestor, representing women in industry.

New Divisions

On Jan. 22, the Secretary of Labor approved a complete plan of administration on a national scale, which covered the establishment of the following new divisions in the Department of Labor:

1. An adequate adjustment service to deal with all industrial disputes.

2. Conditions of labor service to administer conditions of labor in business plants, such as safety, sanitation, etc.

3. Information and education service to promote sound sentiment generally and to provide local machinery and policy in individual plants (including such matters as the development of proper employment, management methods, etc.).

4. A women-in-industry service to correlate the activities of the various agencies dealing with the matter.

5. A training and dilution service.

6. Housing and transportation of workers' service.

7. Personnel service (which may be fused eventually with the information and education service).

Plan of Administration

The general plan of the Administration, while involving complete centralization of control on all matters of policy, will not abolish the existing services in the production departments, which are naturally in immediate touch with production problems and which could not under the circumstances easily be dispensed with. The scheme may perhaps be best described as one of centralization of control, with decentralization of administration, through the agencies which come into direct touch with the problems at issue. In other words, the services of the individual departments will function in general as before, but will have to conform with the central policy of the Department of Labor in its work, thus avoiding the confusion which has heretofore existed. The new plans, although they are being expedited with all speed possible, will necessarily take time

to develop and the transition will have to be gradual. The chiefs of the various industrial-service sections will begin to clear their activities through the appropriate officials in the Department of Labor as soon as the right men can be found to head the new services in the department, and the production departments will be represented on the policies board of the Secretary of Labor, which will serve as a general staff for the Secretary.

There will be flexibility of organization to meet changing conditions. The new services of the department will be established on an emergency basis, and the positions for the present will be nonstatutory in character so that readjustment may readily be made. The plan of organization has been tested by both British and American experience, and as far as can be seen now it meets the requirements. The Department of Labor will be free to establish supplementary agencies as these become necessary. A budget is now ready to be placed before Congress to provide the necessary funds, although the actual organization of the administration will not have to wait for the appropriation of these funds.

Personnel

Every effort is being made to secure the biggest and best-trained men in the country to head the new divisions of the department. The personnel question is being established on a scientific basis, and the appointments for the heads of the new divisions are expected to meet the full approval of the country at large. A personnel bureau will pass on the qualifications of all the new appointees. Otto M. Eidlitz, a New York builder with large experience, has already been appointed as director of housing. Mr. Eidlitz has been studying the problem for two months for the Council of National Defense as chairman of the council's committee on housing, and his practical building experience combined with his knowledge of war conditions acquired through this study seems to make him and ideal man for the place. Future appointments will maintain the same standard.

Basic Understandings on Labor Controversies

To arrive at some kind of a definite understanding or agreement on controversies now existing or likely to arise between capital and labor for the duration of the war a conference was begun in Washington between representatives of the two sides. The representatives of manufacturers, selected by the National Industrial Conference Board, are: Loyall A. Osborne, New York, vice president of the Westinghouse Electric and Manufacturing Co.; W. G. Van Dervoort, East Moline, Ill., president of the Root & Van Dervoort Engineering Co.; L. F. Loree, New York, president of the Delaware & Hudson R.R.; C. Edwin Michael, Roanoke, Va., president of the Virginia Bridge and Iron Co., and B. L. Warden, vice president of the Submarine Boat Corporation.

Labor's representatives, chosen by the American Federation of Labor, are: Frank J. Hayes, Indianapolis, president of the United Mine Workers; William L. Hutcheson, Indianapolis, president of the Brotherhood of Carpenters; Victor Olander, Chicago, representing the Seamen's Union, and T. A. Ricket, Chicago, president of the United Garment Workers. One more representative of labor is still to be selected, as J. A. Franklin, president of the Brotherhood of Boilermakers, was unable to attend.

Ex-President Taft was selected by the employers' representatives as their spokesman, and Frank P. Walsh of Kansas City, formerly chairman of the Industrial Relations Commission, was selected by the employees' representatives in like capacity.

The understandings thus reached are expected to establish the basic principles of adjudication to govern the policy of the adjustment service of the central labor administration. Among the questions to be considered are: Basis for wage determination; strikes and lockouts; piece-work prices and price fixing; method of eliminating improper restrictions of output of war materials from whatever cause; practice to govern dilution of labor; discrimination against union and non-union men; admittance of union agents to plants; method of promptly adjusting disputes at their source through boards containing equal representation of employers and employees; right of workmen to organize.

The Government's whole policy will be one of seeking to prevent disturbances rather than trying to cure them after they have arisen.

The Export of Machine Tools to France

Beginning Jan. 1, 1918, all machine tools included in customs list No. 525 (covering all machine tools) will be requisitioned on their arrival in France and placed at the disposal of the Ministry of War.

This measure is intended solely to permit of the control of the final destination of machine tools and their best use in the interests of the national defense.

As a result of the decisions taken by the federal government of the United States, the War Purchasing Commission will not allow any machine tools intended for the national defense, and which can be used immediately, to leave America.

In view of the physical impossibility of cabling to the French High Commissioner at Washington the destination of the machines ready for embarkment, the French government has guaranteed to undertake *à posteriori* the control requested.

Industrial importers or merchants who are advised of shipment of machine tools for France must forward immediately to the "Secretariat Général de la Commission Interministérielle des Métaux, 14 Rue de la Trémoille, Paris," a detailed list of the machines, giving chief specifications, port of arrival and destination. The Commission Interministérielle des Métaux will make the necessary inquiries from the services for which the machines are intended—inquiries sufficiently rapid to avoid any increased delay in the reshipment of the material out of the French ports.

Each time it is compatible with the requirements of the national defense, and especially with urgent orders for the manufacture of war material, machine tools will be delivered to the party for whom they were originally intended, but no machine tool will be delivered if it is not to be put into immediate use.

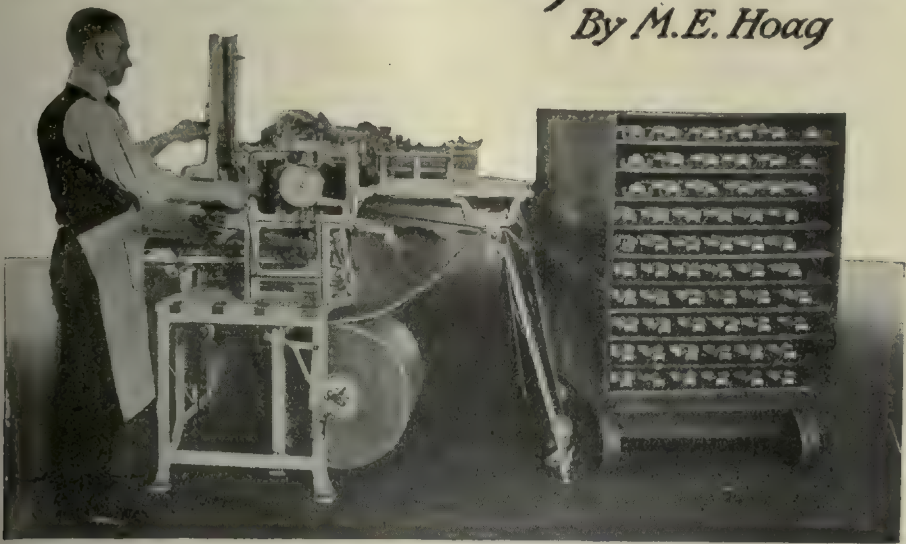
Clementel,

Minister of Commerce, Industry Posts and Telegraphs and Maritime Transports.

Ministry of War, Paris, Dec. 30, 1917.

Manufacturing the Addressograph

By M. E. Hoag



The manufacture of addressing machines as carried on in the factory of the Addressograph Company, Chicago, Ill., involves a great deal of accurate work, as well as some very interesting operations not found in other lines of manufacture.

THE machines manufactured by the Addressograph Company cover a wide range running from the small hand-operated machine shown in Fig. 2, to the large machine shown in Fig. 3, which takes the paper from the roll, prints the sender's address or other device, addresses it, and cuts and piles the printed sheets ready for the mailing department. A sample of the work done by this machine is seen on the mailing wrapper of the *American Machinist*.

Other large and complicated machines are used for printing and addressing gas and electric-light bills, and for addressing letters, envelopes, etc.; they are familiar fixtures in most offices and business houses having large permanent mailing lists to handle.

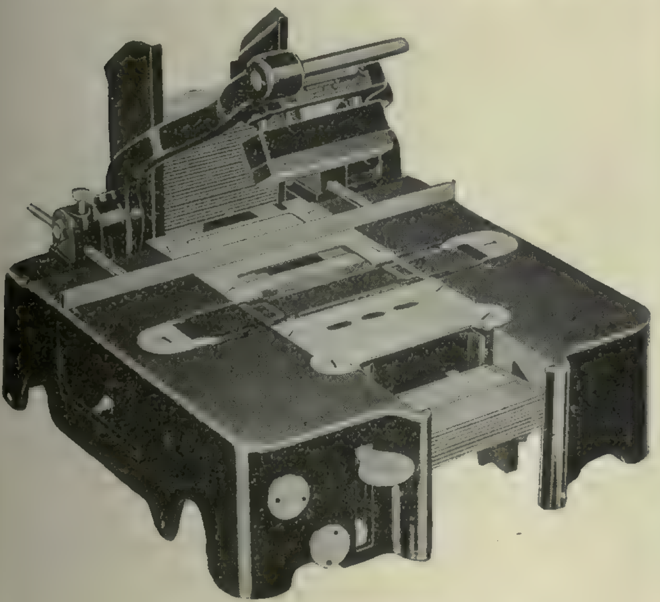


FIG. 2. HAND ADDRESSOGRAPH

In order to use these addressing machines it is necessary to set up the address on a composition metal plate in exact duplication of typewriter type. This work is done on the Graphotype machine, by the use of hardened-steel male and female dies, each pair of which carries a separate letter or character.

The making of these steel dies and punches involves some very accurate and interesting methods, and will be described later, in detail.

An almost inconceivable number of blank address plates, as well as plate holders, are constantly required by the users of these machines, and as these are all supplied by the Addressograph Company, their production develops into a manufacturing problem of no small moment, and requires the use of some interesting dies.

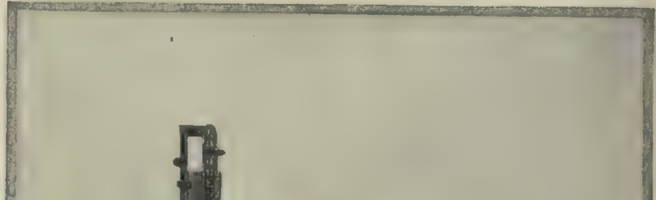


FIG. 3. LARGE MAILING ADDRESSOGRAPH

The nameplate shown in Fig. 4, is made from rolled sheets of special composition. These sheets are first

passed through slitting rolls and cut into three strips ready for the punch-press.

The dies used for punching these blanks are shown in Fig. 5, and handle three strips of stock at once, the entire operation being automatic after the operator starts the strips of metal through the feed rolls *A*, the feed chutes *B* having just enough clearance to permit the passage of one strip at a time to each die.

As three strips of stock are fed into these punches at once, any variation in the thickness of the stock would prevent proper feeding of the stock. To overcome this trouble the under set of feed rollers is divided into three units, the central one being equipped with springs which insures proper tension against the upper set of rolls at all times.

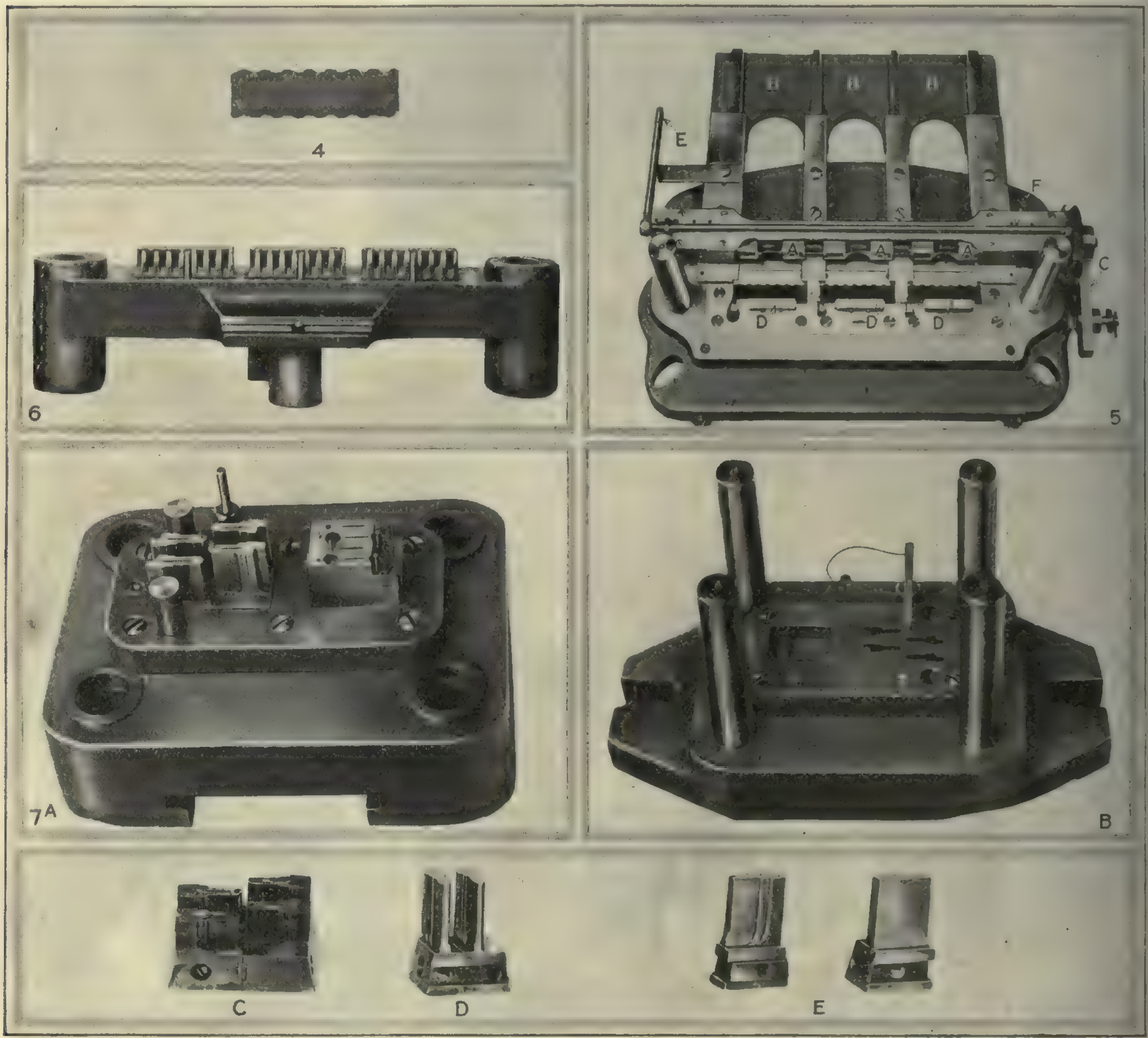
The feed rolls are operated by the wheel and ratchet *C*, the feed being slightly in excess of that required for the blank. As the ends of the strips bring up against the stops *D*, the rolls slip and prevent buckling.

In order to start stock through the rolls, the upper set is released by throwing up the lever *E*, which in turn operates the spring rod *F*. This spring rod is bowed in the center to give it spring, and is what might be called a spring cam.

The punches for these dies are shown in Fig. 6. Considering the fact that these punches and dies are built up, and that the blanks must be free from burrs, it can be readily seen that some very nice work is required in their construction.

Another set of dies of novel construction is shown in Fig. 7. These are for making a small spring index stop, which is placed on address plates and acts as a selective device in such a way that the addressing machine automatically prints or rejects the address plates according to the position of the tab.

These tabs are completed in two operations with these progressive piercing and blanking dies, four tabs being completed at each stroke of the press. In Fig. 7, *A* shows the punches; *B*, the dies with stripper plate in position. A set of blanking punches *C* are keyed to-



FIGS. 4 TO 7. THE NAMEPLATE AND SOME OF THE DIES

Fig. 4—Nameplate. Fig. 5—Triple automatically-fed dies for nameplates. Fig. 6—Punches for nameplate dies. Fig. 7—Built-up dies for index tabs

gether and ready to place in the die holder. A pair of punches *D* are keyed together, and *E* is the second pair of punches separated to show position of keys and construction. These punches, *D* and *E*, were not fully completed when photographed.

This method of construction is rather unusual but nevertheless practical for some punches set close together; while the first cost is a little high, it is offset by the ease with which repairs are accomplished, and by the increased production over that obtained with single dies.

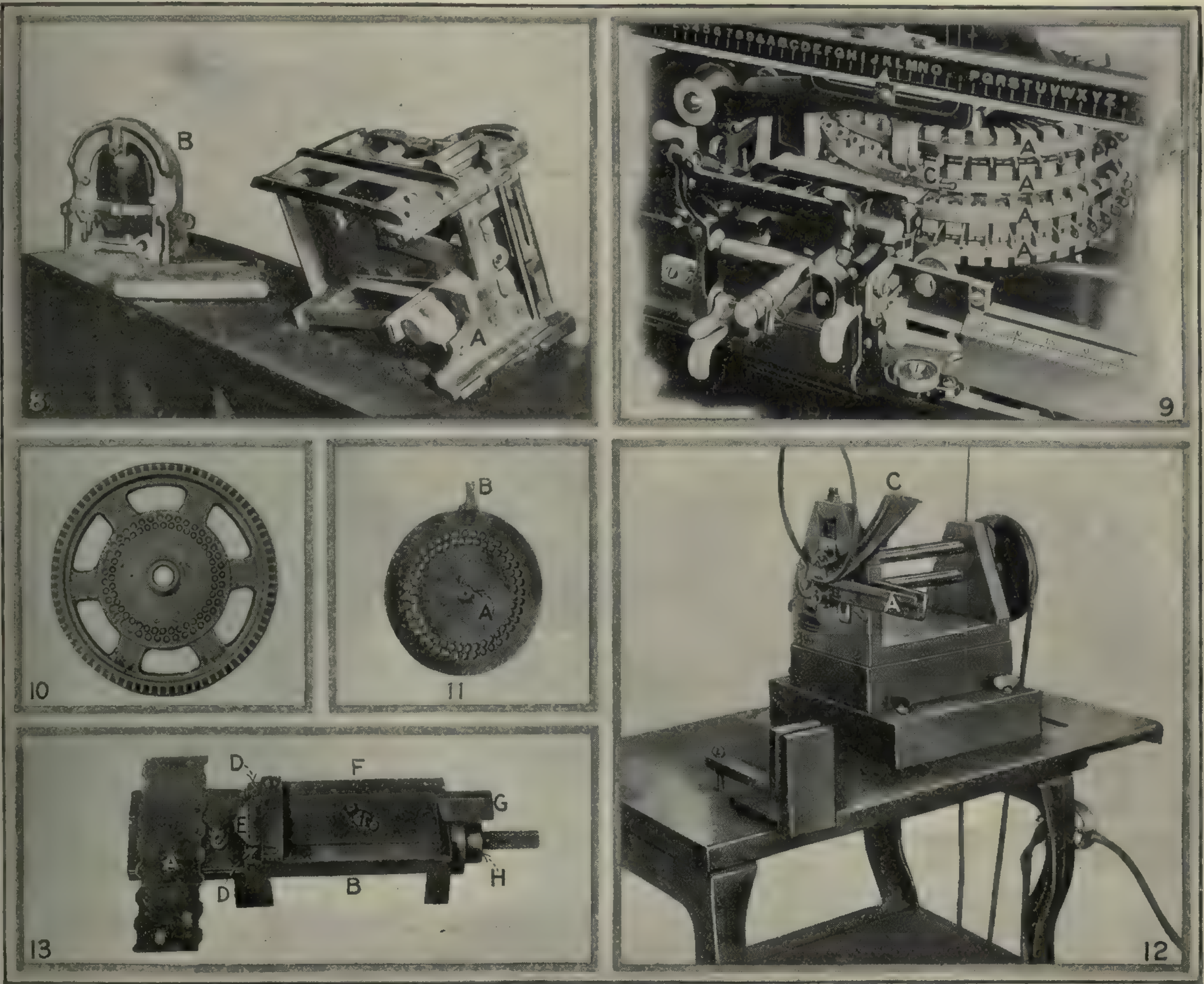
In building the Graphotype, a number of drill jigs are required, one of the most interesting of which is that shown at *A*, Fig. 8, for drilling the frame *B*. This jig is of box-type construction, and carries about 40 drill bushings, the work being operated on from five different positions and angles.

A close-up view of the punch and die heads for the Graphotype is shown in Fig. 9. The body of these heads is of cast aluminum. A top view of a finished head is shown in Fig. 10. The 80 slots for the dies and punches are milled after the piece has been turned and bored. The 80 stop-holes in the web of the piece are drilled with the jig shown in Fig. 11. A plug *A* in the center fits the bored hole in the die head, and is held in place by a nut and washer. Location is obtained by the hardened finger *B*, which enters one of the slots in the rim of the holder.

Narrow steel rings are placed around the die heads, to hold the punches and dies in place as shown at *A*, Fig. 9, and pinned to place. These rings are made of flat stock, cut to length, and the ends punched so as to interlock as shown at *C*. The rings are rolled in the motor-driven machine shown in Fig. 12. The straight blanks are fed into the rolls through the channel *A*, and as the formed rings come out of the rolls they pass up and over a wire rod. The ends enter the chute *C*, which prevents their reëntering the rolls.

After rolling, the ends of the rings are brazed together with a blow-torch flame, and after removing scale and excess spelter are ready for assembling on the die heads.

After the rings are in place on the die heads, each square slot is broached with a handbroach, which produces a slight flat on the inside of the rings just described; it also insures absolute alignment of the upper and lower members, which is absolutely necessary in order that the punches and dies engage perfectly, other-



FIGS. 8 TO 13. SOME OF THE WORK AND THE TOOLS USED

Fig. 8—Drill jig for Graphotype frame. Fig. 9—Graphotype punch and die heads. Fig. 10—Top view of punch and die heads. Fig. 11—Drill jig for stop holes. Fig. 12—Ring-rolling machine. Fig. 13—Gage for locating punches and dies in Graphotype

wise imperfect work or broken dies and punches would result.

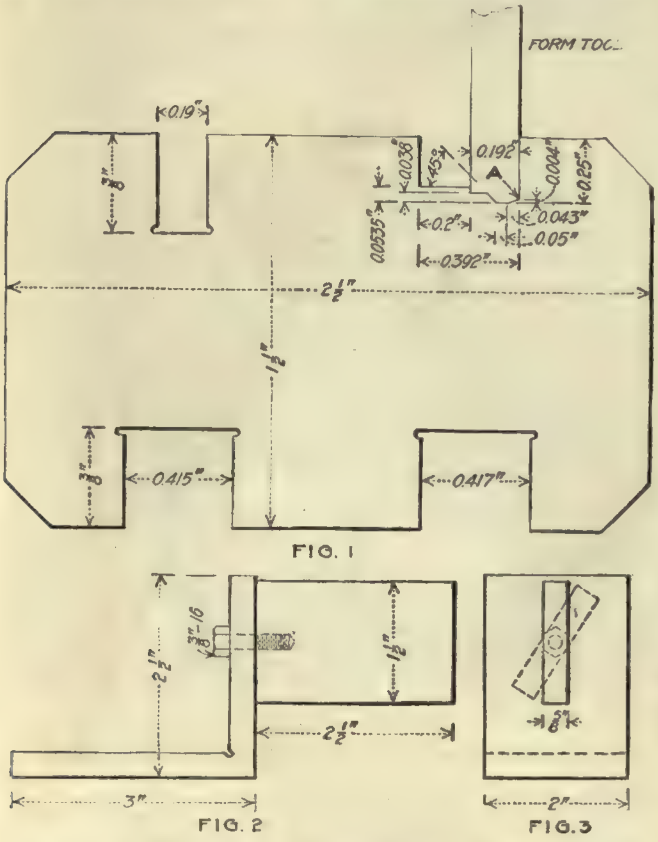
In assembling these Graphotypes, the dies must form the letters on the nameplates a certain distance from the edge and from the front end. To gage this, blank plates are punched as shown at *A*, Fig. 13, and are then measured with the gage *B*. To do this the plate is laid on the table *C* with the edges resting against the stops *D*, and the gaging block *E* is adjusted until it just touches the edge of the character as seen under a glass. Readings on the two scales *F* and *G*, and the micrometer head *H* give the amount the adjustment is out.

Grinding Precision Tools

By Robert C. Morse

Many flat gages are now employed that invariably have to be scraped to precision before hardening, as there is no other available way that is profitable. This necessitates a scraping tool ground to required accuracy, even though the gages are ground and lapped.

Precision tools in reality are gages themselves, and require the skill of a gagemaker to produce an accurate job. Fig. 1 shows a gage which requires a form-tool composed of a series of very minute angles, and



FIGS. 1 TO 3 METHOD OF OBTAINING GAGE ANGLES

by no means a job for an unskilled mechanic. These angles being difficult to measure and there existing various ways they could be measured, some doubt arose as to which method would obtain the most accurate results. The following was adopted: Angle *A*, Fig. 1, was figured out trigonometrically. The protractor was set at proper angle, and the length of angle then obtained by means of size blocks 0.043 in. thick. Care should be taken to have point of blade sharp, that when under the magnifying glass the point will determine the extremity of angle. The 45-deg. angle was ground by originating an angle on the wheel and thus obtaining the sharp corner desired. From the side of the tool, angle *A*, to the beginning of the 45-deg. angle is 0.093 in. Now, setting small adjustable square 0.093 in. with size block and again using glass, grind 45-deg. angle until it comes even with point of blade. Care should be taken to have end of blade perfectly square and corners sharp. Depth 0.038 in. can be measured with depth gage.

Precision tools necessarily have to be backed off, and many times this is accomplished by two different settings, which is unnecessary. The writer's method, and perhaps one used elsewhere, is by means of square block attached to angle iron as shown in Figs. 2 and 3. By such means the double angle can be obtained, eliminating resetting for backing off.

The block is hardened and ground perfectly square all over, and is found useful on many other jobs besides precision tools.

Calculating for Electromagnets

By W. Thomas

A short time ago there appeared an article of mine on page 1096, Vol. 47, on electromagnets, and on page 190 of the current volume S. H. Hartshorn, in reply, refers me to a work on solenoids by Underhill.

As a matter of fact it was the lack of information in Mr. Underhill's book in a form that seemed readily applicable that led me to write the article, and I do not yet see that I asked anything unreasonable. If, as Mr. Hartshorn says, the charts are "more or less impossible, owing to the great changes in magnetic pull made by very slight changes in design," why cannot the best design, or at least a good design, be made a part of the charts? For instance, there is a problem before me at the present time, as follows: I have a battery current of six volts and I wish to get a solenoid that when connected up with this current will consume approximately 6 amperes. The size is of little importance—almost anything under 5 in. in diameter by 6 in. long can be taken care of—but I would prefer it to be about 2 in. in diameter and 3 in. long, provided the large size did not give me considerably greater efficiency.

I do not care what the stroke of the plunger may be, for I can reduce or increase it by means of levers. What I want is to use the 6 amperes of current to the best advantage.

Mr. Underhill states on page 117 that it is easy to get the most efficient arrangement possible and that it is also easy to predetermine a magnet to pull the amounts required in more than one point of its travel. If, as he says, it is easy to do these things, it seems to me that it should not be difficult to design a solenoid that will be the most efficient for a given current. I should like to have the resistance of the wire in the solenoid hold the flow to about 6 amperes, as this would serve as a starting point for the whole design.

I would be very glad indeed if Mr. Hartshorn will show me, by the use of Mr. Underhill's book, how he would easily design a reasonable size solenoid which would give approximately the maximum work for the current above mentioned.

Some Types of Gages for Munitions of War

BY H. J. BINGHAM POWELL

This article contains some practical hints on gagemaking from a man of very wide experience with the matters discussed.

THERE is apparently little scientific basis at present for the choice made of some of the types of gages for munitions. As an example: on a cylindrical piece, a snap gage is sometimes used, while at other times and for no clear reason, a ring gage is used on a similar piece. These two types of gages, snap and ring, function in an entirely different fashion from each other; hence, if it is correct to use the one in certain circumstances, the use of the other in like circumstances must be wrong. The matter will be discussed under a classification of the parts on which the gages are used.

Under plain cylindrical parts are included shells, fuse pellets, fuse and primer bodies on the plain portions, etc.

A ring gage, in practice, can only bear on the major diameter of the piece. Thus, if one would be assured that the piece will assemble in its counterpart, and the actual fit or neutral zone between the two is not of primary importance beyond the allowance permitted by the go and no-go gages, then the ring gage meets the condition; such a case is the fit of a shell into the bore of a gun.

Gage Similar to Gun Bore

The ring gage is similar in form to the bore of the gun, hence we know that the shell will not jam if it has passed such a gage. On the other hand, a snap gage is inappropriate here, because it might bear on a minor diameter of an oval shell and thus be the means of causing trouble. Ring gages are generally used for shell inspection, but for no clear reason snap gages are sometimes used for cylindrical pieces that have to assemble in their counterparts.

A ring gage does not properly check a piece that is out of round; consequently, where a good bearing around the perimeter of the counterpart is essential, a snap gage should be employed and the piece checked on several diameters in the same plane.

For the go gage on screw plug parts a ring with the full thread form is used, but for the no go, sometimes a full thread form is used, while at others a plain ring is considered sufficient. The object of a thread gage is to check the correctness of the form of thread of the product, as well as to furnish assurance that it will assemble. That being the case, neither the plain nor the threaded ring alone is satisfactory. The form of the thread can be of any shape that will pass the go gage, and it will likewise pass inspection with the no-go gage if it bears on either the outside or the root diameter of the thread or on any part of the thread angle. One could imagine a thread of web or fin section that would check correctly with such gages. The writer has particularly noticed that the threads of some pieces which passed inspection with both gages were hopelessly out of shape. This was clearly shown when an image of the pieces enlarged 50 times was projected on a screen by an optical lantern. Some threads had the form of a wavy line, or perhaps only half the correct depth, but which nevertheless had passed inspection with the go and no-go thread gages. It is true that a plain no-go ring gage would take care of a shallow thread, but on the other hand it might accept a thin thread, which is equally objectionable.

Thin Threads Too Weak

Shallow and thin threads are weak, and for cases where the strength of the screw is important, a system of gages has recently been introduced in England. If a ring gage with normal form of thread is used, we know that the inspected screw part will assemble in its place and that the angle between the slopes of its threads is not too great. To insure that the angle is not too small, a threaded ring gage with the crest of the thread cut to a V, the root to a flat, and the pitch diameter made to the low limit, will be the correct no-go gage, since such a gage can only bear on the slopes of the thread, and if the gage will not pass over the work, the angle of the thread is large enough. A no-go plain ring will check the piece for the outside diameter. The root diameter of the piece is not taken care of on the low side, but this is not usually considered a matter of importance. Thus, by the system of three gages described, we are able satisfactorily to check a screw for form and strength.

Screw ring parts are usually inspected by a go plug gage with normal form of thread, and a no-go plug

gage either with normal thread or plain surface. This method is open to the same objections cited with reference to similar gages for screw plug parts, and the system of three gages just described is equally desirable for application in this case.

For screw ring parts we would use, therefore, a go plug gage of normal form; a no-go threaded plug gage, with the root cut to a V and the outside diameter to a flat, and a no-go plain plug gage for the outside diameter.

The outside diameter of the part is not checked for the high side, but this is of small importance, for the same reason that the root diameter of a cylindrical part is usually neglected. That the strength of a screw part is sometimes a matter of such vital importance in munitions, and sometimes so necessary a factor to the prevention of a premature explosion of the shell in the gun, can be understood on considering the enormous pull due to setback or inertia of the several parts of a shell at the instant of firing. For instance, the gaine and adapter that formed part of the British No. 100 fuse had a pull on the adapter thread, due to the inertia on their combined weight, of 10 oz., of nearly four short tons; which, suddenly applied, had the same effect as a static load on the thread of nearly eight tons. With this early form of gaine the thread of the recess for the adapter in the brass body of the fuse was sometimes stripped off, and a recess with stouter walls and a shorter and lighter gaine had to be adopted.

Recessed Parts

The depth of holes is sometimes checked by a plain plug with high and low steps, the bearing of the latter against the product being observed; or a similar plug with a sliding piece bearing on the top of the gage is used. The latter method is the better, because the steps of the plug in this case are seen against a finished surface instead of against that of the rough product as in the first instance; further, the depth is taken from the slide, which bears on the piece in a way similar to the way the latter will bear on the piece with which it is afterward assembled.

Chamfering the Muzzle of a Rifle

By T. E. Daniel

About fifteen years ago, one of the largest manufacturers of rifles in this country conducted a series of experiments with the object of improving, if possible, the shoooting qualities of its product. Starting with the belief that it is only the last inch or less, at the muzzle end of the barrel that directs the course of the bullet it set out to make this last inch perfect.

It was discovered that the chamfer at the muzzle end of the bore (made by taking off the sharp inner edge to protect it against accidental nicking) was not perfectly concentric with the bore. This eccentricity made one side of the chamfer deeper than the other; consequently one side of the bullet would clear the barrel before the other, which, it was thought, would allow the pent-up gases to escape more freely on this side and slightly deflect the course of the bullet. To remedy this condition a very stiff and accurate machine of the turret type was built, in which the barrel was revolved after first being centered by its bore. The barrel was held in place by adjustable chuck jaws, and was cut to length and chamfered by suitable tools held in the turret. Chamfering being the last operation on the bore it was deemed inadvisable to have a guide or pilot on the end of the chamfering tool to enter the bore.

The new machine was not as successful as was expected, and although it turned out better work than the old machines the objectionable eccentricity, though slight, was not entirely eliminated. The engineering staff spent several days trying to discover what caused the error, some believing that the fault was in the machine, while others ascribed it to floor vibration. Before they could come to an agreement the operator who ran the new machine brought some barrels to his foreman asking to have them tested, which was done; and the barrels were found to be perfect. On being asked what he had done to the machine to enable him to accomplish this desirable result, the operator asked the foreman to watch the operation.

Placing a barrel in the machine and cutting it to length, just as had been done in previous tests, he then picked up a three-cornered file sharpened to a point at its end, inserted it in the bore, and the trick was done. The flexibility of the operator's hand allowed the tool to accommodate itself to the slight eccentricity of the bore, the vibration from the machines, or whatever it may have been that caused the trouble. I have never heard that the shooting qualities of the rifle were appreciably improved, but it was a lasting lesson to me never to rely solely upon mechanical experience when designing, but to temper that experience as much as possible with common sense.

American Gear Manufacturers' Association

The American Gear Manufacturers' Association will hold its second annual convention at White Sulphur Springs, W. Va., Apr. 18, 19 and 20, making its headquarters at the Green Brier Hotel. The secretary is F. D. Hamlin of the Earle Gear and Machine Co., 4701 Stenton Ave., Philadelphia, Penn.

Gear standardization will be the principal subject of discussion, and an address by a representative of the United States Chamber of Commerce, of which the association has just become a member, will also bring matters of timely interest before the association.

The convention will begin with meetings of committees on Thursday morning, Apr. 18. At 1:30 the first session will open with an address by President F. W. Sinram, "The American Gear Manufacturers' Association: Past, Present and Future." Following the address by the Chamber of Commerce representative, C. R. Poole will talk on "Hardening and Heat Treating of Gears," and B. F. Waterman will present the report of the standardization committee.

Friday morning's session will include reports of officers and committees, election of nine members of the executive committee and miscellaneous business. An informal banquet will be held in the evening.

On Saturday morning a paper on "Uniform Cost Accounting" will be presented by J. H. Dunn, and on "Hobs and Hobbing Machines" by a representative of the Barber-Colman Company.

Development of the Pneumatic Sand-Blast

BY GLENN B. HARRIS

The importance of the pneumatic sand-blast to our manufacturers of machine tools and to interests closely allied therewith, can hardly be realized or appreciated. There are but few industries in the line of metal manufacture but that can use this extremely efficient form of apparatus to advantage, not only in improving the appearance of their product, but also for improving the machining qualities of castings and forgings.

IT IS a well-known fact that the effect of uncleaned or improperly cleaned castings or forgings on cutting tools is extremely detrimental, subjecting the tool to unnecessary wear; and in this era of high-speed steel for which a large price is charged, it is indeed most desirable that all possible means of effecting a saving be resorted to. The sand-blast is efficient in this regard for the reason that it cleans and thoroughly removes all scale, and in a manner not to be obtained by any other process or method. It is estimated that the life of cutting tools will be prolonged from 25 to 40 per cent. when used on sand-blasted castings or forgings. Another great advantage in the use of the sand-blast is the tenacity with which paint or other coating will adhere to the product subjected to sand-blast action. The pieces thus treated are cleaned in all holes and crevices much more thoroughly than by hand; ornaments are not disfigured nor sharp edges rounded by it; and the work accomplished is anywhere from eight to ten times that possible by hand.

Origin of the Sand-Blast

A thorough search of available records has failed to establish the origin of the art of sand-blasting. Tradition, however, tells us that years ago there lived in the desert regions in the path of travelers to the Orient an old blacksmith, who not only repaired the vehicles of the travelers, but forged various kinds of ornaments of brass and iron which he sold to the tourists. Upon returning to his little shop one day after a severe sand storm, he noticed that the ornaments which stood in front of his shop were brightly cleaned on the side exposed to the sand storm. He perceived that if his ornaments had such a finish he would be enabled more readily to sell them, so he conceived the idea that if he could do mechanically the work which the sand storm had done, it would prove highly beneficial to his business. After a number of futile attempts he finally built what was in all probability the first sand-blast apparatus. It consisted of placing sand in a funnel attached to the nozzle of his forge bellows, thus feeding sand into the path of the discharge of air. With this crude apparatus he was enabled to give his ornaments a brightly finished appearance in addition to making them smooth.

It is said that a European manufacturer traveling that way espied the blacksmith blasting some of the ornaments, and at once decided to adopt sand-blasting in his own business, and on returning home he designed a machine which rendered fairly good service, but which was cumbersome and expensive to operate.

The first patent record of a sand-blast in this country belongs to the invention of B. C. Tighlman of the firm of B. C. & R. A. Tighlman of Philadelphia, Penn., who in 1870 procured a patent on a steam sand-blast machine, which was used principally in cleaning files. The steam sand-blast, however, made no appreciable headway in the manufacturing industries of the country, because it lacked the essentials necessary to make it an entirely satisfactory machine; and it particularly failed in respect of the fact that the sand was moistened by the condensed steam, and clogged the machine.

In the early nineties J. E. Matheson, an Englishman, took out a patent on a pneumatic sand-blast, the rights to which in this country were secured by the Tighlman firm referred to.

From that time the sand-blast made very slow progress; in fact it lay practically dormant until nearly the beginning of the present century, when it came into more general use; but only the hose type of machine was used, and that out of doors.

With the general introduction of pneumatic chipping and riveting hammers, pneumatic drills and other compressed-air appliances, whereby compressed air came prominently and generally into use, an impetus was given the sand-blast business, and within the past ten years the sand-blast has come to be recognized as a necessary and profitable adjunct not only in the foundry but wherever metals are cleaned preparatory to machining, painting or otherwise finishing.

During the past few years much attention has been given the sand-blast cleaning room, and the handling of sand and dust mechanically and sanitarily, for the protection of the workman. Numerous devices and arrangements have been produced to further this end, and all are based on plain and simple rules: as evidently the simpler the arrangement the better the general results; for in handling a current of compressed air, sand and dust the maximum of wear is met on all exposed surfaces; and the renewal of worn surfaces must be considered.

Different Types of the Sand-Blast

There are several types of the sand-blast, and probably the first and the one best known is that operated by direct pressure. This machine is simple and of very few parts, and is adaptable to every kind of sand-blasting work.

A typical form of the positive sand-blast is shown in Fig. 1, in which is provided a cylindrical sand container having a conical bottom into which the sand naturally gravitates and from which it flows under pressure into the sand-blast hose where it is met by the compressed-air current, so that the total or initial pressure is available at the nozzle of the machine. The air passages through these machines are made large, so that little or no pressure is wasted through friction, as would be the case were the air passages complicated or restricted. This form of sand-blast is also provided with a water trap in which the air enters before being

conveyed to the sand receptacle, thus removing as much of the moisture from the air as possible and preventing clogging or caking.

The hose of the sand-blast may be as long as 50 ft., although 20 ft. is the length ordinarily employed. This is governed entirely by the diameter of the nozzle and the pressure of air under which the machine is operated. However, as the blast is portable a radius of action with the shorter mentioned section is suitable for most requirements.

In another form of the direct-pressure sand-blast, a sand receptacle is placed on the top of the cylinder or container, and an automatic valve opens to permit sand to flow into the latter when air pressure is cut off. On admission of air this valve is closed, and the supply of sand to the container stopped. In general construction, however, this form is similar to that shown in the illustration.

In still another type of the positive-feed sand-blast an automatically rocked screen provided with an

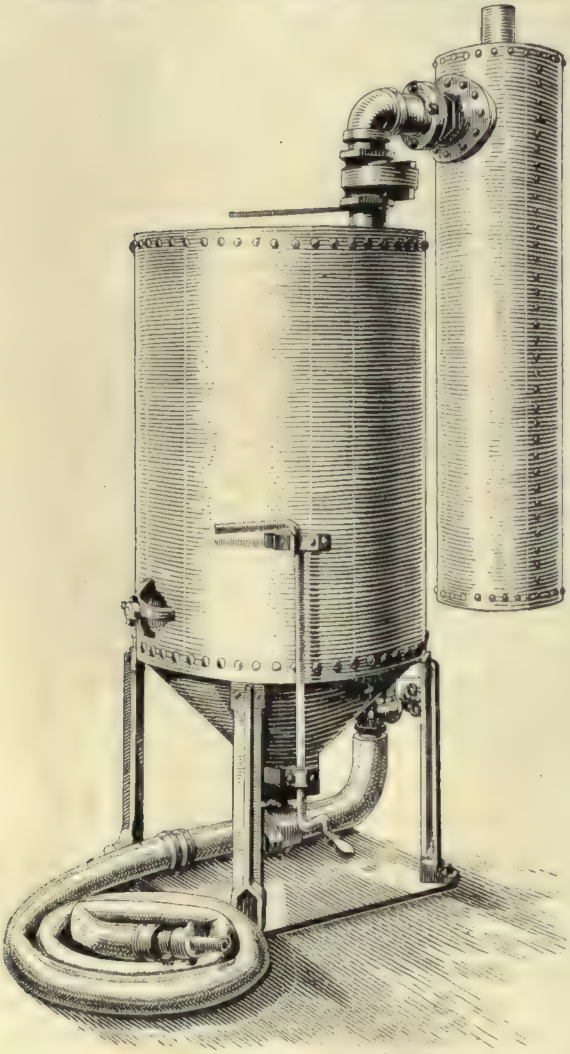


FIG. 1. POSITIVE TYPE OF SAND-BLAST

automatic filling valve is employed, thus sifting the sand at the machine and conveying it to the receiving hopper whence it goes to the tank or container through the valve.

Most of the direct type vary only in minor details of construction, and yet considerable stress is laid on these differences as affording some particular advantage.

It may be stated as a broad proposition that the highest efficiency in sand-blasting is produced by maintaining a full pressure of air at the nozzle of the hose, and in as direct a line with the discharged sand as is possible.

Different pressures of air for different classes of work seem to be essential, and it is probably true that

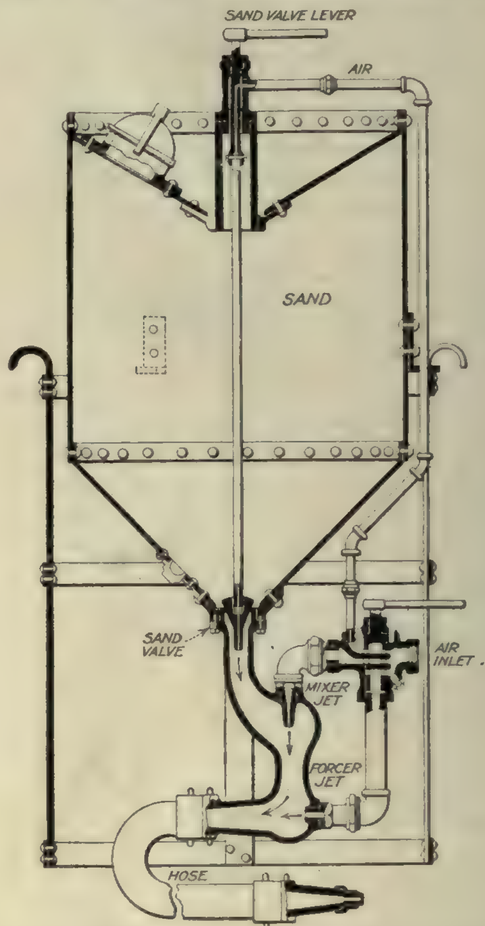


FIG. 2. INJECTOR TYPE OF APPARATUS

no one machine is perfectly adapted for the various sand-blasting operations which are daily practised.

A very interesting type of sand-blast is shown in Fig. 2. It is claimed that this is the only application of the injector principle, as applied to steam injectors, to the sand-blast. In this construction the required velocity is imparted to the mixture of compressed air and sand by several jets of air, thus permitting the quantity of air to be controlled and directed, as may be necessary. From the main air inlet a pipe extends to the upper end of the sand tank where it is connected to a vertical hollow stem having a sand valve at its lower end and adapted to be turned by a hand lever. The valve stem is perforated, so that air is admitted on top of the sand. The sand valve is provided with a vertical passage through which the compressed air flows in small volume, so that when the valve is raised in the necessary degree a slight vacuum will be created which causes the sand to flow with evenness and regularity. Secured to the lower end of the tank is what might be termed a combined mixing and forcing chamber, which is a casting and is formed with contracting walls. Entering the side of the chamber is a mixer jet, the discharge of which is vertically located, its

orifice pointing downward. As the sand flows past the sand valve and enters the chamber it is met by the current of air from the mixer jet, which causes the air and sand to be intimately mixed. The mixture then is forced through the contracted passage with considerable velocity, where it encounters a horizontally arranged forcing jet, which serves to give the mixture

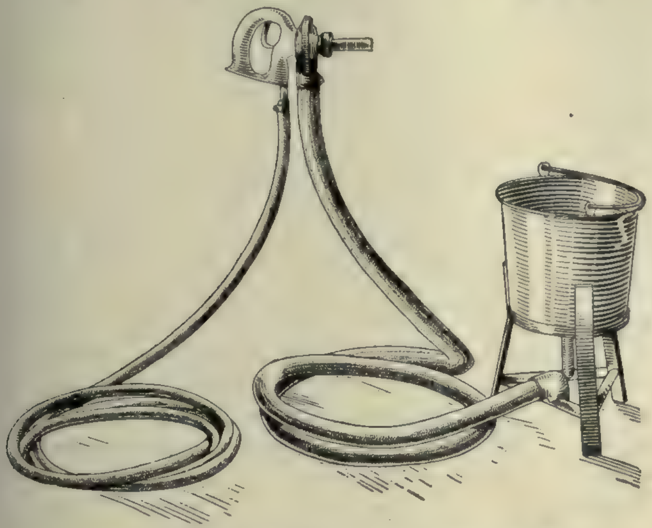


FIG. 3. GUN-TYPE SUCTION SAND-BLAST

increased impetus in its travel through the hose and nozzle. It will be noted that the air supply being subdivided, and applied as indicated, has a cumulative effect, and that a vigorous blast is therefore produced. It is claimed for this machine that the sand and air are so thoroughly mixed before reaching the delivery hose that each grain of sand is projected on the work individually and with the greatest obtainable velocity, and it would appear that there is considerable merit in this contention.

In Fig. 3 is illustrated what is known as a sand-blast gun, which is operated on the suction principle. A container is provided for the sand, and this is of compact form and readily portable. In the bottom of the sand container is provided a discharge pipe to which is connected the suction hose. This suction hose is connected at its upper end to what is termed a spiral gun. The compressed-air hose is attached to the handle of the gun, and the passage of the operating fluid is controlled by means of a trigger as in ordinary pneumatic chipping and riveting hammers. By opening the trigger its full limit the full power of the air is obtained, and this in a degree may be lessend by partially closing the trigger. Should the gun be dropped, the trigger automatically closes, and the machine therefore stops.

This simple apparatus is particularly adapted to the needs of those who can use the sand-blast to advantage but whose requirements are not such as to warrant the purchase of an expensive outfit. A particular advantage in this form of apparatus is its extremely simple construction and ready portability. The gun is lined with soft rubber which resists the wearing action of sand to a greater extent than any other known material, so that the body of the gun is made practically indestructible, as the lining, when worn to a degree rendering it unfit for service, may be removed and quickly replaced.

By the term mechanical sand-blast is meant one in which the castings are located in an inclosure and caused to be cleaned by the blast which operates upon them without the direct manipulation of the workman.

The mechanical sand-blast is of German origin, and was introduced into this country about six years ago and since that time has been made and sold here. A few were imported and redesigned, and as the patents are said to be of practically no value, so far as basic construction is concerned. Nearly every manufacturer of sand-blasting machinery has made this type of apparatus.

In considering the mechanical sand-blast reference will be made first to what is known as the rotary-table type of machine, and which is designed to meet the increasing demand for apparatus that will perform by automatic means the work heretofore performed by an operator by hand-guiding the nozzle of the blast. The rotary-table machine will handle practically all kinds of small castings and can be made in the larger sizes when requirements make this necessary.

In Fig. 4 is shown one type of the rotating-table machine in which the ordinary sand tank provided with a water trap is employed, and the sand and air combined are conveyed to the table through suction hose in correct proportions. The table proper is located in a suitable housing, and a portion of it projects beyond the latter. In this manner the size of the blasting chamber is materially reduced. The rotating wheel or table is mounted on a vertical shaft which revolves in dust-proof bearings.

The surface of this table which supports the material being operated upon is composed of steel bars, which may be easily renewed from stock material, when they become worn. The wheel may be rotated in any desired

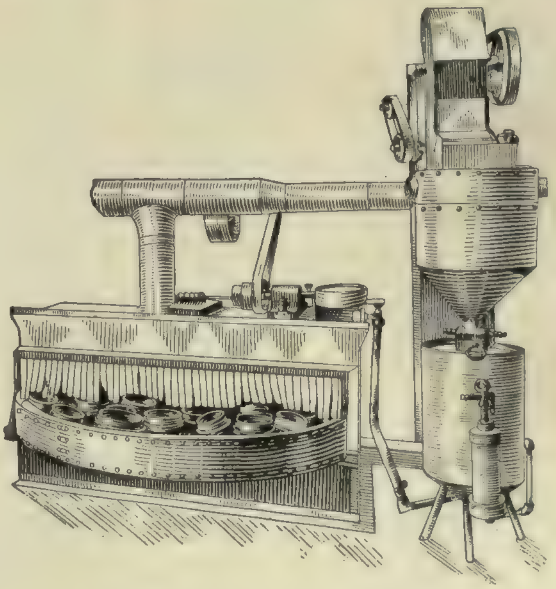


FIG. 4. REVOLVING-TABLE TYPE

manner; but it is preferable that means for this purpose be employed which will prevent the breakage of the machine or a casting should it accidently become caught between the wheel and casing; for this purpose the drive is controlled by a friction drive wheel and cone pulleys.

Entrance to the blasting chamber of the casing is

closed by means of three sets of rubber curtains, each set being composed of a series of strips secured to the casing. Within the latter the required number of nozzles are arranged so that all work entering the chamber is subjected to the action of the blast, and the speed with which the table is rotated is regulated by the adjustment of the cone pulleys. The rubber curtains tightly inclose the work entered in the chamber to prevent the rebound of the abrasive material outside the chamber.

The capacity of the rotary-table sand-blasting machines does not depend entirely upon the size and weight of the pieces to be cleaned, but also on the manner in which the surface of the table is used. In order to obtain the highest efficiency, the table should be covered very closely, and open spaces should be filled out with small castings where possible. Packing the table to its full capacity will not only increase efficiency, but will also save the surface of the table from unnecessary wear and tear.

Evenness of the spreading of the sand is most essential, as an even cleaning of the castings spread on the table can only be obtained when the blast strikes each square inch equally in the same length of time. If this is not the case, the capacity of the machine will be materially lessened, as one part of the castings may be wholly cleaned while others are only partly finished, and the evenness of spreading is particularly desirable and almost indispensable with large pieces which cover the full width of the table; otherwise, places which have already been cleaned would still be subjected to blasting action until the remainder had been considered finished. This means not only a loss of time, but also a loss of air and sand.

In the rotating-table type of machine, the abrasive material discharged in blasting, together with the dirt and refuse removed, is collected in a hopper in the casing and is conveyed by a screw to the elevator, which raises and discharges all material onto a vibrating and rocking screen. This screen makes three separations, depositing in a waste bin all material too large to pass the nozzles, and dropping the effective abrasive material into the sand hopper of the container. An exhaust system is provided for removing the disintegrated sand and dust. By the employment of the rotating table constructed substantially as described, pratically no dust or sand is permitted exit from the apparatus, therefore the room in which it is located is not at all objectionable from a sanitary standpoint by reason of its presence.

Sand-Blast Tumbling Barrels

For cleaning small quantities of small castings, forgings, or tools, instead of handling them on a bench, table or sieve, the sand-blast tumbling barrel has been found very efficient.

There are several types of the barrel manufactured: some rotating on a horizontal axis, some on a vertical axis, or else at an angle of approximately 45 deg. In these barrels the direct-pressure type of blast is employed, and the air and sand is delivered inside the barrel or drum as the latter is slowly rotated. By simple adjusting means the nozzles are maintained at a distance of from 6 to 8 in. from the work, and the blasting stream is moved constantly across the face of the same, while the pieces are continuously rolled over by the rotation of the drums. A door is provided for the introduction of the castings, which may be quickly manipulated either to introduce the charge or to withdraw it when finished. The purpose of rotating the barrel is simply that of turning the pieces; the cleaning is done entirely by the sand-blast and not by the operation of tumbling.

As in the case of the table machine, these barrels may be provided with means for separating the dust, sand and core wires. They operate very slowly and have a capacity up to about 3000 lb. unless specially made.

Where the pieces are too intricate to be cleaned in the table machine or the barrel, and where the output is not large enough to warrant the installation of a sand-blast room, a cabinet may be employed. The pieces to be operated upon are put in the latter through a door arranged in the side walls, or through an opening arranged in the curtain, which is provided on the front of the cabinet. The sand-blasting is done through a slot in the curtain, and the inspection of the work in process is made possible by means of a window in the curtain. If it is so desired the pieces can be held by hand, or turned over through a slot in the rubber curtain.

In plants of large size where there is a very considerable amount of sand-blasting to be done, specially constructed sand-blast rooms are provided, and these rooms are fitted with every possible mechanical contrivance for automatically performing the work. Dust-collecting systems are provided, ingenious separating means are utilized, and everything possible done to make the sand-blast operator's work as light as possible.

General Suggestions

An air compressor of any type and preferably of standard make can be used, provided it is of ample proportions to deliver the required quantity of free air without being operated at an excessive speed.

The air receiver should be strong enough to withstand a pressure considerably in excess of the pressure at which the blast is to be operated, and should be of ample proportions. For the usual run of work a receiver 6 by 3 ft. will be found amply large. The piping from the receiver to the sand-blast should in no case be smaller than the air connection to the latter, and is preferably somewhat larger in order that loss by reason of friction may be compensated. If the air-pipe lines are long they should be protected from condensation. If moisture or water shows in the air at its entrance to the sand-blast, action should be taken for removing it by means of traps or a suitable way of drying; otherwise the sand in the tank will cake and not flow. Even dry sand should not be allowed to remain in the tank overnight, as it readily absorbs moisture and may refuse to flow when it is desirable to place the apparatus in operation. The sand should be sharp and clean and sifted through a screen of proper mesh, and dried long enough in advance to have it cold when used. If too warm it will create steam within the tank, and if too hot, will crack and disintegrate. Almost any local sand may be used, unless it contains an undue amount of clay; and if it does a large amount of dust will be the result, causing dis-

comfort, while doing no part of the actual cleaning. The sand can be dried in a convenient manner on a steam table or a pan.

If the work is done in a room, and by a blast which is not provided with means for taking care of the dust, an ordinary exhaust fan may be used, and this should be placed at approximately the floor level in preference to a location higher up.

Care should be taken not to locate the sand-blast near the air compressor, especially if the latter is also used to operate pneumatic tools, for the dust will not only cut the air cylinder of the compressor, but will also prove extremely destructive to the cylinders, valves, and other parts of these devices, and necessitate their frequent renewal.

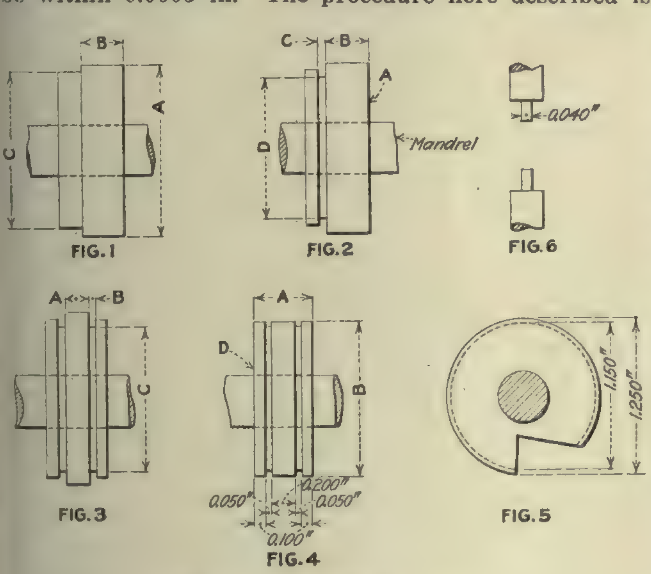
Playing with the blast should be most emphatically discouraged. The sand will travel further than might be expected and serious injury to bystanders might result.

To those engaged in metal manufacture of all kinds, an investigation of the merits of the sand-blast should at least be made, for as a generally stated proposition it can be used to great advantage in cleaning all metal parts and pieces.

Forming-Tool Information

By H. Chinn

On page 648, Vol. 47, information is asked about the cheapest and quickest method of making a circular form cutter, as in Fig. 5 of this sketch, the errors to be within 0.0005 in. The procedure here described is



MAKING A FORMING TOOL

both quick and economical, and most of the measurements can be obtained with a micrometer.

After boring the cutter blank to size, it is pressed on the mandrel and rough turned between centers, as shown in Fig. 1, leaving about 0.020 in. over size all over, except on diameter *A*, which should exceed diameter *C* by just enough to enable a micrometer to be used to measure the width *B*. The face *A*, Fig. 2, can then be finished. Using a parting tool 0.045 in. thick, the other side of the width *B* should be turned leaving a few thousandths for finishing, at the same time working in to within about 0.005 in. of diameter *D* and measuring with a micrometer which has its points ground, as at Fig. 6. Then replace the parting tool by another one 0.050 in. thick, repeat the movement and finish the width *B* and diameter *D*, Fig. 2. The width *A*, Fig. 3, can then be turned to within a few thousandths of size. Followed by the parting tools 0.045 and 0.050 in. thick respectively, measuring with micrometer as before, finishing the width *A* and the diameter *C*, we have now but to turn the top to finish the diameter *B*, Fig. 4, and face *D*, which will give the over-all width *A*. The cutter is then finished, and if ordinary care is exercised it should be within 0.0005 in. of size.

To insure the cutter keeping its size during hardening, the heat treatment recommended for that particular steel should be carried out after the blank has been turned to shape.

Setting a Taper Attachment by Means of a Dial Indicator

By L. S. Watson

An article on page 167 of the *American Machinist* entitled "Measuring Morse Tapers" encourages me to submit a few remarks on my own method of setting the lathe for turning tapers of various kinds. If possible I secure a piece having the same taper as the one to be cut—an end-mill, taper shank reamer, or similar tool. With this on the centers of the lathe and the dial indicator in the toolpost I adjust the taper attachment until the indicator will pass along the sample piece without movement of the pointer.

If no sample is obtainable I put a parallel piece on the centers, mark off a convenient distance, say 6 in., and adjust the taper attachment until the difference in the readings of the indicator at the two marked points equals the sine of half the included angle of the taper, calculated to a radius represented by the distance between the marked points. This method is equally serviceable in setting either the taper attachment or the compound test for boring a taper hole on the lathe.

Getting the Milk from the Cocoanut

By A. T. Page

I have received my first few copies of the *American Machinist* and am very well satisfied with them and their contents. I have a car journey every day to and from my work and, as you know, something interesting to read seemingly shortens the journey.

To carry the *American Machinist* along with its 80 per cent. advertising matter, while of a very interesting nature, is quite an unnecessary load. Therefore, I have devised a method to reduce this load and still retain the articles, which many of my fellow readers would probably like to know about. Remove the cover and separate front and rear portions by cutting out the back. Open up clips at back end, separate all advertising matter from news sections, taking care to preserve clips. Shorten clips and fasten front and back covers in position. This makes a very handy-sized volume for one's pocket and also for the bookshelf, with all articles of immediate interest in convenient form.

Sidelights

EDITED BY E. C. PORTER

The population of continental United States on Jan. 1, 1918, was estimated by the Treasury Department at 105,006,000.

* * *

In Iquitos, Peru, there is a demand now for all kinds of American foodstuffs, dredging machinery, cotton gins, and cotton-baling machinery. In addition there is a large demand for American-manufactured textiles. Iquitos is the distributing point for goods for the whole of eastern Peru.

* * *

A single Thrift stamp will buy a tent pole or five tent pins, a waist belt or hat cord, shoe laces or identification tags; two will buy one trench tool or a pair of woolen gloves. Four Thrift stamps will buy two pairs of canvas leggins; six will buy five pairs of woolen socks or three suits of summer underwear; twelve will buy a steel helmet. One War-Savings stamp will buy 100 cartridges or a cartridge belt or a scabbard for a bayonet; two will purchase two pairs of woolen breeches or two flannel shirts; two and a half will buy a gas mask. Three War-Savings stamps will buy an overcoat or two woolen service coats; three and a half will buy three pairs of blankets; four will buy a rifle.

* * *

The Post Office Department has issued an order signed by A. S. Burleson, Postmaster General, which became effective Mar. 15, 1918. The order, No. 1140, is an amendment to par. 1, sec. 454 of the Postal Laws and Regulations and reads as follows: Sec. 454. Fourth-class mail matter shall embrace all other matter, including farm and factory products (and books), not now embraced by law in either the first or second class, or (with the exception of books) in the third class, not exceeding 70 lb. in weight (when mailed for delivery within the first, second or third zones, nor exceeding 50 lb. in weight when mailed for delivery within any of the other zones), nor greater in size than 84 in. in length and girth combined, nor in form or kind likely to injure the person of any postal employee or damage the mail equipment or other mail matter, and not of a character perishable within a period reasonably required for transportation and delivery.

* * *

Delegates from all the allied countries have arrived in England for conference on international standards, at which a standardization of manufacturing materials as related to the production of machinery, motors, aircraft, etc., will be considered. The American delegation, headed by F. G. Diffen for the Aircraft Board, includes members from all the prominent engineering societies of the country. The purpose of this inter-allied meeting, which is the result of the efforts of Mr. Diffen, is to enable better industrial service to be given, with less man-hour effort, through relieving plants from carrying in stock unstandard materials for which there is small call and concentrating on materials of known performance for the same work. No attempt will be made by the conference to standardize airplane constructions, but rather those materials and units only which are at present causing confusion in purchase and delivery and for which a standard can be established.

* * *

The following excerpt is taken from an editorial in the current issue of the *Railway Age* entitled "Facts Versus Fiction About Railway Salaries."

The public would be warranted in drawing the conclusion from what is being said in some quarters that a railway general officer who is not receiving at least $10,000 a year is poor indeed, and that no president is receiving less than $75,000 or $100,000 a year. But facts often are stranger than fiction, and some facts which stand out in striking contrast to all this fiction are that the average salary paid to all railway general officers in the year ended June 30, 1916, was less than $6000, and that the average paid to all general and division officers was less than $3000. The detailed facts, as shown by statistics recently compiled by the Interstate Commerce Commission, are as follows: In 1916 there were 4247 general officers who received $3000 or more. The total amount they were paid was $27,442,958, an average of $6461.73. The number of division officers who received $3000 or more was 1115, and their total compensation was $4,140,693, an average of $3713.63. The number of both general and division officers who received $3000 or more was 5862, and their total compensation was $31,583,651, an average of $5890. The number of general and division officers who received less than $3000 was 14,401, and their total compensation was $23,970,143, an average of $1664.46. The total number of both general and division officers was 19,763, and their total compensation was $55,553,794, an average of $2811. In view of the talk about alleged excessive salaries the most significant of the statistics given above are those regarding salaries of general officers receiving $3000 or more. This classification includes all officers receiving so-called "fancy" salaries, and probably includes every man receiving as much as $10,000. The total earnings of the railways of the United States in 1916 were $3,473,000,000, and their total operating expenses were $2,277,000,000. The compensation paid to all the 4247 general officers who received $3000 or more was $27,442,958. This was less than $\frac{8}{10}$ of 1 per cent. of the total earnings of the roads and was 1¼ per cent. of the total operating expenses. In other words the total compensation paid to all general officers receiving over $3000 a year took less than 8c. out of each $10 bill the railways earned and took 12½c. out of each $10 charged to their operating expenses. There have been cases where railway officers were scandalously overpaid. It is true, as has been alleged, that there are some parasites on the payrolls—men who are receiving large salaries for doing little or nothing. But such cases are extremely exceptional. As a rule the salaries paid to railway officers are smaller than the salaries and incomes of men occupying comparable positions in other lines of business and professional activity. Generally when large salaries are paid they go to men who have worked their way up from the ranks to positions of the greatest eminence in the business. They are usually for those who receive them, the rewards of many years of arduous and efficient service; and they are, for the younger and more ambitious officers, prizes to work for and incentives to put forth their utmost efforts. Remove the large salaries from the railway business and you will rapidly reduce the number of able and ambitious men who will enter it and as rapidly increase the number of able and ambitious men who will leave it.

The Need of Balancing Production

By H. L. Gantt

AFTER nine months of confusion it is becoming clear that as far as we in this country are concerned the war problem is one of production and transportation on a huge scale. The critical point today is recognized by all sides to be our ability to transport material to Europe. We have in the past repeatedly had estimates as to what transportation facilities we should have, but it is only recently that any real attempt has been made to study the transportation problem thoroughly and to find out what the limiting factors were and how they could be improved. It is hoped that through the investigation now being made we shall shortly have exact knowledge on this subject. In the meantime, however, we already have some knowledge, which indicates that our production of war material is rapidly outrunning the possibilities of transportation.

Early in December Dean Schneider, working for the Ordnance Department of the army in Washington, warned General Wheeler, Acting Chief of Ordnance, of the situation which is now impending, and the Ordnance Department promptly began to investigate the subject. Investigations of this subject by one department, however, are not sufficient. The whole production program must be harmonized with the possibilities of overseas transportation. In other words, an attempt should be made at once to balance our production of war material with the practicabilities of transportation, and wherever necessary the production program should be slowed down at once in order that the congestion on the Atlantic seaboard may be relieved. This slowing down means that energies which have been unwisely directed to war activities must at once be transferred back to the industrial work relating to peace and the upkeep of our industrial organization.

This is necessary for two reasons: First, if we are going to spend fifteen billions a year in war we must produce at least fifteen billions more material than we need in peace times, which means that our working plants must be kept in the best condition; second, if we do not realize that by the production of a surplus of war material we shall ultimately be compelled to cease that kind of manufacture and thereby suddenly throw out of work large numbers of men we may precipitate an economic crisis of great magnitude.

Meeting the Industrial Crisis

There are indications that we are approaching an industrial and economic crisis. One sign of this is the amount of criticism that is being made of those in charge of Government activities, nearly all of which relate to the conduct of the war. Attempts to blame individuals for alleged inefficiencies are being made increasingly, and it is only natural that in this confusion army officers and Government officials should be the first to come under censure, for it is the general belief that Government officials are less efficient than business men.

The number of applications from private manufacturers for the help of efficiency engineers, which has increased so much lately, indicate that many of our manufacturers realize their methods are also not what they should be. The people who are applying for help are in many cases no worse off, so far as methods are concerned, than others who have not yet discovered how badly they are doing their work. The whole subject seems to resolve itself into the fact that our business and industrial systems are not suited for times like the present when it is necessary to combine all our energies and exert our full driving power toward the achievement of the one supreme object.

We should not be surprised that this is the case, for our economic theory has never contemplated teaming up all the industries of this country for one object, but rather has discouraged that idea and encouraged individual competition of the most strenuous kind. In other words, we are a nation of individualists who have never really seriously contemplated coöperation for the common good.

The New Problem of Coöperation

When this problem of coöperation is suddenly put up to us as it has been by the war it is not surprising that our business men, trained in the individualistic school, should be entirely unfitted to solve it. Moreover it might be expected that the men who have been most successful in individualistic competitive business, in which profit was the main aim, should be actually the ones least fitted to establish a scheme of business and production for the benefit of the community. It is a new problem to them and one altogether outside of their experience.

It is granted that such business men individually possess great driving power, but this very quality in individuals or corporations at times is likely to make confusion worse unless a means of coördination is established which will keep this driving power in proper balance.

It has become evident that the capacity of the nation to produce war material is enormously greater than its capacity to ship it to Europe, and that in order to prevent the choking of our Eastern ports we must at once not only balance this production but slow it down. The five-day shutdown and the one-day-a-week shutdown ordered by the Fuel Administrator were our first attempts at slowing up production. Now we ask ourselves if this was really the best way, and the answer comes that if we are making too much war material we had better turn some of our activities to the manufacture of articles of peace. This in turn brings us to the financial situation, which at present seems to seriously hamper new undertakings.

Rebuild the Railroads

It would seem that the claim of the railroads that they need to expend $1,000,000,000 in improvements should at this time be considered. Here is one organization now devoted exclusively to the service of the nation, which, being under the control of the federal Government, can be financed directly by that Government, and there would seem to be no reason why the production programs of war material should not be limited and a certain amount of the energy now being expended

in that direction turned at once toward the improvement of our transportation facilities.

This is the first suggestion that occurs to one as a means of avoiding the economic situation which seems to be forcing itself upon us. If we can afford to spend billions for war, should not our Government be authorized to deflect whatever surplus energy has been inadvisedly called into this work into channels that will be beneficial to the country in time of peace?

The Housing Problem in Washington

By E. M. Jenkins

The country at large is interested in events transpiring at Washington, and this is especially true of the people who are desirous of locating there in the Government service. Thousands are eligible for appointment under the Civil Service, but many to whom such appointments are offered hesitate to accept them owing to the wide publicity which has been given to the lack of accommodations to be had in the Capital City. It has been stated by those having access to such statistics that the proportion of those accepting Civil Service appointments is only 50 per cent. of those to whom such positions are offered, and also that an appreciable number of appointees, after a few day's experience in getting located, have relinquished their positions and returned to their homes.

At the beginning of the war, Washington was not prepared to house the thousands of men and women who went there to carry on the clerical war work. The inaugural crowds were naturally transient, and accommodations for them were only temporary; but the war clerks must have homes. The building activities of Washington have always been normal, keeping pace strictly with the actual increase in population. A large floating population, such as pass through the ports of New York or San Francisco, has never been a factor in Washington. From its initial start as the seat of the Government to its present position near the top of the map, its growth was steady, the suburbs being filled as developed.

The Work Done

These conditions threatened to seriously cripple the clerical supply made immediately necessary for war preparations. It became imperative that decisive steps be taken to provide for the influx taking place. Suggestions were offered through press, pulpit and private citizens. Committees were formed and conferences held and many tentative plans submitted. Among these, the District Council of Defense stands prominent, working through the daily press, explaining the absolute need of room and asking that householders as a patriotic service offer all the room in their homes that could possibly be spared for the shelter and comfort of the new population pouring into the city. Also, on certain Sundays, all pulpits were requested to urge this action upon their respective congregations.

Vast numbers responded from every section of the city, and the wealthy and the poor alike are housing Government clerks. It is estimated that 50,000 are now provided for in Washington. This number comprises a small city in itself; but now comes the announcement that 30,000 additional war clerks are necessary and will be in Washington within the next three months. Further steps are necessary to house them.

Volunteer war workers inspect all rooms listed by the Council of Defense, making sure that the surroundings are desirable and the rentals in proportion to the accommodations offered; then an effort is made to bring the suitable clerk and quarters together.

The Young Men's Christian Association and the Young Women's Christian Association have rendered invaluable service in the housing problem, enlarging their facilities for transient and permanent accommodations and rendering efficient service to the newcomers.

When the appointment is sent to the Civil Service eligible, information accompanies it directing the appointee as to the securing of accommodations upon arrival. Attention is called to the booth established at the Union Railway station. The new arrivals are directed to the Y. M. C. A., the Y. W. C. A. and the District Council of Defense, the intention being to wisely direct the clerks to quarters that they will be spared days of searching in a strange city. The clerks often go back to the associations to express their thanks or to ask further advice. The kindly men and women in charge are their first friends in Washington.

Arrangements for a Census

The Council of Defense is at this time completing its arrangements to take a house-to-house census in the effort to ascertain what available accommodations may still be secured, thus assisting the Government in arriving at a definite conclusion as to the extent of Government housing needed. Every effort has already been made not only to provide for but to safeguard the young men and women whose clerical aid the Government is securing. Many of these clerks are coming from distant parts of the United States, where customs and surroundings differ in a marked degree. It is the desire of the Government that they may be assisted in every way in order that their services may be efficient and remain so.

These measures and endeavors have been faithfully carried out, but the supply of vacant rooms, apartments and small houses is exhausted. The Government has now taken charge. To meet adequately the serious need for housing the war workers in different parts of the country, Congress has appropriated $50,000,000. This appropriation bears no relation whatever to philanthropy. It is as essentially a war measure as the providing of munitions.

This fifty million dollars is to be used in various ways. The erection of houses, the purchasing and repairing of the few suitable buildings now available, and the taking over by the Government of small apartment houses within a radius of a mile of the departments are projects now under consideration.

If the dormitory system is followed young men and young women clerks may be located separately, the young men more or less under quasi-military control, while the young women may be suitably quartered as in a high-class educational institution. The bills now in Congress also provide for the erection of what may be termed cottages. These will vary in size and kind in order to suit the number in family and the various grades of salary.

In addition the bill provides for lending money to

persons desirous of opening boarding houses, but who lack the funds, provided they give acceptable guarantees as to responsibility and ability. This measure would doubtless result in the opening of many homelike boarding places managed as a business and not as a result of loss of fortune.

The clerks will be doubly benefited by this modern appropriation, for not only will the housing facilities be especially adapted to their needs, but the rates in all cases will be fixed, the dormitory accommodations and room rentals at a minimum charge, while the parties conducting boarding places financed by the Government will be subject to Government supervision.

In addition to the clerical increase, great numbers of men engaged in the trades are to be called to speed up war work at the navy yard located at Washington. Of these men the machinists come first. The country at large is to be searched for the needed supply and every effort made to secure capable workers. The navy yard here needs, and is to have, 5000 high-class machinists. They are to be housed in comfortable quarters.

The Volume of Work

The necessity for this number is at once apparent when the huge volume of work is considered. The navy yard is expected to turn out work in days instead of months—and perfect work, as machinists' work has to be! The conditions of work will be as ideal as the finest brains in the United States and all the money needed can make them. An impetus will be given this trade that will last long after we have won the war. Quantities of the most modern and up-to-date machinery and tools will be needed to supplement and complete the equipment at the yard.

The appropriation for housing the 5000 machinists is of paramount importance, and must be answered among our first war calls.

A Self-Tightening Chuck

By A. Smith

The self-tightening chuck described here was designed and developed in a plant making 3-in. Russian shrapnel.

Experience showed that an initial pressure was not sufficient to hold the forgings while a large amount of stock was being removed, so it was essential to provide some means for holding the shells securely while a heavy cut was being taken.

The ordinary jaw and collet chucks failed, which compelled the operator to stop his machine and tighten the chuck at almost every cut. Large spanners were used for this purpose, making it easy for the operator to tighten his chuck very hard, the result being that the chucks soon became ineffective and in a short time their replacement became necessary.

The self-tightening chuck here shown and described is small, compact, positive in action and can be made to fit any size of lathe spindle. Furthermore, it can be used on any work which may come within the limit of the jaws.

The illustration shows the construction: The chuck *A* has the threaded cast-iron collar *B* secured to it and by which it can be attached to the lathe spindle.

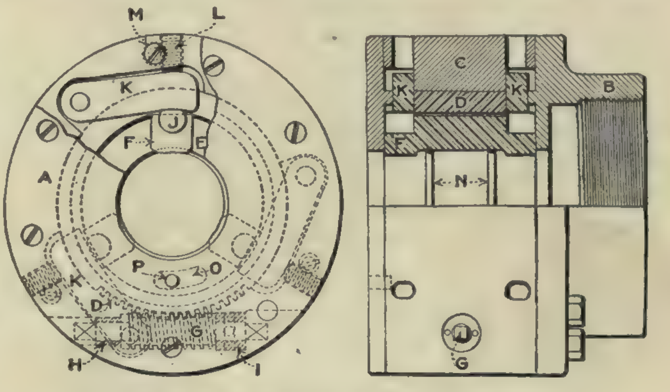
In the body *C* of the chuck is located a ring *D*, formed with openings *E*, to receive the chuck jaws *F*, said ring being partially toothed as shown. In the body *C* is located a worm-shaft *G*, which meshes with the toothed portion of the periphery of the ring for the purpose of turning the latter. The worm-shaft is mounted to turn in bearings *H* and *I*, the bearing *I* being threaded into place to hold the worm-shaft against longitudinal movement. The ends of this worm-shaft are square, to accommodate a socket wrench used in turning.

In the outer end of each jaw are provided two rocker-pins *J*, which are flattened on their outer faces and which project beyond the jaws as shown. These rocker-pins are designed to turn slightly so as to present the full flattened surface to the action of the dogs *K*, as the jaws are tightened on the work. The dogs are pivoted at one end in the body, and as stated bear on the rocker-pins. The outer faces of these dogs are on an incline. Adjusting screws *L*, located in the body, bear against the inclined faces of the dogs and thereby hold the jaws in position. Fillister-headed screws *M* are employed to hold the adjusting screws in place.

Split spring rings *N* are located in the jaws to hold the latter in place, and are compressed thereby when moved inwardly against the work. When pressure is released from the jaws the latter are moved outwardly to an open position.

A curved slot *O* is provided in the ring *D* to receive a stop pin *P*, which limits the turning of said ring.

The operation of the chuck is as follows: The work is inserted between the jaws and the worm-shaft turned,



SELF-TIGHTENING LATHE CHUCK

thus causing the ring *D*, carrying the jaws *F*, to be partially rotated. This partial rotation of the ring causes the inclined faces of the dogs *K* to bear tightly against the adjusting screws *L* and force the jaws inwardly through the medium of the rocker-pins *J*, thus securing the initial tightening of the jaws on the work.

With the material tightly held in place, and the machine set in motion, the cutting tool is brought against the work, and as it is cutting against the direction in which the chuck is turning, it will be apparent that the deeper the cut taken, the greater the force exerted to clamp the jaws on the work.

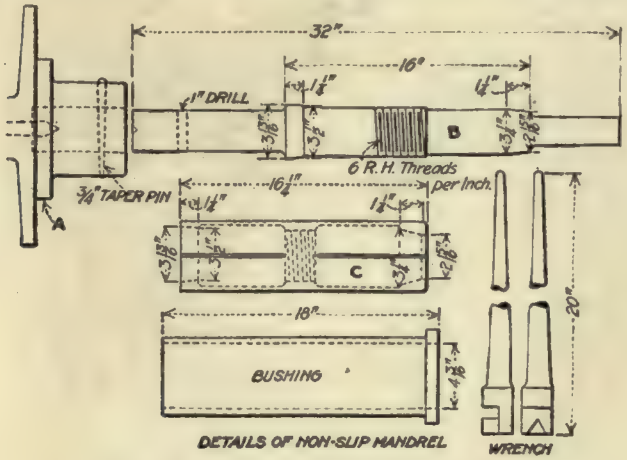
To withdraw the work, the machine is stopped and the worm-shaft turned in a reverse direction, thus causing the dogs to loosen on the rocker-pins. The split rings which were compressed in tightening, now expand and return the jaws to their initial position, thereby permitting the withdrawal of the work.

Nonslip Expanding Mandrel

By Edwin Chapman

The illustrations published with this article show a positive-drive expanding mandrel which was designed and constructed by the writer for the purpose of finishing some special bronze bushings, 18 in. long, $4\frac{3}{16}$-in. bore, $4\frac{15}{16}$ in. in diameter, with a 6-in. diameter by $\frac{3}{4}$-in. head or flange on one end, and having three equally spaced oil grooves, $\frac{1}{8} \times \frac{1}{16}$ in. deep broached clear through.

A holder of cast iron is bolted to the faceplate of the lathe and bored through to fit loosely over the mandrel. The taper pin passes loosely through the mandrel, serving as a driver and also holding the mandrel in place while changing the work. The mandrel



DETAILS OF A NONSLIP MANDREL

B has two tapers as shown, and is threaded at a point midway between them. A corresponding sleeve *C* finished to a nice fit in the bushings, has three slots cut in each end to a point about 1 in. from the center, and has one $\frac{1}{8} \times \frac{3}{32}$-in. deep groove cut the whole length on the outside.

In operation, a piece of $\frac{1}{8}$-in. drill rod is laid in this groove and the sleeve slipped into a bushing, one of the oil grooves covering the wire. The sleeve and bushing are then slipped over the mandrel, the thread run up by hand, the tail spindle brought up to place and a cut started. As soon as the tool takes hold, the bushing turning the sleeve through the medium of the wire in the oil groove, makes up the threads and expands the sleeve until the friction is sufficient to drive the work.

To release the work, the wrench, Fig. 3, is slipped on the head of the bushing with the V-shaped part in one of the oil grooves; the bushing is then turned back about one-half turn, when it can be taken off and the sleeve run off by hand ready for the next piece.

For this work, this mandrel has several advantages over the standard, four-blade expansion type: as the centers remain true, the work cannot slip, and only the bushing need be lifted into and out of the lathe.

Lapping Scored Cylinders

By F. B. Skridshol

The illustration shows how we lap scored cylinders of automobile engines. The cylinder block, which is for a four-cylinder engine, is set up on the table of a vertical, power-driven, drilling machine. The connecting rod is clamped up to the chuck of the drilling machine, as shown in Fig. 2, by means of a plate across the face of the split crankshaft bearing. By raising and

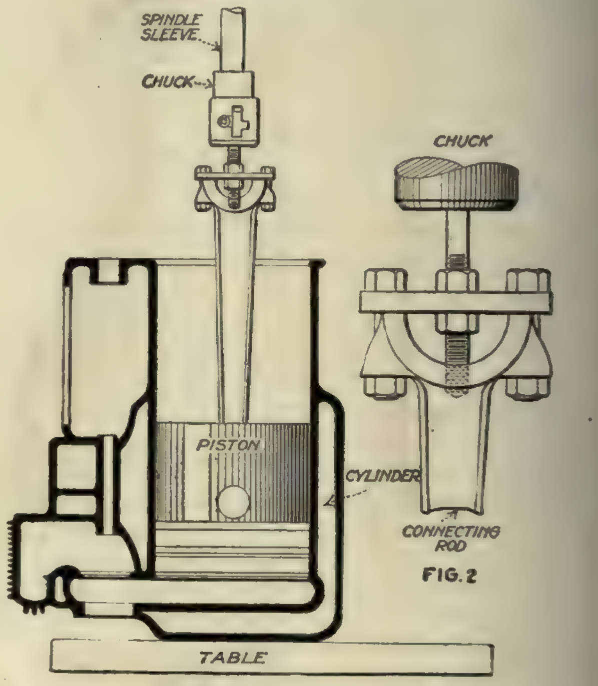


FIG. 1

FIGS. 1 AND 2. DETAILS OF THE METHODS USED FOR LAPPING THE CYLINDERS

lowering the spindle, while the piston is rotated in the drilling machine, lapping in of the scored piston and cylinder is accomplished. The cylinder wall and the piston are smeared over with lapping compound or powder before the piston is put into the cylinder.

A Computing Caliper

By J. A. Lucas

The question often arises in the jobbing shop or toolroom as to what size round stock will make a given square or hexagon, or conversely what size square or hexagon can be made from a round of certain diameter. If the workman be properly acquainted with shop trigonometry a lead pencil will tell him. If he has a handbook in his tool box, it will solve his problem, but if neither of these courses be open to him he can make the tool herewith described which, with an ordinary scale, will answer his question with a considerable degree of accuracy and much quicker (the second time) than either of the other methods.

In Fig. 1 the distance from C to C' is the distance across the flat of a square, and from B to B' the same property of a hexagon that can be inscribed within a circle whose diameter is represented by the distance from A to A'. To make this tool, first determine what length of leg will be best suited to the regular line

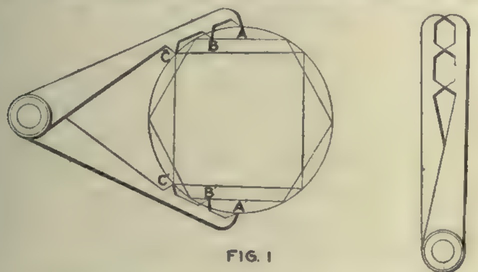
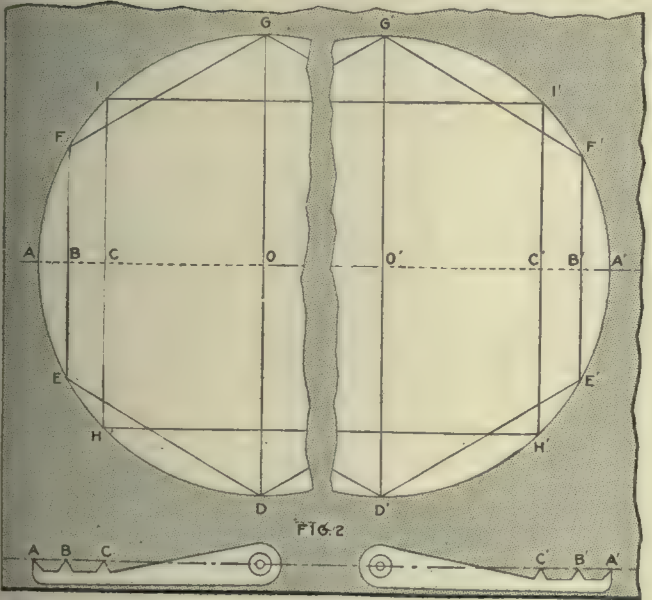


FIG. 1



FIGS. 1 AND 2. A COMPUTING CALIPER AND THE LAYOUT FOR MAKING IT

of work, and with a pair of sharp-pointed dividers set to this length as a radius, describe two sections of a circle upon a suitable piece of sheet metal as at Fig. 2. Draw a line passing through the centers of these circles and cutting the circumference at the points A A'.

Draw vertical lines through centers O and O'. With dividers still set to this radius step off in each half circle the points D, E, F, G and D', E', F', G', drawing in the connecting lines to make two half hexagons.

By trial with dividers locate points H and I, and H' and I', and draw in the lines of the square. Near one edge of the sheet of metal, which edge should be ground or otherwise finished straight to allow the use of a try-square in laying out, draw a line parallel to the edge and far enough away from it to allow for the layout of the legs of the calipers.

With the try-square project points A, B, C and O, and O', C', B' and A', to this lower line.

Lay out the legs as shown, cut out and carefully file to the indicated points, joining the legs with rivet and washer in the manner of all firm-joint calipers. It is important that all the points lie in a straight line, passing through the center of the tool, and this can be tested by closing the caliper, when if properly made, all three pairs of points will touch.

Time Studies in Screw-Machine Practice

By Roy A. Hinkel

Time-study articles and charts relative to the output that can be reasonably expected from various machine tools are of great value to manufacturers of machinery. The chart illustrated herewith is the result of time-

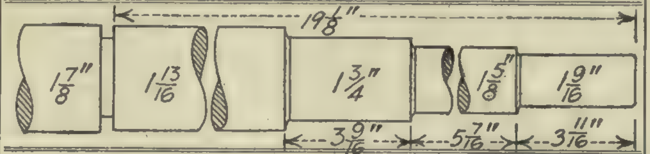
R.A.H. 5/23/17 **TIME STUDY** Form 283-5-17-1M

NAME SHAFT 82895 MAT. M.S.

SYMBOL X PIECE NO. 623 OPER. NO. 1x1

OPERATION TURN 4 DIAM. FOR GRIND FACE NECK ROUND CORNER

TYPE J & S 2½" X 26" OPERATOR Norum MACH. NO. 266



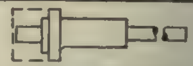
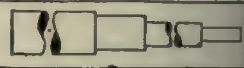
DETAIL OPERATIONS	Depth Cut	Cut Speed	R.P.M.	Feed	Minutes	
Cut off shaft-Stock out & Clamp-Index-Neck for true up-Index-True up- Head to cut					3	08
Turn--1-13/16" -X- 19-5/8	1/32	111	236	025	3	35
Index---						37
Turn--1-9/16" -X- 3-11/16	1/8"	96	234	008	2	08
Face & Index						40
Turn--1-5/8" -X- 5-7/16"	3/32	132	310	008	2	10
Face & Index--						32
Turn--1-3/4" -X- 3-9/16"	1/32	142	310	008	1	42
Face & Index						33
File - Round corner						67
Index-Neck 3 diam.--Gage-Index					2	00
1 7-8" Machine steel Bars 16' long						
Get bar---------7 min. Prepare end-----3 "						
Machine time 8.93 Handle " 7.17						
Stock Removed 2.3#						
Actual Floor to Floor Time					16	10

A TIME-STUDY SHEET

study work in the screw-machine department of the Gisholt Machine Co., and is one of many compiled from a great number of time studies having corresponding speeds and feeds. Considerable care was required in laying out these charts that they might embrace as

many different parts as possible, thereby assisting the rate setters in locating the proper time studies to follow.

If necessary, the chart may be used without the time studies, but to set a rate that is just to the operator, the hand-feed and handling time is required. The chart is self-explanatory and when used in conjunction with the time study illustrated, will aid in setting accurate rates. The work from which these charts were compiled was the product of hand-operated turret machines, which were belt driven through three-speed countershafts.

SCREW MACHINE PRACTICE												
TIME STUDY NO.	DEPTH CUT	DIAM. STOCK	FEED	REV. P.M.	IN. P.M.	LENGTH TURN	LENGTH PIECE	MACH. NO.	MATERIAL	PIECE NO.	HAND TIME	SKETCH
9	1/32	1-1/2	.026	230	6	10-7/16	10-7/16	188	M.S.	X-768	1.90	
1	1/32	1-1/2	.012	234	2.8	11	18	266	M.S.	X-610	11.98	
5	1/32	1-1/2	.032	310	9.6	7-15/16	7-15/16	266	M.S.	H-641	2.75	
10	1/32	1-1/4	.023	310	7.1	10-5/8	10-5/8	266	M.S.	I-720C	.83	
10	1/32	1-3/16	.012	310	3.7	2-9/16	10-5/8	266	M.S.	I-720C	.83	
10	1/32	1-1/4	.031	310	9.6	10-5/8	10-5/8	266	M.S.	I-720C	.83	
10	1/32	1-3/16	.031	310	9.6	2-9/16	10-5/8	266	M.S.	I-720C	.83	
4	1/32	1-7/8	.023	310	7.1	19	19	266	M.S.	X-623	6.83	
4	1/32	1-13/16	.008	310	2.8	3-9/16	3-9/16	266	M.S.	X-623	6.83	
6	1/32	2-1/4	.012	234	2.8	6 1/2	6 1/2	266	M.S.	H-03691	1.75	

A CHART ON SCREW MACHINE PRACTICE

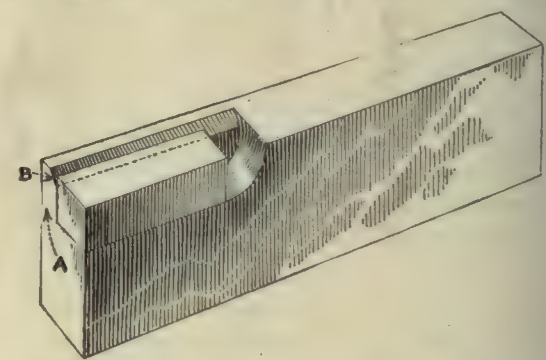
Brazing Stellite

By P. P. Hale
Sales Engineer Haynes Stellite Co., Kokomo, Ind.

I have noticed the various articles printed in the *American Machinist* regarding the brazing of stellite to steel shanks. The latest article called to my attention was that of Mr. Bogart's, on page 43. Mr. Bogart is evidently on the right track. The Haynes company, however, discovered a method of brazing stellite to steel shanks which we believe is superior to this method. By referring to the illustration, the reader will notice that a thin web *A* is left on the side opposite the cutting edge of the bit. This web is of course governed by the width of the bit and should be chamfered, as shown at the point *B*, at about a 45-deg. angle, and of a depth that is approximately ½ of the total depth of the bit. The reason for leaving this web is to insure plenty of copper in the joint prior to lifting the tool from the fire.

Place the stellite tip and the shank in the forge, allowing both to soak in the fire and become white hot. Then place a thin sheet of copper between the steel shank and the stellite tip, applying borax freely. Bring the tool to a white or such heat as will soften the stellite slightly. From time to time additional copper should be melted—either from a piece of copper tube or copper sheet—and allowed to flow in the chamfer *B*, being careful to borax the joint freely before the copper is flowed in. In this way the copper will run down and wash away any dirt, and at the same time exclude the air and do away with oxidation.

After the tool is brought to a point at which the stellite begins to soften it should be removed from the fire and squeezed slightly with a pair of tongs or any other convenient tool, such as a vise or press.



METHOD OF SETTING A STELLITE BIT

This method will require some practice and the maker of the tool should not be discouraged if his first braze is not a success, as we have found that these tools are capable of standing any strain up to a point of breaking the shank.

Getting Ready for the Third Liberty Loan

THE preparations for the third Liberty Loan are under way. The drive itself is to be short, sharp and decisive. When it is launched there will not be a moment to lose.

In order to avoid all delays in getting started we are showing in this issue just how the previous loan was handled in different shops. The limited time available makes it necessary for us to utilize every available method.

WE did not want to enter the war. We were far more prosperous before. But patience ceased to be a virtue, and we could do no less. And having entered there can be no turning back if the world is to be a worth-while place in which to live. We must be made reasonably sure that no nation can plunge the world, or even part of it, into misery and desolation for its own aggrandizement; that treaties shall be more than scraps of paper.

The cost of this insurance necessitates the Third Liberty Loan. Our boys must have the best of everything—arms, clothes, food. And we must give them all they require, going without ourselves if need be. The boys in France must be our first consideration.

THE machine industry of the country has already proved its loyalty and its patriotism in many ways. It supported the two previous loans in a praiseworthy manner. It will do the same now.

The two loans already placed were handled by the shops in various ways. The experience gained will make it easier to handle the present loan. And to make this experience available to all, we have gathered data as to the various methods employed by shops in different parts of the country. This is presented in another section of this issue, and will be followed by a detailed account of one large shop's method in a succeeding issue.

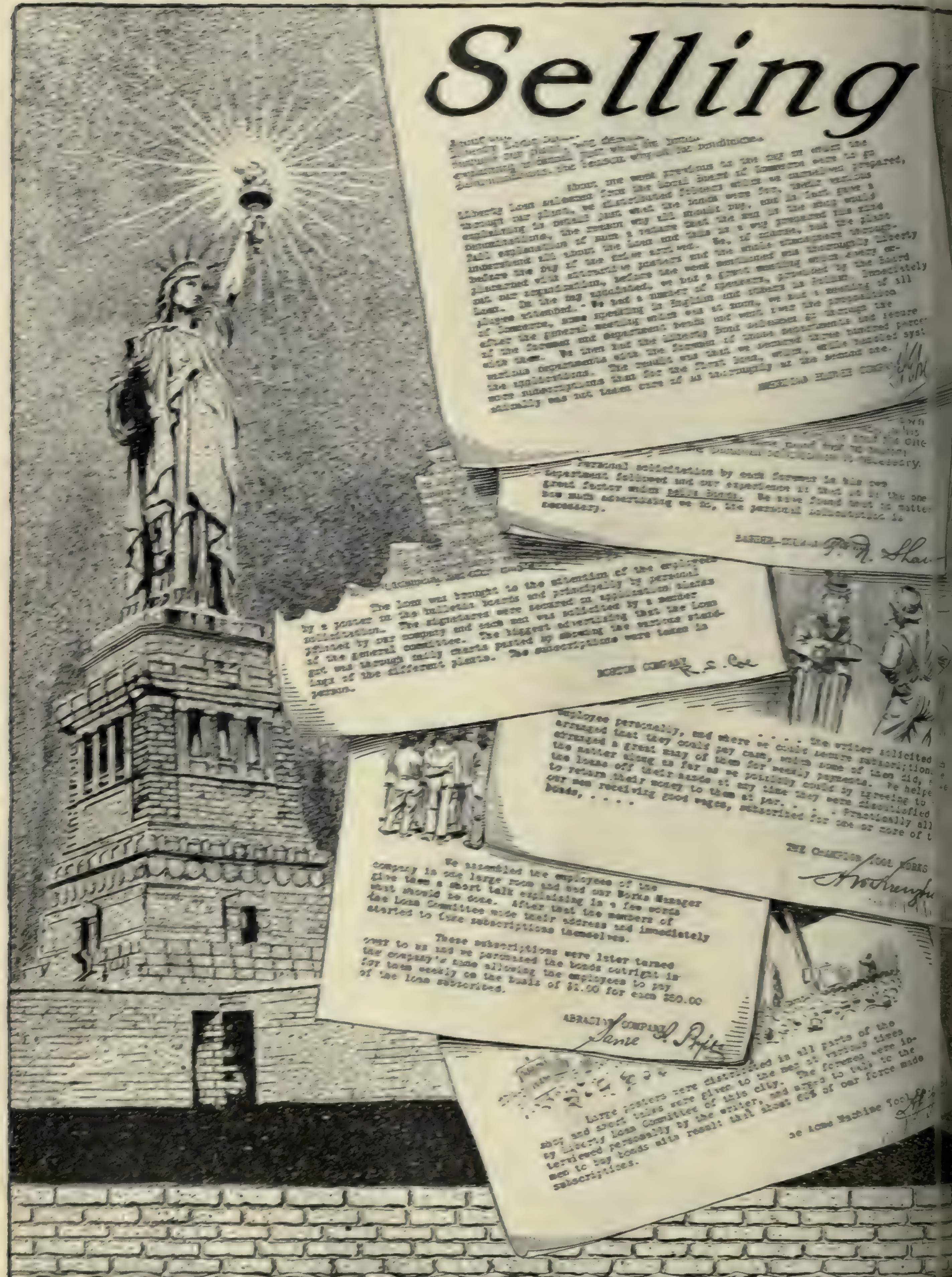
RUNNING through all the various letters which came so generously in response to our inquiry was the indication that personal contact with the men was the prime factor in securing subscriptions to the bonds. Circulars, posters and printed matter paved the way; but the actual subscriptions came as the result of personal contact with the men.

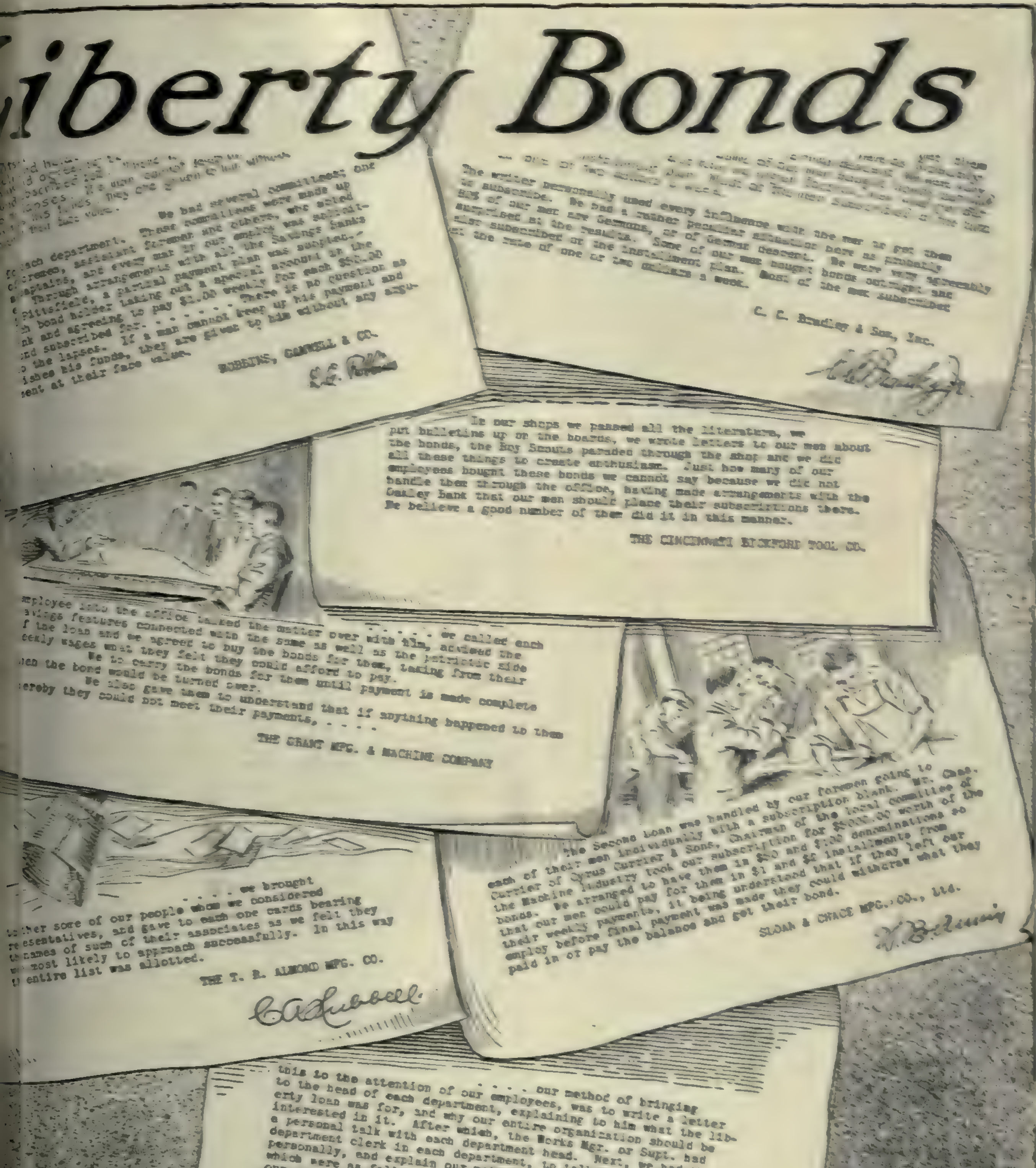
This of itself points to the value of the personal touch in all shop dealings and is a suggestion which may well be followed in many other cases.

MAY we suggest that no matter how successful you were before, you look over the methods given by others. They may give new angles, new ways of presenting the problem and may perhaps make the work easier this time.

We want to know how the Third Liberty Loan goes in your shop. If new methods are developed we want to bring them to the notice of the whole industry. Co-operation will help here as in all other phases of our civilization.

Get ready now for the Third Liberty Loan!


Selling
We assembled the employees of the company in one large room and had our Works Manager give them a short talk explaining in a few words what should be done. After that the members of the Loan Committee made their address and immediately started to take subscriptions themselves.
These subscriptions were later turned over to us and we purchased the bonds outright in the company's name allowing the employees to pay for them weekly on the basis of $1.00 for each $50.00 of the loan subscribed.


Liberty Bonds
We had several committees; one for each department. These committees were made up of foremen, assistant foremen and others, who acted as captains, and every man in our employ was solicited. Through arrangements with all the Savings Banks in Pittsfield, a partial payment plan was adopted, each bond holder taking out a special account in the bank and agreeing to pay $1.00 weekly for each $50.00 bond subscribed for. . . . . There is no question as to the lapses. If a man cannot keep up his payment and wishes his funds, they are given to him without any argument at their face value.
ROBBINS, GAMWELL & CO.
The writer personally used every influence with the men to get them to subscribe. We had a rubber peddler solicitor here as probably 80% of our men are Germans, or of German descent. We were very agreeably surprised at the results. Some of our men bought bonds outright, and also subscribed on the installment plan. Most of the men subscribed at the rate of one or two dollars a week.
C. C. Bradley & Son, Inc.
In our shops we passed all the literature, we put bulletins up on the boards, we wrote letters to our men about the bonds, the Boy Scouts paraded through the shop and we did all these things to create enthusiasm. Just how many of our employees bought these bonds we cannot say because we did not handle them through the office, having made arrangements with the Oakley Bank that our men should place their subscriptions there. We believe a good number of them did it in this manner.
THE CINCINNATI BICKFORD TOOL CO.
employee into the office talked the matter over with him, advised the savings features connected with the same as well as the patriotic side of the loan and we agreed to buy the bonds for them, taking from their weekly wages what they felt they could afford to pay.
We to carry the bonds for them until payment is made complete when the bond would be turned over.
We also gave them to understand that if anything happened to them whereby they could not meet their payments, ...
THE GRANT MFG. & MACHINE COMPANY
The Second Loan was handled by our foremen going to each of their men individually with a subscription blank. Mr. Chas. Currier of Cyrus Currier & Sons, Chairman of the local committee of the Machine Industry took our subscription for $5000.00 worth of bonds. We arranged to have them in $50 and $100 denominations so that our men could pay for them in $1 and $2 installments from their weekly payments, it being understood that if they left our employ before final payment was made they could withdraw what they paid in or pay the balance and get their bond.
SLOAN & CHACE MFG. CO., Ltd.
. . . we brought together some of our people whom we considered representatives, and gave to each one cards bearing the names of such of their associates as we felt they were most likely to approach successfully. In this way the entire list was allotted.
THE T. R. ALMOND MFG. CO.
. . . our method of bringing this to the attention of our employees, was to write a letter to the head of each department, explaining to him what the liberty loan was for, and why our entire organization should be interested in it. After which, the Works Mgr. or Supt. had a personal talk with each department head. Next, we had the department clerk in each department, to talk to each man personally, and explain our methods of handling this loan, which were as follows: Employees could pay spot cash, or through our payroll department, we were willing to deduct $1.00 weekly, or $2.00 weekly, and we were also willing to deduct the entire amount, or part, from the Xmas Savings Fund, which was paid at the end of the year, and which would in most cases, pay for the entire amount, or at least 75% of it.
One of these liberal arrangements were sure to be satisfactory to any man, unless for some special reason, such as sickness, or other unusual causes.
THE CINCINNATI PLANER COMPANY.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

McKee Proportional Mixer

The illustrations show the McKee proportional mixer and its application to a hardening furnace. It may be used for practically any installation where gas is used as a fuel. The device delivers the gas and air mixed in any predetermined proportions and is claimed to effect savings in fuel, power and piping. It is also claimed to give any type of flame desired—reducing,

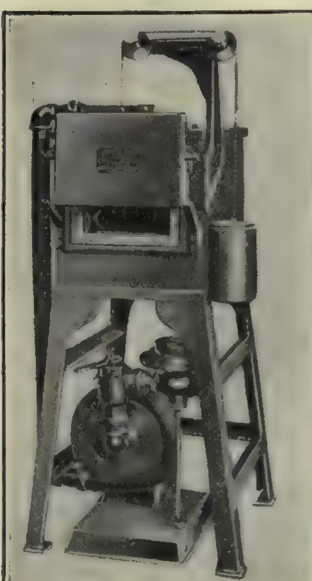


FIG. 1. MIXER APPLIED TO A FURNACE.

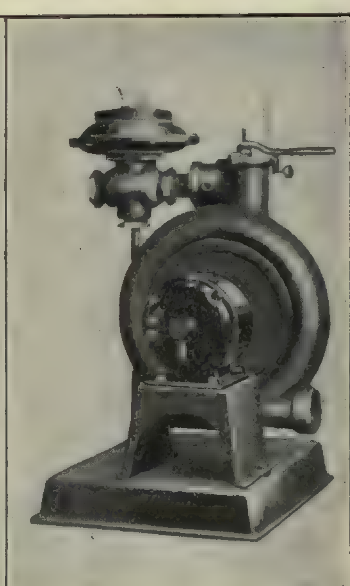
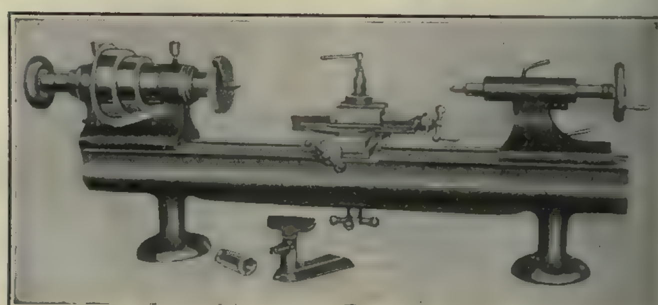


FIG. 2. McKEE PROPORTIONAL MIXER

oxidizing or neutral—and to make the quality of the flame self-adjusting when turned down. The gas passes through a special regulator at the left, Fig. 2, its uressure there being reduced to practically zero. The suction intake of the fan then picks up the air and gas in proportion to the size of the air and gas openings in the mixing valve. The outlet pressure in standard machines is 2 oz. The quality of the mixture is changed by an adjusting screw at the top of the valve, and when properly made it need not be altered unless the quality of the gas varies. An indicating pointer shows the position of the ports, and a thumb nut is provided to lock the valve in any desired position. A screw is provided as a stop for the valve handle so that the valve cannot be entirely closed, this feature preventing backfire. Fig. 1 shows the device applied to a hardening furnace. The device is made in three sizes with outlets of $1\frac{1}{2}$, 2 and 3 in.; motors of $\frac{1}{8}$, $\frac{1}{8}$ and $\frac{1}{4}$ hp., and gas capacities per hour of 600, 1000 and 2000 cu.ft. The Eclipse Fuel Engineering Co., Rockford, Ill., is the manufacturer.

DeMant Precision Bench Lathe

The bench lathe illustrated is one of the recent products of the DeMant Tool and Machine Co., 79 East 130th St., New York City. The headstock spindle, spindle bearings and the tailstock spindle are hardened



DeMANT PRECISION BENCH LATHE

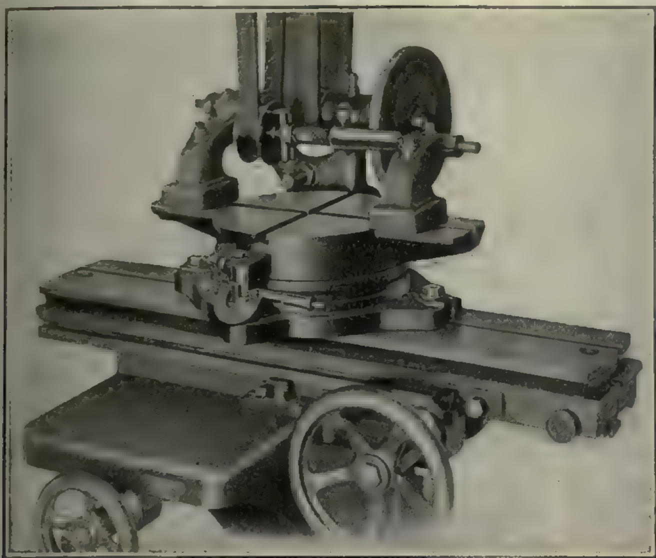
Swing, 7 in.; length of bed, 32 in.; distance between centers, 16 in.; capacity of chucks, $\frac{1}{64}$ to $\frac{3}{4}$ in.; capacity through spindle, $\frac{15}{16}$ in.; diameter of tailstock spindle, $\frac{13}{16}$ in.; diameter of spindle nose, $1\frac{5}{8}$ in.; width of belt, $1\frac{1}{4}$ in.; taper of centers, No. 3 Jarno; speed of countershaft pulleys, 400 and 800 r.p.m.

and ground and are adjustable for wear. The compound rest has large graduated dials and may be adjusted without the necessity of using setscrews or locknuts. This feature facilitates rapid adjustment. The machine is furnished complete with the compound rest and the three-speed countershaft.

"Hanton" Chord Plate

The R. W. Beckman Co., 920 Hume-Mansur Building, Indianapolis, Ind., is now marketing the "Hanton" chord plate shown in the illustration. The device is intended for use in grinding tapers of various character on the grinding machine, but may also be used in various other classes of work. It is made in two sizes, 3- and 6-in.; and in two styles, horizontal and vertical. The device consists of a base plate carrying a revoluble upper plate upon which the work is mounted

by any suitable means, such as angle plate, vise, centers, etc. The two pins shown at the front, one on the upper and one on the lower plate, act as the measuring points. The angular setting is determined by measuring the chord of the arc by means of a micrometer used over these two measuring points. Two bolts turning in a



"HANTON" CHORD PLATE

circular T-slot in the base plate lock the upper plate in position when set. The upper plate is fitted to the base by an angular bearing which renders any lateral play impossible. The upper plate will move through the full circle of 360 deg. A chart is furnished with the device, giving the micrometer settings for various angles and for tapers per foot.

Heinkel Multiple-Spindle Drilling Machine Heads

The Heinkel Machine Tool Co., Sandusky, Ohio, is now marketing a line of multiple-spindle drilling heads, two of which are shown in the illustrations. Fig. 1 shows an eight-spindle, fixed-center head, while Figs.

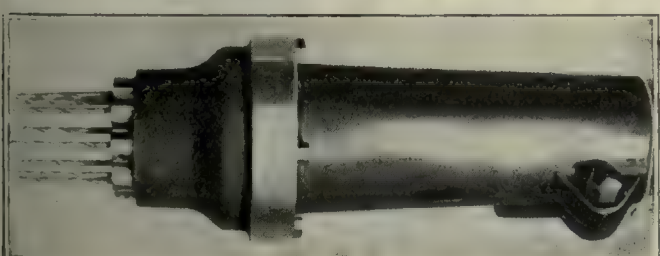


FIG. 1. EIGHT-SPINDLE, FIXED-CENTER DRILLING HEAD

2 and 3 illustrate a four-spindle head on which the center distances are adjustable. Both drilling heads are of the gearless type, the construction being as shown in the sectional view. The spindles may be adjusted to any center distance within their range while the machine is running, a feature that is not possible with most of the heads on the market. When once adjusted and locked in position the spindles are rigid and cannot move. Another feature claimed for this head is the elimination of overhang on one side of the drilling-machine spindle, as the method of adjustment allows for movement in a complete circle, thereby making it possible to keep the drills equally balanced across the center line of the spindle. It is claimed that the crank

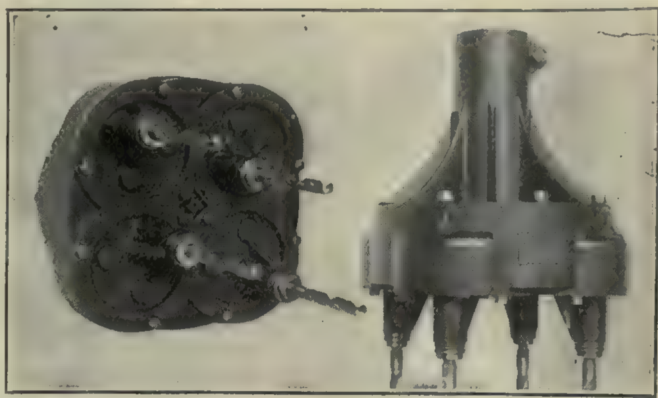


FIG. 2. FOUR-SPINDLE, ADJUSTABLE-CENTER DRILLING MACHINE HEAD

method of driving allows quieter operation, closer center distances, lighter and smaller heads and less loss of driving power through bearing friction. All working parts of steel are hardened and ground. The adjust-

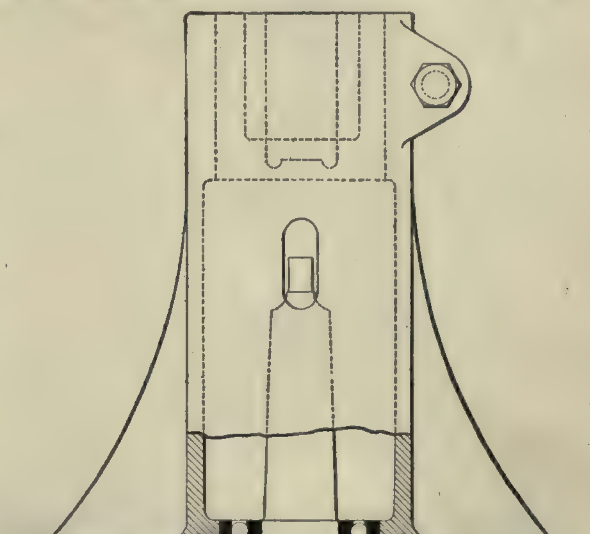


FIG. 3. SECTIONAL VIEW OF THE ADJUSTABLE-CENTER HEAD SHOWING THE CONSTRUCTION

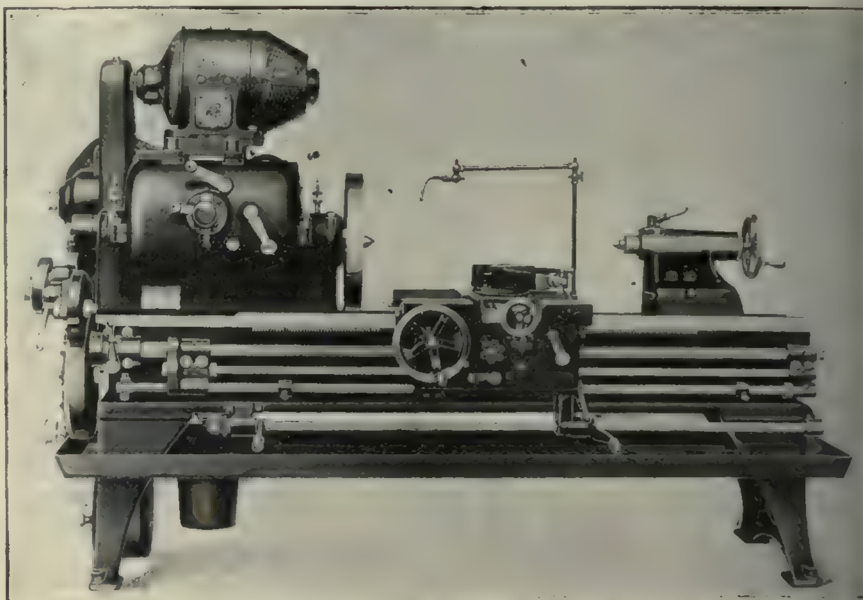
able type of head is at present made in two standard sizes with minimum center distance of $1\frac{5}{8}$ and 2 in. respectively.

The fixed-center heads are, of course, made up for center distances as required by the purchaser. They are made in a number of sizes.

Springfield 18-In. Geared-Head Lathes

The illustration shows an 18-in. geared-head lathe that is one of the recent products of the Springfield Machine Tool Co., Springfield, Ohio. This machine is made for motor or belt drive and is also made in 14-, 16- and 20-in. sizes. All journals except the main spindle bearings are ball bearing. The speeds are arranged in geometrical progression and are obtained by means of 14 gears. Any speed may be obtained directly, it not being necessary to pass through any series of speeds to reach the one desired. The entire head mechanism is inclosed and is oil-tight, all gears running in a bath of oil. The clutch pulley is at the rear of the head and contains the friction clutch, which is operated by a push rod, this feature eliminating the necessity for a countershaft. If desired the head can be furnished with a reversible drive. Where the motor-driven machine is used arrangement may be made to place the motor on the floor, ceiling, rear of leg or on top of the head as desired.

It will be noticed that the control levers are placed at the front within reach of the operator and are comparatively short. This latter feature renders it difficult to apply enough force to injure any gears.



SPRINGFIELD 18-IN. GEARED-HEAD LATHE

Swing over bed, 19 in.; swing over carriage, 13 in.; distance between centers with 6 ft. bed, 1 ft. 6 in.; front bearing, $3\frac{3}{4}$ x 7 in.; rear bearing, $2\frac{3}{4}$ x $5\frac{1}{4}$ in.; hole in spindle, $1\frac{9}{16}$ in.; diameter of spindle nose, $2\frac{3}{4}$ in.; threads on spindle nose, Acme; number of spindle speeds, twelve, 9 to 380 r.p.m.; diameter of head pulley, 14 in.; width of belt, 4 in.; horsepower recommended for motor drive, 3 to 5; speed of motor, 1200 r.p.m.

Garrison Drilling Heads and Gear Holding Chuck

The Garrison Machine Works, Dayton, Ohio, is now manufacturing the devices shown in the illustrations. Figs. 1 and 2 show one of a line of multiple-spindle

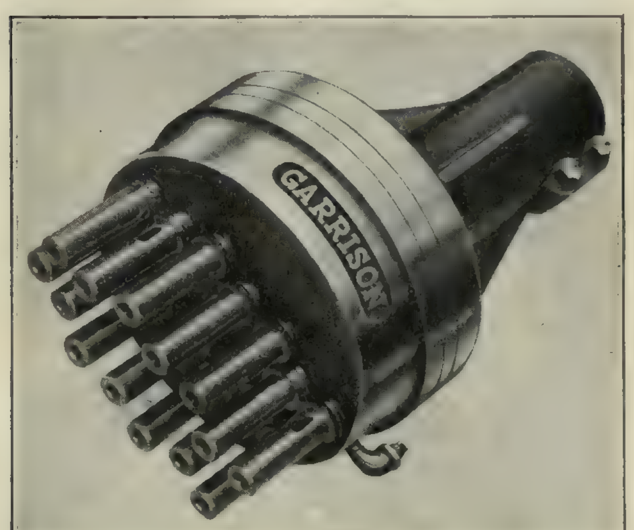


FIG. 1. EXTERIOR VIEW OF ONE TYPE OF THE GARRISON DRILLING HEAD

drilling heads. The spindles are of steel, machined all over, and all bearings and seats for gears are ground to size. The bearings are bushed, the bushings being so made that they may be replaced at any time. Chrome nickel steel, heat treated, is used for the gears. Force-feed lubrication is used, the oil returning over and through the gears to a dust-proof reservoir, provision being made to prevent any sediment in the oil from entering the bearings. Spindle speeds are arranged to give the correct cutting speed for the size of drill used. The case is made of gray cast iron, and the drive is through a taper shank engaging the

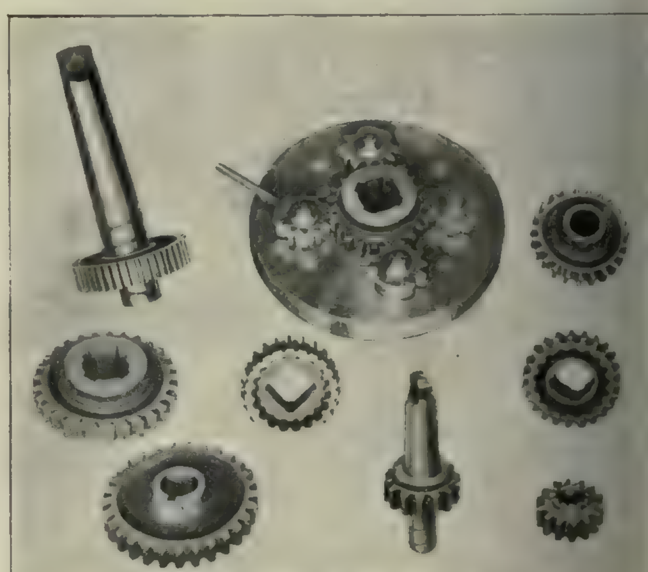


FIG. 3. THE "JOHNSON" GEAR CHUCK AND SOME OF THE WORK WHICH IT WILL HOLD

end of the drill spindle. The heads are made in a number of styles and sizes as may be desired.

Fig. 3 shows the "Johnson" gear chuck. It is claimed for this chuck that it will hold gears with such accuracy that holes or other integral parts may be machined concentric with the pitch diameter with errors not exceeding 0.001 in. The chuck with one set of members

will hold all gears of a given pitch and it has no loose parts that may be lost. It may be applied to any machine the same as an ordinary chuck, and indicates over a range of 0.030 in. the amount the pitch diameter of the gear is over or under size. All steel parts are hardened and bearings are ground and lapped. The outside diameter of the chuck, which is made in various

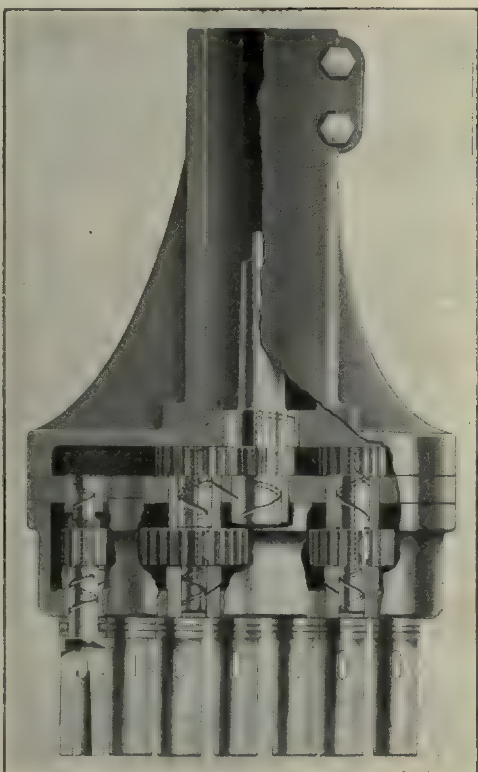
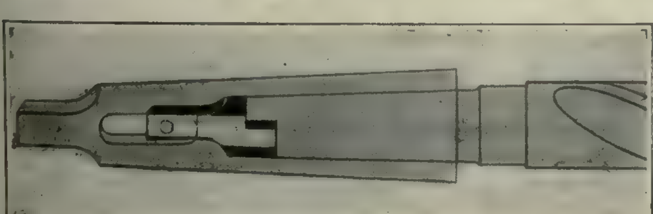


FIG. 2. THE INTERIOR CONSTRUCTION OF THE GARRISON DRILLING HEAD

styles, is not less than the sum of the pitch diameter of the largest gear to be chucked plus the outside diameter of a 24-tooth gear of the same pitch. It is claimed that the chuck will automatically compensate for any distortion of the gears due to heat treatment and that the work may be chucked accurately in from 4 to 6 seconds.

"Economy" Repair Tang for Taper-Shank Tools

The Mailometer Co., Kresge Building, Detroit, Mich., has recently placed on the market a new reclaiming device for tools with broken tangs. The device is known as the "Economy" tang. When a tool breaks the end

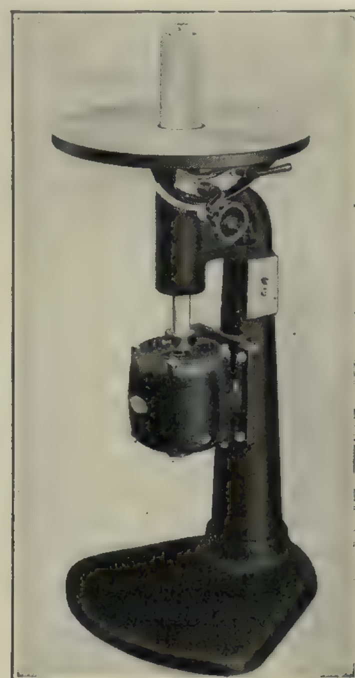


"ECONOMY" REPAIR TANG

is sawed off to fit the driving shoulder of the repair tang, a special gage being provided for the sawing so that there shall be no material variation in the lengths of the reclaimed shanks. After being so fitted the tool may be held in any socket and driven through the repair tang. An important feature claimed for the device is that it does not increase the driving power of the shank and cause the tool breakage that is common with some forms of repair devices. The illustration shows the construction clearly.

Carter & Buchholz Motor-Driven Sander

The oscillating-spindle sander illustrated is for use in pattern shops and woodworking plants and is the product of Carter & Buchholz Co., Inc., 1234 South State St., Syracuse, N. Y. The machine is equipped throughout with New Departure ball bearings and is driven by a $\frac{1}{2}$-hp., inclosed, ball-bearing motor. The table is 20 in.



MOTOR-DRIVEN SANDER

in diameter and tilts 45 deg. downward and 15 deg. upward. Two spindles are furnished, measuring 2 x 9 in. and 3 x 9 in. respectively. The motor is for either alternating or direct current, as specified.

Clean Shop Windows

By J. A. Raught

Robert C. Heinmiller's article on page 96 anent clean shop windows is as significant as it is novel. The writer agrees with Mr. Heinmiller that the importance of cleanliness in this respect is too often overlooked. Some years ago, while in charge of a small shop, I decided that it would be of distinct advantage to the shop to have the windows washed both outside and inside. Shortly after the completion of this innovation I heard a neighbor ask the "old man" if his "foreman had knocked all the glass out of his shop windows." The increased amount of light that reached the inside of the shop made it seem as though spring had come. Another advantage arising from clean shop windows is the amount of heat derived from the sun's rays.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., March 16, 1918—Great effort is being made to get special machines to build heavy guns and similar munitions. The building of these machines s a new job to many, and delays are bound to occur. But the unfortunate feature is that the hand of the grabber is showing very plainly in a few instances, and in cases where there seems to be very little excuse for it—if we deem lack of money an excuse for anything of the kind.

It is hoped that an accurate account is being kept of the financial aid being extended to all firms in this line, and that the whole personnel is also carefully noted. For aid is being given in some cases where the financial standing of the concerns invoking it make it hardly necessary.

This aid is extended to equip shops with the necessary machines and frequently to pay the foundry and forge bills before work is begun. This is doubtless perfectly justifiable in many cases, but it is a bit disheartening to find that your Uncle Samuel, which means all of us, is being called upon to pay for machines that are purchased with a much keener eye to their future use than to the work in hand, and, in addition to this, that they are given preferential priority certificates. If the machines which are being paid for by the Government are credited as belonging to it and are to be removed at the end of the war we shall have a wonderful collection to dispose of when it is all over; enough perhaps to help materially in reducing our war debt.

* * *

This could largely be avoided by having the equipping of all shops under the direction of a bureau of control, which would supervise the selection and purchase of all machines. Such a machine-tool dictator (as he would virtually be) could prevent the purchase of unnecessary machines; could direct the use of a cheaper machine or one less in demand at the present time. He could prevent precision lathes being ordered where the work could be done on an ordinary bench or speed lathe; he could forbid the purchase of a machine which was sorely needed on some classes of work but not absolutely necessary on immediate work.

Such a machine-tool dictator would not have a friend left after assuming his duties, but he could prevent machines being bought at Government expense and with an eye solely to its future use, as has been done in too many cases. It seems difficult to be able to wipe out the old selfish traits even under the stress of war. These cases are the exceptions of course. Some concerns—Henry Ford, for example—are only asking that machines be secured for them; they pay all their own bills, buying and paying for machines that will be of little or no use in their regular product.

Now there is nothing objectionable in the Government's helping to equip a shop—the objection is to the shop owner who is equipping his shop at Government expense for future use. Sometimes this is cleverly camouflaged in various ways, as for instance, when the men who help decide are interested in the plant. As to this we can say that when the cards are laid on the table some of these days there will be some interesting sidelights.

When all is said and done it all resolves itself into a question of personal honesty. And with both the equipping of the plant with someone else's money and the spending of that money like drunken sailors because it is a cost-plus contract, the whole question comes back to the question of plain, raw honesty—nothing more. To be sure a cost-plus contract is a terrific strain on one's conscience, but that is hardly an excuse for buying the most expensive tool steels for ordinary turning, or, in fact, for managing the business any more extravagantly than were it your own.

* * *

Standardization is an excellent slogan, but, like interchangeability, it can be carried too far for practical purposes. One of the best examples of this is the development of the new ¾-ton army standard truck. No one doubts the desirability of standards, or that the truck is not a good one; but in this case we had one already at hand.

When it comes to the small truck, years of experience has demonstrated that a certain chassis made in Detroit by a man whose name spells Henry Ford is a mighty reliable proposition. No one claims it is perfect—the new truck may be better in many ways. But here is a truck that can be turned out at the rate of 1000 a day, or more; that probably does not cost half as much as the new truck, and that keeps on the job. Further than that it should be remembered that the motor and a big part of the chassis is the same as nearly every ambulance in France, so that the number of repair parts of a truck of this specification could be kept at a minimum.

The navy uses a tremendous amount of horse sense in its standardization program, and its practices may well be followed by many others.

Common sense, the most uncommon human attribute, is coming to the aid of the inspection division of the Ordnance Department and rescuing it from much of the criticism it might otherwise have received. Limits

are being increased in many cases and nonessential dimensions being treated very liberally by many of the inspectors. I am authorized to state that in any cases where the present practice does not seem to be based on logical lines, the matter will be carefully considered. These can be sent to our Washington editor, Maryland Building, Washington, D. C.; to the New York office, or direct to the Inspection Division, Sixth and B St., Washington, D. C. If sent through us, the rulings and explanations can be published for the benefit of all interested.

In this connection it is well to remember that all of us are human and that none of us are burdened with a superabundance of brains. At least we seldom display its presence. Let us also remember that when men are sorely needed none of us have a happy time in getting high-grade men, particularly if the powers that be only allow us, to pay from half to two-thirds of the prevailing wage rate. This is exactly what the Ordnance Department was up against. So it is but natural when they could hire only the most common garden variety of draftsmen in many cases that high-grade intelligence and discrimination was not always displayed.

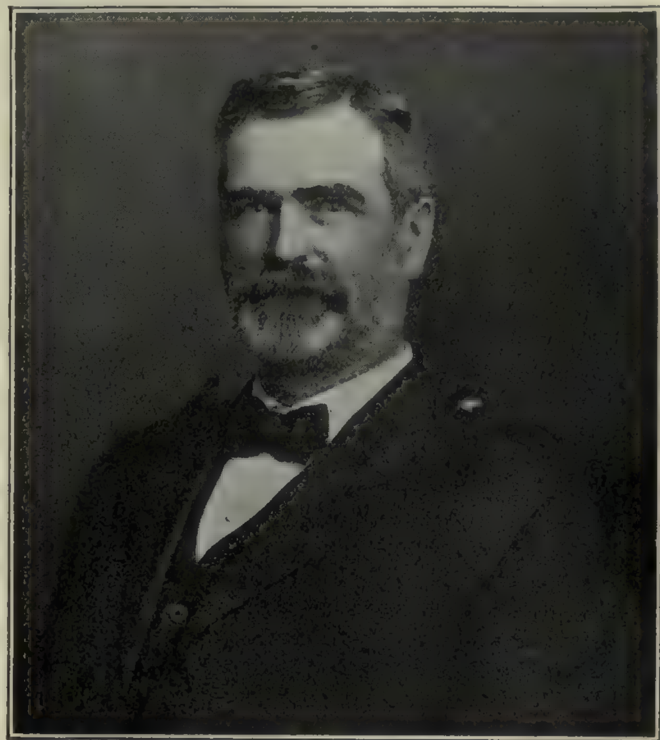
This explains many cases of radius dimensions to four decimal places of odd figures when in reality it is only a fillet or the rounding of an outside corner which fits nothing but the atmosphere. The original drawing was probably in even millimeters, just as we would say three-sixteenths or three-eighths of an inch without having in mind any undue exactness. But instead of translating 7 mm. as ¼ in., which would have been plenty close enough in such cases, the faithful draftsman, having no orders to make a change, translates it as 0.2779 in. And the inspector, perhaps also without experience or authority, cannot allow any changes to be made. So radius gages are made at a considerable expense for many places where the commercial set of radius gages, which can be bought for about $1.50 at a hardware store, would be plenty good enough for this work.

This is not a criticism of anyone. It is simply one of the inevitable consequences of extremely rapid expansion; of the inability to get thoroughly experienced men for the various jobs, and the lack of men to check drawings and to catch all these unnecessary refinements. The same thing would happen in any private concern under the same conditions. When we see the errors that creep into drawings in times of peace, without the excitement and stress of war to disturb the supply of skilled men or the minds of the men after you get them, we can afford to go a little easy in condemning someone else for the same failing.

Arthur Irving Jacobs

Arthur Irving Jacobs died Feb. 16, 1918, at St. Francis Hospital, Hartford, Conn., after a brief illness. He was born in Hebron, Conn., Aug. 13, 1858, the son of Zalom Luman and Mary Elizabeth (Babcock) Jacobs.

Educational advantages during his boyhood were very meager, and after his ninth year his schooling was limited to a short period in the winter. He was trained in mechanical work in the laboratory of his father, where he remained until he had attained his majority, when through Rev. George F. Dodge he secured employment at $1.25 a day in the Knowles Loom Works, Worcester, Mass. There his talent became manifest, and in less than three weeks he secured from the superintendent a contract to make harness chains for looms. When the foreman learned of this he said to Mr. Jacobs: "What do you want of that job? You can't make your salt at it. No former contractor ever made a dollar a day on it." Mr. Jacobs, who was then less than twenty-two years of age, replied: "Well, I would like to try it." Mr. Jacobs proceeded to make such efficient improvements that he received not less than one dollar an hour for the time he worked on the contract. Thus economy and efficiency have been the keynote of Mr. Jacobs' life. Long before the word efficiency was dinned into the public's ear he was inventing machines, changing methods and eliminating operations to improve and increase productivity without increasing overhead charges.



ARTHUR IRVING JACOBS

Mr. Jacobs remained at the loom works until 1887, and during that period invented and built a book-sewing machine, several of which were purchased by Boston bookbinders. The Smith Manufacturing Co., Hartford, Conn., became interested in this invention, purchased the patent and engaged Mr. Jacobs to come to Hartford and perfect the machine. Here he remained until Dec. 1, 1901, and during this period invented and perfected several machines for use in the bookbinding business. Among these may be mentioned a machine for making book covers at a greatly reduced cost and a machine for cutting cloth for covers from the roll.

In 1902 he invented the Jacobs drill chuck. This was patented on Sept. 6, 1902, and a company to manufacture it was incorporated on Oct. 30, 1903. At the time of his death Mr. Jacobs was president of the Jacobs Manufacturing Co. and also president of the Rhodes Manufacturing Co.

Personal

A. B. Seelig, general manager of the Bristol Brass Co., Bristol, Conn., has been elected vice president.

J. B. Mansfield of the J. E. Bolles Wire and Iron Works, Detroit, Mich., has been made president and general manager.

Frank S. Reitzel has been made first vice president of the Wright-Martin Aircraft Corporation, New Brunswick, N. J.

H. P. Bope, vice president and general manager of sales of the Carnegie Steel Co., has been re-elected president of the Pittsburgh Radium Co. of Utah.

I. E. Edwards, for twelve years chief engineer, has been made works manager of the ingot-mold foundry of the Marshall Foundry Co. at Josephine, Penn.

Leon O. Hart was elected treasurer and director of the Driver-Harris Wire Co., of Harrison, N. J., at the annual meeting of its stockholders and directors.

Arthur G. Kimball has been elected president of Landers, Frary & Clark, New Britain, Conn., succeeding Charles G. Smith, who becomes chairman of the board.

J. B. Howell of the sales department of the Bound Brook Oil-less Bearing Co. has entered active service in the United States Army and is now training at Camp Dix.

Edgar C. Felton, formerly president of the old Pennsylvania Steel Co., has been appointed federal examiner of the Delaware Valley shipbuilding industry, including Baltimore.

H. I. Arnold, formerly with the Pierce-Arrow Motor Car Co., is now located with the Cadillac Motor Car Co., Detroit, Mich., as supervisor of its planning and standards departments.

Henry Johnson, formerly general manager of the Fairview Foundry Co., Detroit, Mich., is now in charge of the Theisen-Braithwaite Co., Port Huron, Mich., maker of gray-iron castings.

J. S. Green, erecting engineer and master mechanic for the Wickwire Steel Co., Buffalo, N. Y., has resigned to accept the position of master mechanic with the Edgewater Steel Co., Pittsburgh, Penn.

A. B. Hall, vice president of the Whitman & Barnes Manufacturing Co., of Akron, Ohio, has been given the supervision of the company's sales. He has for the past 21 years been connected with the company in various sales and official capacities.

R. S. Carter, district representative of the Whitman & Barnes Manufacturing Co., with headquarters in Pittsburgh, Penn., has been promoted to sales manager and will have direction of twist-drill and reamer sales from the Akron, Ohio, general office.

R. L. Hibbard, formerly assistant manager and gas engineer of the Riter-Conley Co., Pittsburgh, Penn., and connected with that concern for 15 years, has resigned and has opened an office in Room 8058, Jenkins Arcade Building, Pittsburgh, Penn., as general consulting engineer.

H. E. Fischer, formerly with the Pittsburgh Model Engine Co., Pittsburgh, Penn., has become associated with the Whitman & Barnes Manufacturing Co., Akron, Ohio. He succeeds R. S. Carter as mechanical engineer and will have charge of sales in the Pittsburgh district.

Paul E. Thomas, of Chicago, for a number of years connected with the traffic department of the Seaboard Air Lines, has become associated with the Whitman & Barnes Manufacturing Co., Akron, Ohio. His position is that of sales manager in charge of the department of wrenches and spring cotters.

Uldric Thompson, formerly chief engineer of the International Steel and Ordnance Corporation, who until recently has been serving in an advisory capacity in equipping the new artillery-ammunition assembling plant at Rock Island arsenal, has opened an office at 120 Broadway, New York, under the firm name of Uldric Thompson, Jr., Inc., consulting and industrial engineer.

Paul R. Ketzer, formerly manager of the Ketzer Machinery Co., Philadelphia, Penn., has become manager of the machinery and engineering department of W. H. Robinson & Co., Real Estate Trust Building, Philadelphia, the Ketzer Machinery Co. having been consolidated with Robinson & Co. This new department will conduct an export and domestic business in machinery and allied lines.

Business Items

Cyril J. Bath & Co., machinery dealers of Cleveland, Ohio, have moved their offices from the Leader-News Building to their showrooms at 721 St. Clair Ave. N. E.

The Amalgamated Brass Co. of Cincinnati, Ohio, has moved its main office and factory to its new plant at Blanchester, Ohio, where all future communications should be addressed.

The Machine Shop Equipment Corporation, 170 Oliver St., Boston, Mass., has been organized under the laws of Massachusetts, and is absorbing the old Maine corporation of T. Crowther & Co. The former business of T. Crowther & Co. will be continued under the management of J. K. Barber as treasurer and general manager of the new company.

The Trussed Concrete Steel Co. of Detroit, Mich., has changed its name to Truscon Steel Co. For years the company has been generally known by the name of "Truscon," which is an abbreviation of the longer name, and for this reason Truscon Steel Co. was selected. Aside from the change of name there has been absolutely no change in its organization or management. This company has its plant and general offices at Youngstown, Ohio, with representatives in all principal cities.

New Publications

BROACHES AND BROACHING—By Ethan Viall, managing editor of the "American Machinist." Two hundred and twenty-one 6 x 9 pages, 187 illustrations and 37 tables. Published by the McGraw-Hill Book Co., 239 West 39th St., New York City. Price, $2.

For the first time data in regard to broaches and broaching has been put into convenient book form for easy reference. It is especially timely now that many mechanics are being called upon to do work they have never before attempted. From this book a man can gain the results of the experience of a wide range of workers in the broaching field. The author has drawn liberally from articles published from time to time by others, although a large part of the material used was gathered first hand by himself. By the use of the numerous formulas, tables and illustrations in this book any intelligent mechanic should be able to design, make and use broaches for various classes of work with a clear idea of the real principles involved. The author starts out with a chapter on the various types of broaching tools and shows examples of them. He also defines what work should be classed as broached work and what should not. Next the various standard broaching machines for both pull and push broaching are shown and described. While no attempt is made to show all the different makes of machines, every known type is represented. Then follow chapters on the use and design of pull and push broaches, in which definite answers are given to almost any question that a practical man might ask. The book is printed on a very good grade of paper, and the illustrations are clear and distinct. Apparently the book will be as useful to the ordinary machinist in the shop as to the toolmaker, draftsman, designer or engineer. The titles of the various chapters are as follows: Chapter I, Broaching and Broaching Tools; Chapter II, Standard Types of Broaching Machines; Chapter III, Examples of Pull-Broaching Work and Practice; Chapter IV, Examples of Push-Broaching Work and Practice; Chapter V, The Design of Pull Broaches; Chapter VI, The Design of Push Broaches; Chapter VII, Making Broaches. In an appendix are given tables of S.A.E. spline practice and of the Baker keyways.

Trade Catalogs

"D & W" Magnetic Chucks. D & W Fuse Co., Providence, R. I. Circular 206-A. Pp. 4; 8½ x 11 in.; illustrated.

Link-Belt Silent Chain for Rubber Mill Machinery. Link-Belt Co., 39th St. and Stewart Ave., Chicago, Ill. Book No. 299. Pp. 24; 6 x 9 in.; illustrated.

Recuperative Heat Treating Furnaces for All Industries. A. Hermansen, Woolworth Building, New York. Catalog. Pp. 72; 6 x 9 in.; illustrated. This contains line drawings showing details of construction.

Hilo White Enamels. Moller & Schuma[illegible] Co., Marcy and Flushing Aves., Brooklyn, [illegible] Y. Bulletin No. 3. Pp. 12; 5 x 8 i[illegible] illustrated. This bulletin describes the [illegible]ferent uses to which these enamels are [illegible]plied.

A new stock list has been issued by [illegible] Gale-Sawyer Co., 33-37 Wormwood St., [illegible]ton, Mass., which lists over 10,000 h[illegible] speed steel end mills, with Brown & Sha[illegible] or Morse tapershanks, keyway cutters, [illegible] in stock for immediate delivery.

"Hydro" Gas Meters. Bacharach In[illegible]trial Instrument Co., Pittsburgh, P[illegible] Catalog E. Pp. 12; 6 x 9 in.; illustra[illegible] This contains data as to the various m[illegible]ods employed for measuring gases [illegible] shows the application of these meters [illegible] blast furnaces, etc.

Forthcoming Meetings

The American Gear Manufacturers' A[illegible]ciation will hold its second annual con[illegible]tion at White Sulphur Springs, W. [illegible] Apr. 18, 19 and 20, with headquarte[illegible] the Green Brier Hotel. The secreta[illegible] F. D. Hamlin of the Earle Gear and [illegible]chine Co., 4701 Stenton Ave., Philadel[illegible] Penn.

American Society of Mechanical [illegible]neers. Monthly meeting, first Tue[illegible] Calvin W. Rice, secretary, 29 West [illegible] St., New York City.

Boston Branch National Metal T[illegible] Association. Monthly meeting on [illegible] Wednesday of each month, Young's [illegible] Donald H. C. Tullock, Jr., secretary, [illegible] 41, 166 Devonshire St., Boston, Mass.

The sixth annual meeting of the C[illegible]ber of Commerce of the United Stat[illegible] America will be held in Chicago, Ap[illegible] 11 and 12, 1918. Elliot H. Goodwin, [illegible] Building, Washington, D. C., is ge[illegible] secretary.

Engineers' Society of Western Pen[illegible]vania. Monthly meeting, third Tues[illegible] section meeting, first Tuesday. Elm[illegible] Hiles, secretary, Oliver Building, [illegible]burgh, Penn.

The National Foreign Trade Council [illegible]ference will be held in Cincinnati a[illegible] Gibson Hotel, Apr. 18, 19 and 20. Appl[illegible] reservations to O. K. Davis, secreta[illegible] Hanover Square, New York City. The [illegible]eral chairman is Robert S. Alter.

The National Metal Trades Associ[illegible] announces the following program [illegible] forthcoming convention, which will be [illegible] at the Hotel Astor, New York City: [illegible]day, Apr. 22, 10 a.m., executive comm[illegible] meeting; 7 p.m., secretaries' dinner. [illegible]day, Apr. 23, 10 a.m. to 5 p.m., c[illegible] meeting; 10 a.m., meeting of local [illegible]taries; 6:45 p.m., alumni dinner. We[illegible]day, Apr. 24, 9:30 a.m. and 2 p.m., [illegible]vention; 12:30 p.m., buffet luncheo[illegible] p.m., banquet. Thursday, Apr. 25, [illegible] a.m., and 2 p.m., convention and m[illegible] of the incoming administrative c[illegible] Homer D. Sayre, People's Gas Bui[illegible] Chicago, Ill., is the secretary.

The National Gas Engine Associatio[illegible] hold its eleventh annual meeting a[illegible] Hotel Sherman, Chicago, Ill., June 3 [illegible] The headquarters of the association [illegible] Lakemont, N. Y.

New England Foundrymen's Assoc[illegible] Regular meeting, second Wednesd[illegible] each month, Exchange Club, Boston, [illegible] Fred F. Stockwell, 205 Broadway, [illegible]bridgeport, Mass.

Philadelphia Foundrymen's Assoc[illegible] Meetings, first Wednesday of each [illegible] Manufacturers' Club, Philadelphia, [illegible] Howard Evans, secretary, Pier 45 [illegible] Philadelphia, Penn.

Providence Engineering Society. [illegible]ly meeting, fourth Wednesday of [illegible] month. A. E. Thornley, correspondin[illegible]retary, P. O. Box 796, Providence, R[illegible]

Rochester Society of Technical [illegible]men. Monthly meeting, last Thursd[illegible] L. Angevine, Jr., secretary, 857 Gene[illegible] Rochester, N. Y.

Superintendents' and Foremen's C[illegible] Cleveland. Monthly meeting, third [illegible]day. Philip Frankel, secretary, 31[illegible] England Building, Cleveland, Ohio.

Technical League of America. [illegible] meeting, second Friday of each [illegible] Oscar S. Teale, secretary, 35 Bro[illegible] New York City.

Western Society of Engineers, C[illegible] Ill. Regular meeting, first Wed[illegible] evening of each month, except Ju[illegible] August. E. N. Layfield, secretary [illegible] Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Presses, Open-Back Inclinable

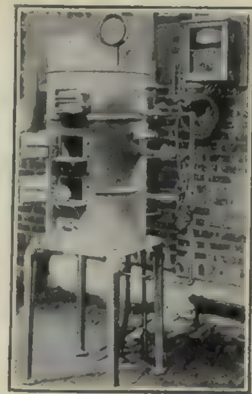
Sidney Power Press Co., Sidney, Ohio

"American Machinist," Mar. 14, 1918

Made in six sizes specifications for No. 3 press as shown: Weight, 2600 lb.; weight of flywheel, 450 lb.; speed of flywheel, 110 r.p.m.; distance from column to center of slide, 10 in.; distance from bed to slide, with stroke down and adjustment up, 7 in.; width of opening in back of frame, 9 in.; width between gibs, 8 in.; standard stroke of slide, 2 in.; maximum stroke of slide, 6 in.; hole in slide for shank of punch, 2 in.; height to center of shaft, 62½ in.; floor space, 26 x 36 in.

Furnace, Heat-Treating, "Triad"

W. R. Bennett, Elmwood, Conn.

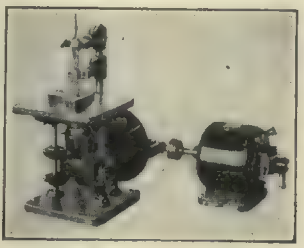


"American Machinist," Mar. 14, 1918

Designed for the heat treatment of carbon, tungsten or high-speed steel tools. Operated by a single burner, but is so constructed that the three steps—preheating, high heating and tempering—can be accomplished simultaneously. Burns either fuel oil or gas and occupies a floor space of 4 sq.ft. The temperatures in both the intermediate and lower compartments are determined by means of pyrometers, while the temperature in the tempering compartment at the top is determined by a thermometer and is controlled by an air inlet from the main air line operated by a valve and a mercury air gage. It is claimed that the atmospheric conditions in the intermediate and lower chambers are reducing

Filing Machine

Holmes Manufacturing Co., Shelton, Conn.

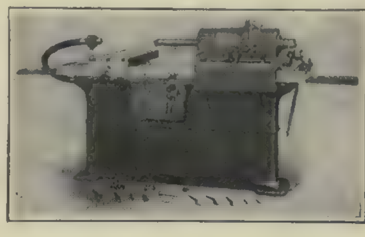


"American Machinist," Mar. 14, 1918

This company has made a number of improvements on its motor-driven filing machine. It is driven through a set of friction disks. Size of wood base, 13 x 20 in.; machine table, 8 in. square; height of table, 9 in.; stroke, 0 to 2 in.; speed, 200 to 800 r.p.m.; motor, $\frac{1}{10}$ hp., either a.c. or d.c.; weight assembled, about 40 lb.

Grinding Machine, Cylinder No. 23

Baxter D. Whitney & Son, Winchendon, Mass.



"American Machinist," Mar. 14, 1918

This company has purchased from the Brown & Sharpe Mfg. Co. the rights, designs, etc., for this machine. Capacity, grinds holes 3 to 7 in. in diameter up to 14 in. deep; maximum radius described by wheel spindle, 1½ in.; speeds of wheel-spindle revolving drum, six, 66 to 146 r.p.m.; feeds of sliding table, eight, 7 to 55 in. per minute; working surface of cross-table, 13 x 30 in.; floor space, 44 x 144 in.; weight, 4700 lb.

Gages, Adjustable-Limit, Snap

J. M. Clark Co., Bridgeport, Conn.

"American Machinist," Mar. 14, 1918

This company is now marketing a line of adjustable-limit snap gages. It is claimed that the construction is such that the measuring plugs are positively clamped in position against the adjusting screw. This construction also allows the holes for the adjusting screws to be tapped out for a larger size in case they should become worn. The gages are made in 18 sizes varying in steps of ½ in. up to and including 6 in., and in steps of 1 in. for work from 6 to 12 in. in size. Measuring plugs for threads and other special shapes can be furnished if desired

Wires, Thread Measuring

B. Seaboldt Corporation, 25 West Broadway, New York City.

"American Machinist," Mar. 14, 1918

This concern has placed on the market a line of thread-measuring wires which are hardened and lapped by special processes and are guaranteed to meet required conditions. The wires are furnished in sets of three. The sets are made in sizes varying from 0.010 to 0.150 in. in diameter and from 1½ to 3 in. long respectively. A short section in the middle of each wire, varying from ⅝ to 1¼ in. long, according to the size, is finished to the required degree of accuracy, the remainder of the length being reduced to about 0.002 in. under the nominal size.

Scraper, Motor-Driven

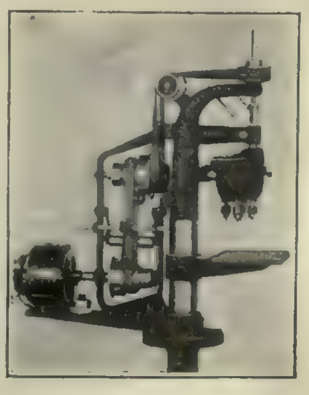
Modern Manufacturing Co., Bridgeport, Conn.

"American Machinist," Mar. 14, 1918

A new device for obviating hand-scraping work on aluminum and brass castings, such as motor crank cases and similar work. It consists of an electric motor and a flexible shaft, as shown, which may be used to drive burrs of various sizes and styles. The motor is ball bearing and is suspended above the work by means of a universal joint. The flexible-shaft casing is attached to a cone holding lubricant for the shaft, and a hand piece is provided at the lower end which takes the different burrs. These are readily interchangeable

Drilling Machine

Landau Machine and Drill Press Co., 368-370 Broome St., New York City



"American Machinist," Mar. 14, 1918

This machine includes a four-spindle drilling head only one of whose spindles is used at one time. Each spindle is automatically locked into place when in proper alignment. One spindle can be fitted with tapping attachment if so desired. Speeds three, 650, 1100 and 1800 r.p.m.; height with column, 64 in.; height without column, 30 in.; floor space, 12 x 28 in.; weight with column, 250 lb.; weight without column, 190 lb.; number of spindles, 4; travel of spindles, 2½ in.; travel of tapping spindle, 1 in.; forward speeds of tap, three, 110, 190 and 310 r.p.m.; reverse speeds of tap, 165, 275 and 450 r.p.m.

Patent Applied For

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Mar. 14, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$27.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	35.50
*Bessemer, Pittsburgh	37.25	37.25	36.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia................	33.75	33.75	34.75
*No. 2, Valley......................	33.95	33.95	36.00
No. 2, Southern Cincinnati............	35.90	35.90	29.90
Basic, Eastern Pennsylvania...........	33.75	30.75	30.50

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Mar. 14, 1918	One Month Ago	One Year Ago	Mar. 14, 1918	One Year Ago	Mar. 14, 1918	One Year Ago
Structural shapes ...	$4.20	$4.20	$4.10	$4-4.04	$4.10	$4.20	$3.75
Soft steel bars......	4.10	4.10	4.00	4-4.04	4.00	4.10	4.00
Soft steel bar shapes.	4.10	4.10	4.00	4.14	4.00	4.10	3.75
Plates, ¼ to 1 in. thick	4.45	4.45	5.15	4.39	5.00	4.45	4.75

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Mar. 14, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York..................	4.70	3.75
Warehouse, Cleveland	3.98½	3.95
Warehouse, Chicago	4.10	3.75

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Mar. 14, 1918	One Month Ago	One Year Ago	Mar. 14, 1918	One Year Ago	Mar. 14, 1918	One Year Ago
*No. 28 black.......	5.00	6.45	6.45	6.00	6.385	5.50	6.45	5.40
*No. 26 black.......	4.90	6.35	6.35	5.90	6.285	5.40	6.35	5.30
*Nos. 22 and 24 black	4.85	6.30	6.30	5.85	6.235	5.35	6.30	5.25
Nos. 18 and 26 black	4.80	6.25	6.25	5.80	6.185	5.30	6.25	5.20
No. 16 blue annealed.	4.45	5.65	6.65	5.45	5.585	5.20	5.65	5.45
No. 14 blue annealed.	4.35	5.55	5.55	5.35	5.485	5.10	5.55	5.35
No. 10 blue annealed.	4.25	5.45	5.45	5.30	5.385	5.05	5.45	5.30
*No. 28 galvanized..	6.25	7.70	7.70	5.25	7.635	5.00	7.70	5.20
*No. 26 galvanized..	5.95	7.40	7.40	8.00	7.335	7.25	7.40	7.50
No. 24 galvanized...	5.80	7.25	7.25	7.70	7.185	6.95	7.25	7.20

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Mar. 14, 1918	One Year Ago
New York	List plus 10%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Mar. 14, 1918	One Year Ago
New York	$15.00	$9.50
Cleveland	15.00	7.50
Chicago	15.00	6.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16, No. 8, 5/32 and No. 10, ⅛, No. 12, 3/32, No. 14 and 1/16, No. 18, No. 20	21.00 @ 30.00

Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
⅜ by 19 in long.........	12.00
½ by 21 in. long.........	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Mar. 14, 1918	Cleveland Mar. 14, 1918	Chicago Mar. 14, 1918
Tire	4.10	4.00	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel..	7.50	8.00	8.25
Spring steel (crucible analysis)	11.00	11.25	11.25
Coppered bessemer rods..	9.00	8.00	7.00
Hoop steel	4.95	4.75	4.95
Cold-rolled strip steel....	9.00	8.25	8.25
Floor plates	6.19½	6.00	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4......	29%	17%
4½ to 6......	44%	32½%	4½ to 6......	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Mar. 14, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	37.00
Tin, in 5-ton lots..................	85.00	85.00	54.50
Lead	7.25	7.00	10.75
Spelter	7.75	8.00	11.00

*Government price.

ST. LOUIS

Lead	7.10	6.85	10.50
Spelter	7.75	7.87½	10.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Mar. 14, 1918	One Month Ago	One Year Ago	Mar. 14, 1918	One Year Ago	Mar. 14, 1918	One Year Ago
Copper sheets, base.	31.50-33.00	32.00	44.00	32.50	46.00	36.00	43.00
Copper wire (carload lots	32.00	32.00	39.50	28.50	44.00	33.50	39.00
Brass pipe base....	36.50	36.50	47.50	38.00	52.00	38.00	47.50
Brass sheets	30.75	30.75	45.50	32.00	45.00	33.50	43.50
Solder ½ and ½ (case lots)......	62.00	43.00	45.50	48.50	33.50	40.00	33.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Mar. 14, 1918	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	37.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.. 19.00

	In Casks Mar. 14, 1918	In Casks One Year Ago	Broken Lots Mar. 14, 1918	Broken Lots One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	20.00	23.00	20.50	23.25
Chicago	21.50	22.50	22.00	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Mar. 14, 1918	One Year Ago
New York	13.50	31.00
Cleveland	16.50	34.00
Chicago	16.00	32.00

Manufacture of the 4.7-Inch Gun

Model 1906—I

BY E. A. SUVERKROP

The manufacture of artillery is probably the most highly specialized industry in the United States. Up to the outbreak of hostilities there were less than half a dozen firms in the country who knew anything at all about it. Since the entry of the United States into the war a number of contracts for guns have been awarded to private concerns. Appreciating the waste of effort for each of these firms to send representatives to the Government arsenal to learn the art of gunmaking the "American Machinist," with the coöperation of the War Department, has delegated one of its editors to gather all available data on this little known activity. It is hoped that this series of articles will be of material assistance to the manufacturers and incidentally to our boys at the front.

WHEN received at the arsenal, the forging for the tube (the first of the set of rough forgings to be machined) is roughbored and turned to the sizes given in Fig. 1. As the bore is approximately 4.3 in. in diameter this leaves but 0.2 in. a side to be removed in the arsenal's first rough- and finish-boring operations. The breech end of the rough forging is 8.1-in. outside diameter and is finished to 7.72-in. diameter, so that approximately the same amount of metal is to be removed from the exterior as from the interior of the forging. It should therefore be remembered that the hole in the rough forging is usually drilled from both ends, and that the two rough-drilled holes are seldom exactly round or concentric; therefore it is often necessary to humor the forging so that it will clean up both inside and outside. In Fig. 2 the error in the rough-drilled hole is exaggeratedly shown, the dotted line indicating the true hole.

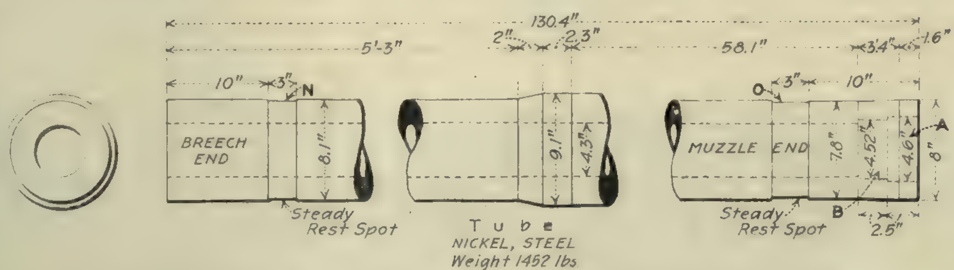


FIG. 1. ROUGH-BORED AND TURNED TUBE FORGING FOR THE 4.7-IN. GUN

One end of the tube is first chucked in a four-jaw independent chuck *B* on the live spindle of the lathe. The other end is supported on a revolving center *P*, Fig. 3, mounted in the tail spindle, the large conical end of the center entering the rough-drilled hole in the forging.

The lathe operator then places a parallel across the ways of his lathe, and using either an ordinary surface gage or one that has a pivoted needle and graduated arc, indicates the outside of the forging. If it is found that the outside of the tube does not run true enough to clean up, the hole in the end for the tail center is thrown over, and if necessary the jaws of the chuck are adjusted so that the tube will run true. But the operator must be careful that he does not throw the work so much that the bore will not clean up to the dimensions desired.

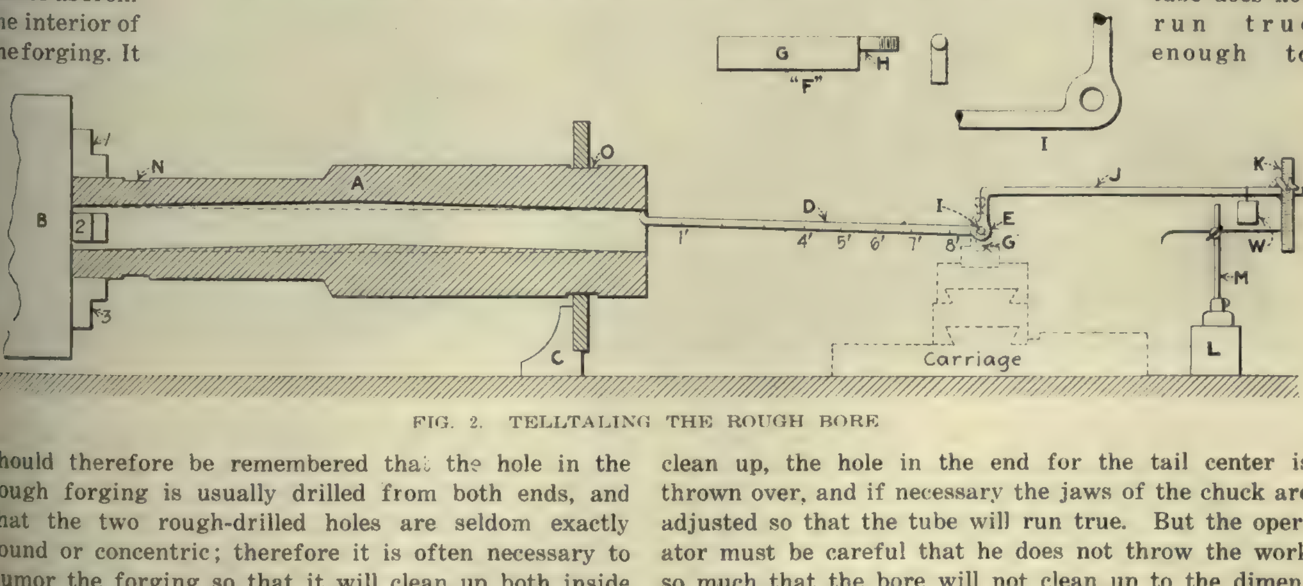


FIG. 2. TELLTALING THE ROUGH BORE

The setting of the tube in the lathe having been accomplished the operator proceeds to turn two steady-

rest spots, one near each end of the tube, as shown at *N* and *O*, Figs. 1, 2 and 3. As the accuracy of the subsequent operations depends on the accuracy of these spots, care should be taken to have them as nearly cylindrical as possible; and also, for the sake of speed in handling later, to have them positioned properly; that is to say, they should be an equal distance from each end of the forging so that it will not be necessary to readjust the steadyrest on the lathe bed when reversing the tube in the lathe.

The speed of the lathe for spotting should be such that there is no tendency for the work to whip, which is sure to occur if the speed is too high, and which results in spots that are out of round. On work that will permit of it both the spots should, for the sake of rapid production, be of the same diameter to avoid frequent adjustment of the steadyrest jaws. The spots should be deep enough to have a uniformly clean surface, but as it may be necessary later to respot in order to bring the rough bore nearer to concentricity they should not be made deeper than necessary.

On the 4.7-in. tube the spots are about 3 in. wide and about 10 in. from each end, as shown in Fig. 1. After they have been turned the breech end of the gun tube is still gripped in the four-jaw independent chuck in the headstock, but the steadyrest at C, Fig. 2, is adjusted to the spot *O* near the muzzle end and the tailstock is run back out of the way, as shown in Fig. 3. When adjusting the steadyrest the operater sees that the carriage is between the tailstock and the steadyrest.

If it is desired to telltale the entire length of the gun from one end, the lathe should be three times the length of the work, or floor space must be available for mounting the telltale and scale. The lathe shown in Fig. 3 is a little more than twice the length of the tube, as in this instance the tube is telltaled for half of its length only and then turned end for end in the lathe and the remainder telltaled.

The sizes of the rough-turned and drilled forging are given in Fig. 1. At *A* and *B* are given the sizes of the roughing (hog-nose) and finishing reamers that are passed through the tube before it is turned on the outside for shrinking the jacket on. The operation of telltaling is employed to ascertain whether or not the tube will clean up to the desired sizes.

In the illustration, Fig. 3, and the line engraving, Fig. 2, similar reference letters will be used so far as possible, so that the reader can more readily follow the operation. The tube *A* is held at the breach end in the four-jaw independent chuck *B*, and supported at the muzzle end in the steadyrest shown. The telltale is a cranked rod of rough machine steel—in this instance it is ¾-in. diameter round steel—but many are of flat bar, the narrow dimension vertical when in working position. The part *D* of the telltale is a little longer than the length of the tube *A* and is roughly graduated with the edge of a half-round file at each foot of its length. Mounted in the toolpost *E* is a piece of rectangular steel shown in detail at *F*. Its shank *G* fits the slot in the toolpost. The cylindrical portion *H* acts as a pivot for the telltale to swing upon. This part of the telltale is shown in detail at *I*. The end of the pivot *H* is threaded and furnished with a nut and washers to provide adjustment so that it can be made a free, but not a loose fit sidewise when the part *I* is assembled on it. The end of the telltale that enters the tube is turned upward at right angles to the body of the bar *D* so as to give a point contact on the top wall of the bore. The indicating end *J* of the telltale is the same length as the end *D*, and in order to keep the contact point of the telltale against the top of bore of the tube a weight *W* is hung on *J*. About the same distance from the fulcrum point *I* as the contact point, a scale *K* is at-

	1	2	3	4
1	0	1a	0	0
2	0	0	2b	0
3	0	2a	1b	1a
4	0	0	2a	1a
5	0	1b	2b	1b
6	0	2b	2b	1b

FIG. 4. CHART FOR NUMBERED JAWS

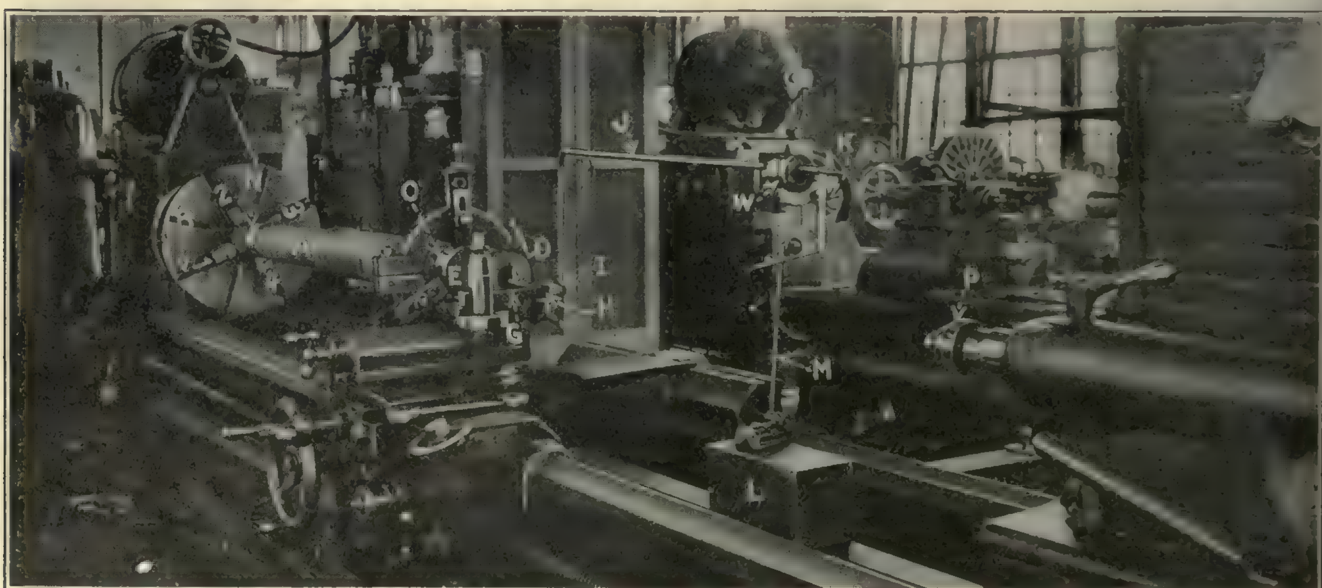


FIG. 3. LATHE SET-UP FOR TELLTALING

tached to J by means of an ordinary C-clamp. The scale is graduated in hundredths, and as it and the contact point are equidistant from the fulcrum, any movement of the contact point will be reproduced by the scale. A heavy parallel L is placed astride the ways of the lathe, and on it the operator places the surface gage M.

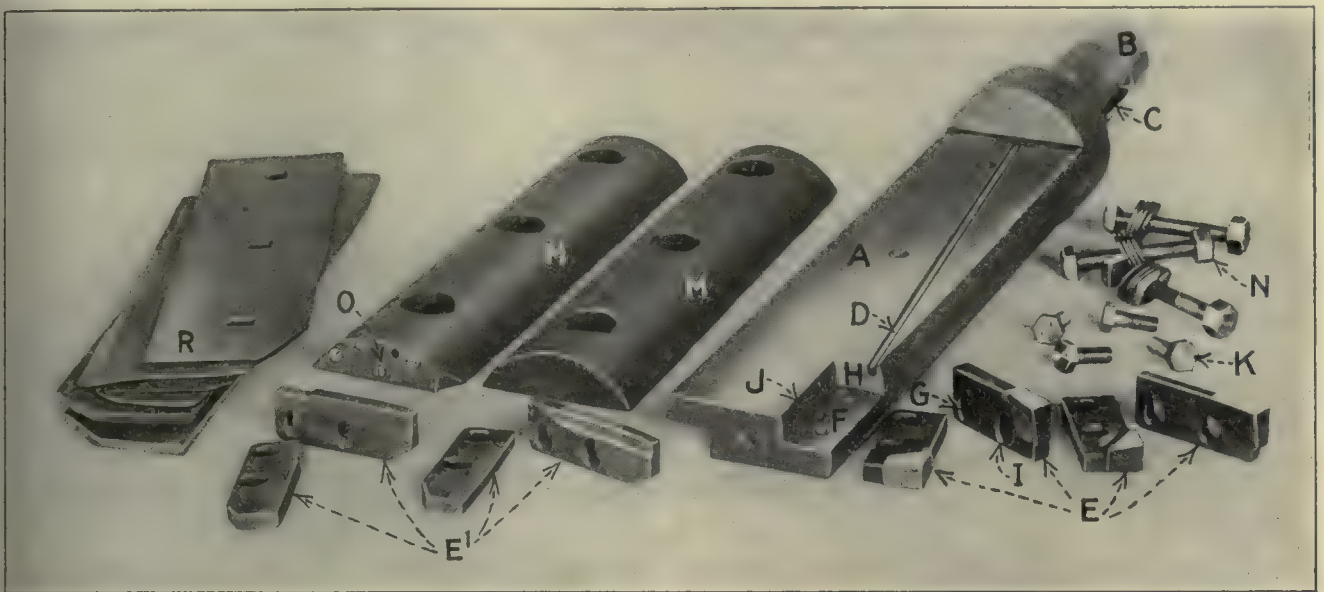


FIG. 5. COMPONENT PARTS OF COMBINATION BORING TOOL

As the end of the forging was set upon the rotating center P when the spot O was turned, the end of the hole is pretty sure to run approximately true; for this reason the first test of the concentricity of the tube is taken at a depth of 1 ft. To do this the lathe carriage is moved till the first foot graduation on the telltale is flush with the end of the tube.

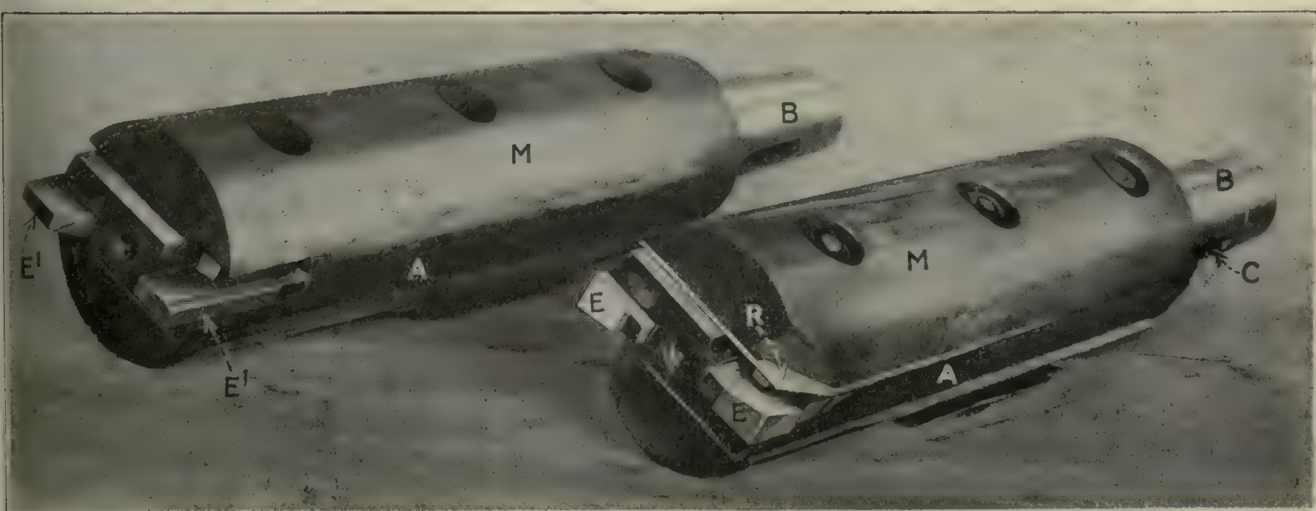


FIG. 6. FINISHING REAMER AND HOGNOSE READY FOR FINAL SIZING OF THE WOODS

Before proceeding with the telltaling the operator chalks the figures 1, 2, 3 and 4 on the four jaws of the chuck and also chalks a mark on the tube opposite the No. 1 jaw. This is done so that the approximate locations of the eccentricities of the bore can be known.

With the work and chuck so turned that jaw No. 1 is at the top, the operator sets the needle of the surface gage M to one of the larger graduations on the scale K, as, for instance, at an inch mark. He has already prepared a piece of paper, as shown in Fig. 4, so that the record of the errors can be kept for reference should they prove so bad that they must be corrected. The row of figures 1, 2, 3 and 4 at the top represent the four jaws of the chuck. The vertical figures on the first column represent the depth in feet within the tube at which the readings have been taken. It will be noticed that all the reading under No. 1 jaw are at zero. The reason for this is that the readings for each depth are started at the No. 1 jaw and the needle of the surface gage is set anew on the inch graduation on the scale as the readings for each depth are begun. Having set the needle to the inch graduation on the scale the operator turns the work and chuck till the No. 2 jaw is at the top. He then looks at the needle of the surface gage and observes whether the scale has moved up or down with relation to it. If the telltale has moved up or down, the reverse of the amount of its movement will be readily seen and read in the altered position of

the inch graduation with relation to the surface-gage needle. If there be any change it is marked on the chart in the square under No. 2 jaw and opposite the 1-ft. depth, the letter *a* meaning above and *b* below. The work and chuck are then turned to bring No. 3 jaw on top, and the next reading taken and recorded. After No. 4 jaw has been telltaled in the same manner the carriage is moved to bring the telltale to the 2-ft. depth; the surface gage is again set at the inch mark on the scale and the operation repeated.

The chart shown is not from actual practice, but shows conditions that might very easily occur.

Having telltaled each foot of half the length the tube, it is reversed end for end in the lathe and the other end telltaled in precisely the same manner. If the maximum eccentricity is not enough to prevent the tube from cleaning up both inside and out with the steadyrest spots used in telltaling it, the operator proceeds with the next operation; which is internal spotting for the rough- and finish-boring tools.

If, however, the eccentricity at any point is so great that the tube will not clean up both inside and out, the new steadyrest spots must be made to offset the inaccuracies of the tube.

To do this the one end of the tube is gripped in the chuck in the headstock of the lathe while the other is gripped in a similar four-jawed chuck that is revolvably mounted on the tail spindle of the lathe in place of the cone center *P*, Fig. 3.

The chart, Fig. 4, numbered jaws and chalk marks on the tube tell the operator the amount and location of the eccentricities on the inside of the tube. The exterior of the tube is under his eye and he can see just how much he dares to throw that. He then proceeds to divide up the available metal between the exterior and the interior. This is done by shifting the jaws of the chucks at either or both ends. The original spots on the tube give him positive surfaces from which to measure. Measuring is done with the aid of a surface gage set on a parallel athwart the ways of the lathe.

Having thus balanced the external and internal eccentricities he proceeds to turn new steadyrest spots. These are usually made alongside of the original ones and nearer the ends of the tube. Having made the new spots, the muzzle end of the tube is again carried in the steadyrest, the four-jawed chuck is removed from the tail spindle and the tailstock run back out of the way.

The boring tools used for gunmaking are what used to be called lag drills; that is to say two lipped drills cutting at or near the end and steadied in the bore by wooden lagging which fits tightly in the hole made by the drill itself. Where drills of this type are used the hole must be started for them. This is done with an ordinary, single-pointed boring tool held in the tool-post of the lathe.

The internal spot marked *A*, in Fig. 1, is for the finishing tool, or reamer as it is termed in the arsenal, and the one marked *B* is for the roughing drill or hog-nose. These two tools are put through the tube before it is turned on the outside preliminary to shrinking on the jacket. It will be observed that the finish bore is 4.6 in., which leaves 0.10 in. to take out before the gun is finished. This allowance is necessary because of a slight distortion that may occur in the shrinking operation. (It may be noted that the size of the hole is also

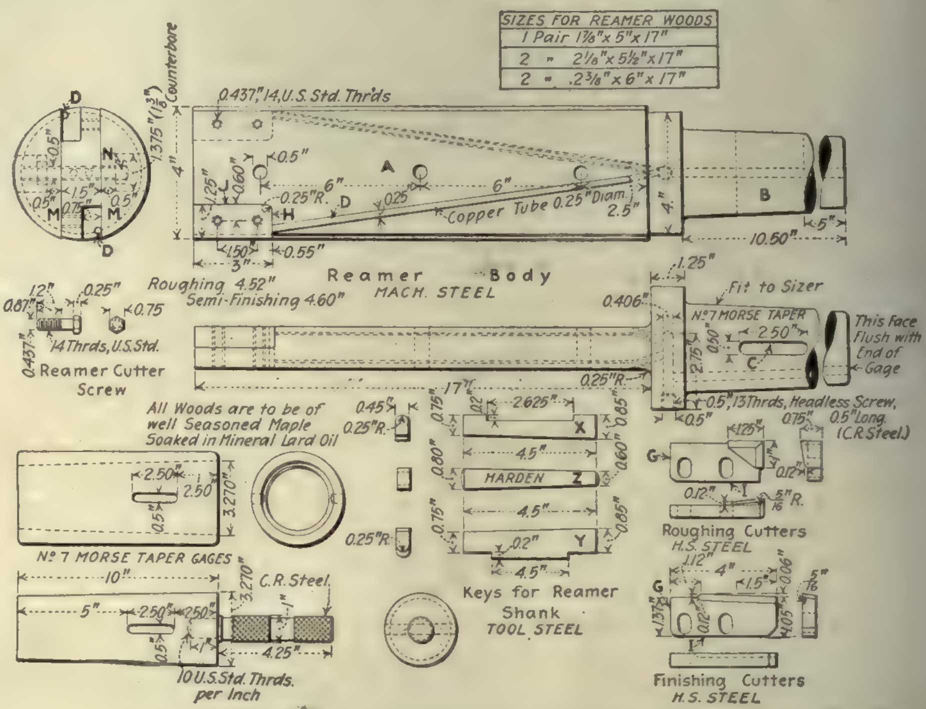


FIG. 7. DETAILS OF COMBINATION BORING TOOL AND PARTS

likely to be decreased by the compression of the jacket when it is shrunk on; this will be referred to later.)

The speeds for spotting this size tube at the arsenal are 14 r.p.m. for the roughing cuts and 6 r.p.m. for the finishing cuts. No lubricant is used for the external spots, but on the internal one, marked *A* in Fig. 1, lard oil is used to obtain a smooth surface that will not cut the woods on the finishing reamer.

The tube is now ready for the boring operation, but before following it to that operation we had better go over to the reamer department and see how the hog-noses and finishing reamers are made.

It was previously stated that the boring tools are practically the same as the old lag drills used years ago for boring straight holes; but while their principle is practically the same, the tools used at the arsenal and developed there in past years possesses refinements and conveniences not known to the users of the old-style tools. The results obtained with these tools are remarkable. For instance, when boring the tube for a 16-in. gun recently, one side of the boring tool in places took a cut of about ⅝ in. while the other side was cutting barely ⅛ in.; the hole was nearly 70 ft. long and in that length the variation from a straight line was less than 0.01 in.

The heads of the boring tools are for the smaller sizes—in which the 4.7 in. is included—made of machine steel. The larger ones are made of steel, semi-steel and in some cases of iron castings. The form of head now almost universally used at the arsenal is

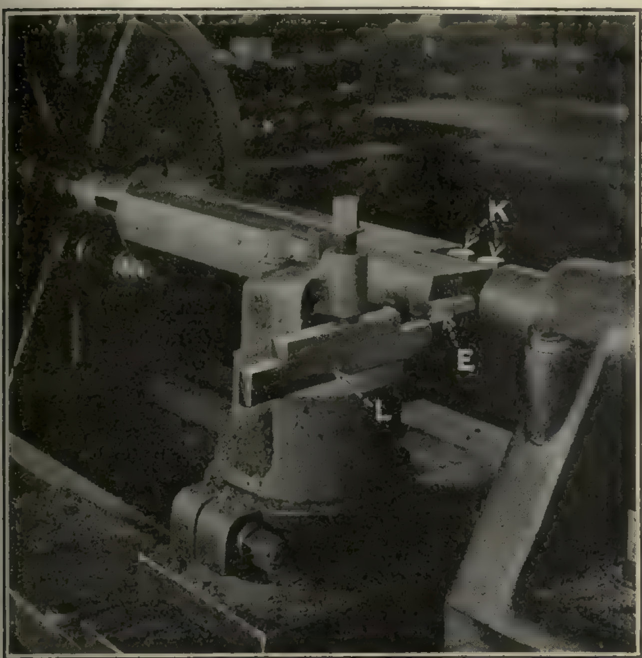


FIG. 8. BORING HEAD ON CENTERS READY FOR ASSEMBLING

shown in Figs. 5, 6 and 7. It is termed the combination head; that is to say, by merely changing the cutters the same head is used for both roughing and finishing. Centers are provided at both ends of the body *A*, which is finished all over. At one end is the taper shank *B* that fits the tapered hole in the boring bar. A cotter hole *C* passes through the bar and taper shank, and two keys and a cotter *X*, *Y* and *Z* seat the head *A* securely in the bar and prevent it from turning under working conditions. The head is drilled for two oil ducts, the face of the body being milled for two copper oil pipes *D* which lead the lubricant directly to the cutting edges of the cutters *E*. The boring bars are provided with copper oil tubes laid in milled grooves along the sides. The seats for the inserted cutters are also uniformly machined so that the inserted cutters can be used interchangeably. Each head will bore a variety of sizes within a fairly wide limit. This latter feature is obtained either by packing the cutters out radially or by using wider cutters, and of course means lengthened life for the cutters, as they can be reground and packed out to size. The packing for the cutters is made of steel, brass and paper.

Combination Boring Head

The line engraving, Fig. 7, and the illustrations, Figs. 5 and 6, give an excellent idea of the combination boring head. The inserted cutters *E* and *E'* are provided with elongated bolt slots for radial adjustment. The face *G* fits snugly against the back *H* of the cutter recess in the head, and the face *I* either abuts direct on the face *J* or upon shims between it and *I*.

The operation of preparing a boring head for use is as follows:

The operator inserts the cutters in their seats in the head, if necessary packing each side out the required distance with shims of steel, brass or paper so that there will be a few thousandths to grind off the edge. Before finally tightening the capscrews that hold the cutters he sees that they are properly seated at both edges where they bring up against the seat in the body. This he does with a hand hammer. This assembling is done with the head between centers in the lathe, as shown in Fig. 8. The capscrews *K*, Figs. 5 and 8, are then screwed down tightly and the seating of the cutters again tried with the hammer. The operator then takes a rectangular piece of copper of a size that will fit the toolpost of the lathe and sets it in the toolpost, as shown in Fig. 8 at *L*, just as though he were going to turn the cutters with the soft copper tool. The reverse however is the case, for with his hands he turns the boring head, and with one of the cutters takes a light shaving off the end of the copper tool. Without changing the position of the copper tool the second lip is brought around also by hand and its location with relation to the shaved

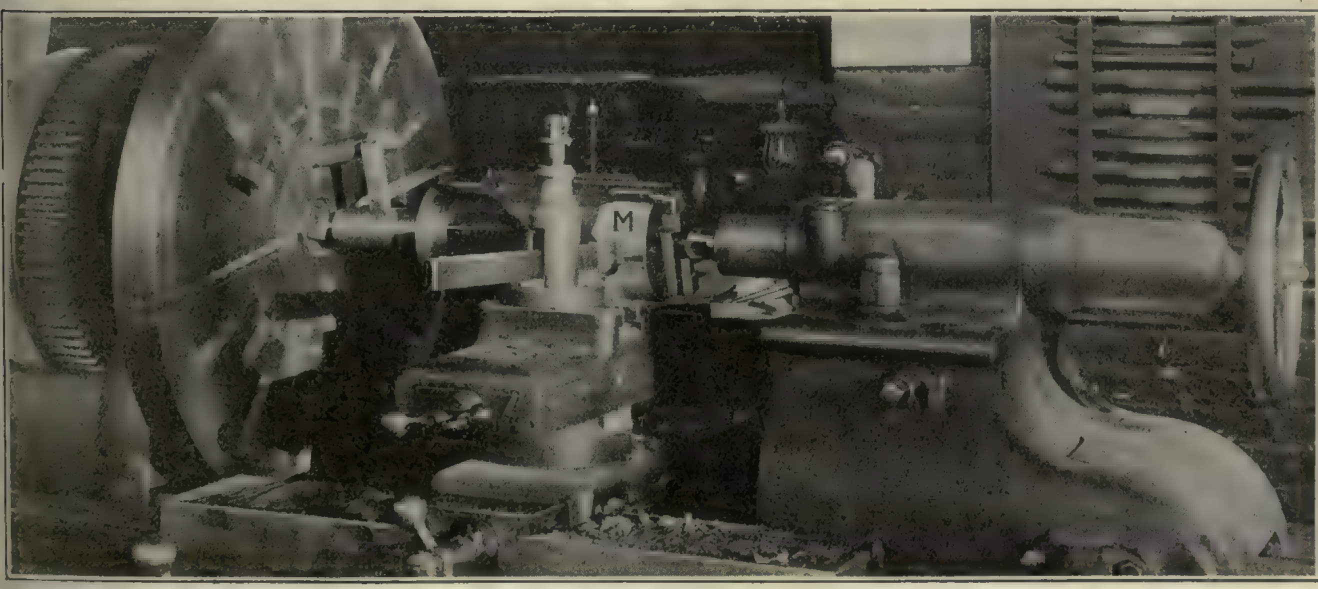


FIG. 9. ROUGH TURNING THE WOODS

portion of the copper tool noted. If necessary one or other of the inserted cutters is packed out so that they both will be equidistant from the axis of the head.

The next operation is grinding. In the smaller sizes this is done between centers on a cylindrical grinding machine and needs no explanation. On the larger sizes the grinding is done by a grinding attachment in the large lathe where the boring tool is assembled. The cutters referred to as E, in Figs. 5 to 8, are those for the hognose, which cut on the forward end only. The front ends of the cutters are next ground with a cutting clearance of 3 degrees. The cutters having been ground the head is taken back to the lathe and tested again with the copper tool. This time the operator carefully stones away any difference in height of the forward or cutting edges of the two cutters E. The head is now ready for the lagging of wood pieces M, Figs. 5, 6, 7 and 9. The wood used in the arsenal is hard maple soaked in mineral-lard oil, but the writer has used hard English beech and apple wood, both of which gave satisfaction.

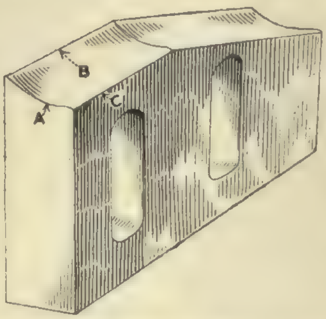


FIG. 10. RELIEF OF FINISHING BITS

To hold the wood pieces in this size of head, three ½-in. bolts N, Fig. 5, are used. The wood pieces M are counterbored as shown, so that there is no chance of the bolt heads or nuts coming in contact with the bore of the tube. When old wood pieces are used they can be shimmed out to turning size with poplar veneer of various thicknesses or with paper, shown at R, Figs. 5 and 6. To prevent the steel borings working their way back and catching between the tube and the wood pieces, brass plates O, Fig. 5, are screwed on the forward faces of the wood pieces; but before these are put on, the wood pieces are roughly turned to about ⅛ in. oversize, as shown in Fig. 9. The final finish turning of the wood pieces and brass faces is done only just before the boring heads are to be used. The reason for this is that the wood pieces shrink and swell with the temperature and atmospheric changes of the shop. When the boring-lathe operator is ready for the boring head it is put in the lathe and the wood pieces are turned 0.005 in. larger than the size the cutters are set to bore.

As previously stated the cutting angle of the hognose tools is about 3 deg. The faces of the bits presented to the cut are about square with the axis of the head. Some operators prefer to have the faces of the two bits so ground that they present an obtuse angle of a little less than 180 deg. to the work, the apex of the angle being in front of the forward end of the head.

As the hognose tool will be immediately followed by the finishing reamer it may be just as well to describe the work of setting, stoning and finishing the reamer blades E^1, Figs. 5, 6 and 7. These are set in the head in exactly the same manner as the hognose cutters. It will be seen that they center the tube with a tapered end and not squarely or quasi-squarely across it, as do the hognose cutters. Behind the taper the cutting edges are parallel with the axis of the head. After they are ground conically on the end and cylindrically at the part behind the taper the operator grinds them concave, as shown at A in Fig. 10. The object of this is to facilitate the final finishing of the cutting edge with the carborundum oilstone. In other words it gives him less metal to remove. The land at B, in Fig. 10, is about $\frac{1}{32}$ in. in practically all sizes of bits. The heel at C is relieved just enough with the oilstone so that it does not bear on the tube.

In operation the bits are disposed in a horizontal plane passing through the axis of the tube being bored. There is of course more wear on the bottom wood than there is on the top one. This results in a dropping of the head and brings the bits below the center line of the work. Theoretically this would result in an increase of size in the hole, but practically there is no increase, or at most so slight an increase that the wear of the bit will offset it. The action is practically the same as that of a turning tool in an engine lathe. With the tool on the center line of the work a slight vertical displacement of the tool does not materially affect the diameter of the work, but a radial displacement causes a variation in size equal to twice the displacement.

In case anyone else should fall into this same error it may be as well to state that a four-bitted boring tool was made and tried out at the arsenal. This was arranged when in working position with one cutter top and bottom and one on each side. The wear of the wood naturally took place on the bottom, and while this displacement of the boring head, due to wear, did not affect the work done by the cutters in the horizontal plane the ones in the vertical plane were dropped from their starting position by an amount equal to the wear on the wood at the bottom; and as the wear was cumulative the hole gradually increased in size by twice the amount of the wear on the bottom wood.

Defective Milling-Machine Design

By Donald A. Baker

The writer heartily agrees with E. P. Armstrong, page 348, *American Machinist*, in regard to the length of milling-machines saddles. Particularly have I noticed this defect of late in a number of the vertical-spindle milling machines which we use in our drop-forge die-sinking department.

While we use the largest and heaviest types of machines, they are far from being rigid enough for the work; for not only is the supporting knee narrow but also the saddle carrying the table; and when one gets a die block weighing somewhere around 5000 to 6000 lb.—and we have plenty of these—one needs a machine that is built from the ground up. In the case of these milling machines it seems to me a waste of time to make them with a vertical adjustment to the table which necessitates the use of a knee and its attendant evils.

How much easier and simpler would it not be to make a massive base with cross and longitudinal tables on top and wide and well-supported bearing surfaces under them, and let all vertical adjustment be taken care of in the head, which is certainly much easier to handle than a heavy die block, knee, saddle, and table weighing four or five tons.

How to Increase the Efficiency of the Shipyards

By CHARLES PHILIP NORTON

One thought that is probably uppermost in the minds of every true American may be expressed by the question, "How can we speed up the war?" The author of this article discloses how the men who are in closest contact with the shipbuilding industry—the man on the inside, as it were—feels about it. At the same time the author strikes a note of optimism that will find echo in the heart of every loyal citizen.

EASTERN reports that organized labor in the Seattle shipyard is holding up the Government and the employers for the purpose of obtaining high wage rates are erroneous. The wage schedules now in effect were agreed to by, and are mutually satisfactory to, the Government, the employers and the workers. The reports that the policy of "folded arms," or sabotage, is practised in the shipyards at Seattle are best answered by the fact that these yards are launching for the emergency fleet a new steel vessel every eight days, and that more than one million tons of steel and wooden ships will be built and delivered for the national merchant fleet before Christmas bells ring again.

Industrial harmony prevails at Seattle. The *esprit de corps* is such that the army of 21,000 workers is doing its best to maintain leadership in production. The unusual spectacle is presented of a coalition between capital and labor in all war work, their joint efforts being coördinated and centralized through a wideawake Chamber of Commerce and an equally diligent and intelligent Central Labor Council. All debatable industrial problems have been postponed until after the war, and indications point to a long era of coöperation between the two great factors in industry and commerce. This amicable situation may not appeal to persons who want industrial war in centers of war work, but it is a situation eminently satisfactory to the Pacific Northwest.

The Seattle shipyards are new. Thousands of the skilled workmen are erstwhile mechanics in the building and structural-iron trades. The labor turnover in Seattle would make a separate story of itself, but results count most, and the brilliant fact appears that the Seattle shipyards are producing more vessels with which to win the war than any other place in the country.

Hoping to contribute something toward ways and means of speeding up ship production the writer sought out among the expert machinists in one of the principal yards the man who, according to his fellows, best knew what should be done to attain maximum efficiency. We will call him Bill, a master machinist, working under direction, who for 30 years has commanded top wages. Given permission for a half hour's talk, Bill said:

"Sure, we skilled machinists know how to speed up production. We are doing all we can under present conditions, but the great thing needed in all the shipyards is inspection by United States Government experts. I mean this, that the Emergency Fleet Corporation should immediately employ a corps of inspectors, selecting them from among the skilled mechanics in each shipyard, where they are familiar with conditions. These men, of whom there are many available, should know their trade in every department. They should understand toolmaking and toolroom practice; they should be familiar with the labor problem; they should be American citizens; they should be sincere and full of zeal for the war. Being all of this they would be genial and friendly toward the men. They would evince the spirit of helpfulness, teaching here, helping there, giving a word of commendation for high efficiency, admonishing how to improve and how to qualify for higher rating.

Knowing the Weak Spots

"The skilled workmen know the weak spots; they know how to eliminate them, how to build up production, how to keep the men on their toes and keep them satisfied. Officers in the army look first to the safety and comfort of their men; they relieve them of unnecessary danger, of unwarranted abuses, of superfluous tasks. General Pershing the other day, on inspecting the battlefront, trudged through the icy muck of the trenches, halting men to ask them if their feet were warm; if they had enough to eat, etc. He is sincere about it, and his men know it. They would die for him and be glad of the opportunity. The human equation, therefore, is first. Man-power is the chief essential. The workingmen, and this includes our comrades in the trenches, must win the war. We are all soldiers."

A remark by the interviewer caused Bill's eyes to flash fire. He said: "Let me tell you something, sir. If the Government were building ships for the emergency fleet upon a nonprofit basis, building them at cost, to win the war, nine out of ten of the skilled mechanics would care nothing about the wage scale. Put that in your pipe and smoke it. It is straight stuff. Suppose the war were let on contract and various captains of industry employed the fighters at a figure as low as they could get them, making a handsome profit on their services. What would be the morale of the troops? Would they feel the same urge to fight and die? Would they be satisfied with army wages? We are giving now an honest day's work for an honest wage. American workmen resent the slanders that are being heaped upon them."

Persuaded back to the main subject, Bill said: "What we need is competent inspection. The men are eager for the highest efficiency. We need inspectors who understand operating costs, machine costs, material costs; how to keep the machines in good condition and going at top speed; how to prevent accidents, waste, damage and delay. First of all, we should eliminate

all inspectors who are not bona fide American citizens. Foreign methods won't do in American industry. Ideas that work fairly well in England or Australia don't fit into the American scheme of things. We see errors on all sides, technical mistakes in design and management, mistakes costly to the employers and the Government, mistakes that probably cost lives; and with inadequate inspection and supervision these mistakes become progressive errors and so general efficiency is reduced."

Bill ran after his visitor, as an afterthought, saying confidentially: "Don't quote me as criticising the inspectors. I'd get the can and that might cause trouble." There's a lesson in this too.

Technical Training School

Business men in Seattle, proud of the achievements in the shipyards, earnestly desiring to increase war work and to develop shipbuilding into a great permanent industry, early in February appointed a committee to devise ways and means of establishing a technical-training school for the development of executive talent. Men like Bill, the skilled machinist, will be enrolled as students. A full course will be provided, including trigonometry, arithmetic, designing and everything requisite to efficiency. The idea is to train for the work the inspectors and executive foremen now so scarce and so badly needed in every shipyard.

This school will be made permanent. The plans include an assembly hall for every shipyard, equipped with a library of technical books and the literature of the various trades. The classes will be taught at night and during leisure time by skilled men of the highest efficiency.

Meanwhile the state of Washington has appropriated $20,000 a year to be expended in providing a training ship for nautical students. This school will develop crews for the deep-sea vessels produced in the Puget Sound shipyards. The ship will be equipped with all necessary apparatus, a library and modern facilities. A corps of instructors is being selected. This service was the outgrowth of an idea proposed by "Bert" Alexander, the famous president of the Pacific Coast Steamship Company.

The shipbuilders of Seattle have a splendid slogan heard in crescendo at every launching. This shibboleth alone and the energy of its utterance by the toilers should be sufficient to give the lie to the far-reaching story that these shipyard workers "have used dynamite," or that they practice the "folded arms" policy, etc. Here's the slogan:

"Washington! First in peace, first in war, first in the fears of autocracy!"

Dr. Garfield on Democracy After the War

A decidedly interesting phase of the present crisis is that men in various walks of life are thinking along similar lines with regard to our human relationship. We have had Charles Schwab and Chief Justice Hughes and Theodore Shonts point the way toward greater democracy. Now comes Dr. Garfield in his address to the alumni of Williams College. Said he:

"After the war is finished, when peace shall have come, the conflict that will engage our young men now under arms will be the conflict of democracy against autocracy in our political, economic and social life. Most of us are unconscious autocrats. Some really believe that the country would be better off if they were left in undisturbed control. They are less concerned about justice and fair dealing than about efficiency and large profits. We can pay too much for efficiency. In the choice between efficiency and the democratic spirit of coöperation among willing workers let us have the latter by all means.

A Monoply of Virtue

"My experience with the coal problem has proved to me that neither capital nor labor has a monopoly of virtue. If capital has in some instances endeavored to profit overmuch in the present emergency, labor has also been at fault; for there have been those, some of them leaders, who have apparently been unable to put aside selfish interests and to work only, as the great majority have done, for the common good. But these are the exceptions. The great majority of the operators and mine workers with whom I have come in contact have seen the vision and they deserve praise for their attitude in the present crisis. They have been ready at all times to sacrifice all, if need be, in the spirit of true coöperation.

"I cited the exceptions merely to indicate something of the nature of the problem with which these young men must deal in the coming days when the sword shall have been sheathed and when the great work of rehabilitation is undertaken. They have responded nobly to the nation's call to arms, informed by their experience and inspired by the vision of a world made free. They will assuredly enlist in the great enterprise of peace which shall be the establishment of the spirit of democracy in our own midst. They will array themselves on the side of those who demand equal justice and fair opportunity, and against those who, by whatever means, would secure themselves in power against the common welfare. I do not fear the result because our young men have risen to notable heights. They too have seen the vision and they will not allow the hope of America to fail."

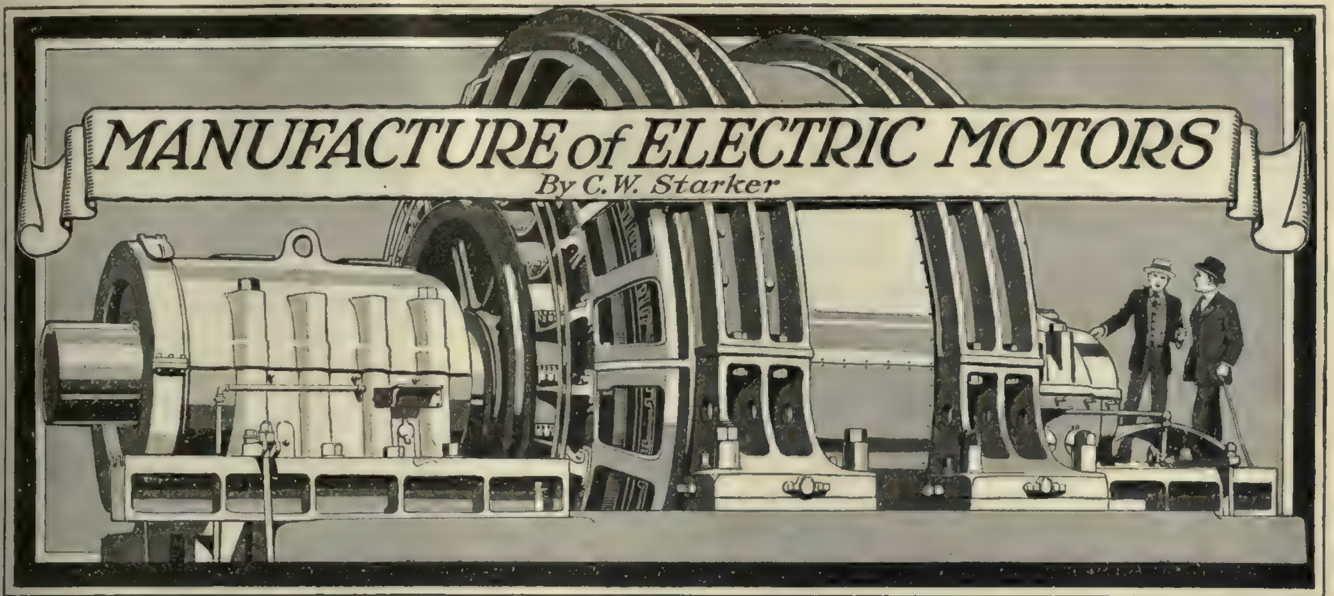
Cottonseed Oil as a Lubricant

By Burton L. Casner

The writer was trying to spline some small gears of a particularly tough grade of tool steel and was not having the best of luck, the cutters roughing up, choking and breaking until patience was exhausted.

The splines were $\frac{1}{8}$ x $\frac{1}{4}$ in. in a bore $2\frac{1}{2}$ in. long, and the machine was a small Mitts & Merrill. The tool was the usual form of pull cutter used in this machine fed to the cut by a wedge. There was nothing wrong with either machine or cutters except that they simply would not cut.

I had been using lard oil for a lubricant, but thus far had experienced nothing but trouble and I was getting desperate. As a last resort I applied cottonseed oil and the effect was magical—the cutter stopped choking and got busy; failure had become a success. and a new name was added to the list of panaceas for the evils that beset us.



XII—Balancing, Assembling and Inspection

Preceding installments have described in detail the manufacturing processes and construction of the revolving element of motors, these elements in direct-current motors being called armatures, while in alternating-current motors they are called rotors. This installment deals with the balancing of rotating parts and with the assembling and inspecting of motors.

BEFORE assembling in the stationary elements, the rotors and armatures must be tested for balance; that is, any uneven distribution of weights must be equalized by adding or removing weight at the corresponding points of the armature or rotor, so that there will be a minimum of vibration in the motor when running at any speed for which it is designed. There are two methods of balancing. In one—the static balance—the rotor rests on ways accurately set up, Fig. 127; if in proper balance it should remain stationary in any position. If it rolls and shows a tendency of coming to rest with a certain point at the bottom, it is not in balance, but probably an excess of weight is present at the bottom point. This is equalized either by drilling away material on the heavy side (a practice followed only on very small units) or by adding weight on the opposite side. The latter is done either by fastening steel or lead weights in the proper place, or by pouring molten lead into suitable pockets provided for the purpose on the rotor. The amount of weight required is determined by trial. This method of balancing is simple and sufficient for slow and medium speeds. For higher speeds (above about 1800 r.p.m. for the average diameter of rotor or armature) a dynamic balance is required. In this method the rotor is tested under running conditions at different speeds on a special testing machine, Fig. 128. The rotor shaft rests on rollers supported by a sensitive, pivoted, vertical arm, so that any vibration becomes magnified and readily detected. Pointers at each end of the shaft indicate the point out of balance, but the amount to be added is a matter of experiment.

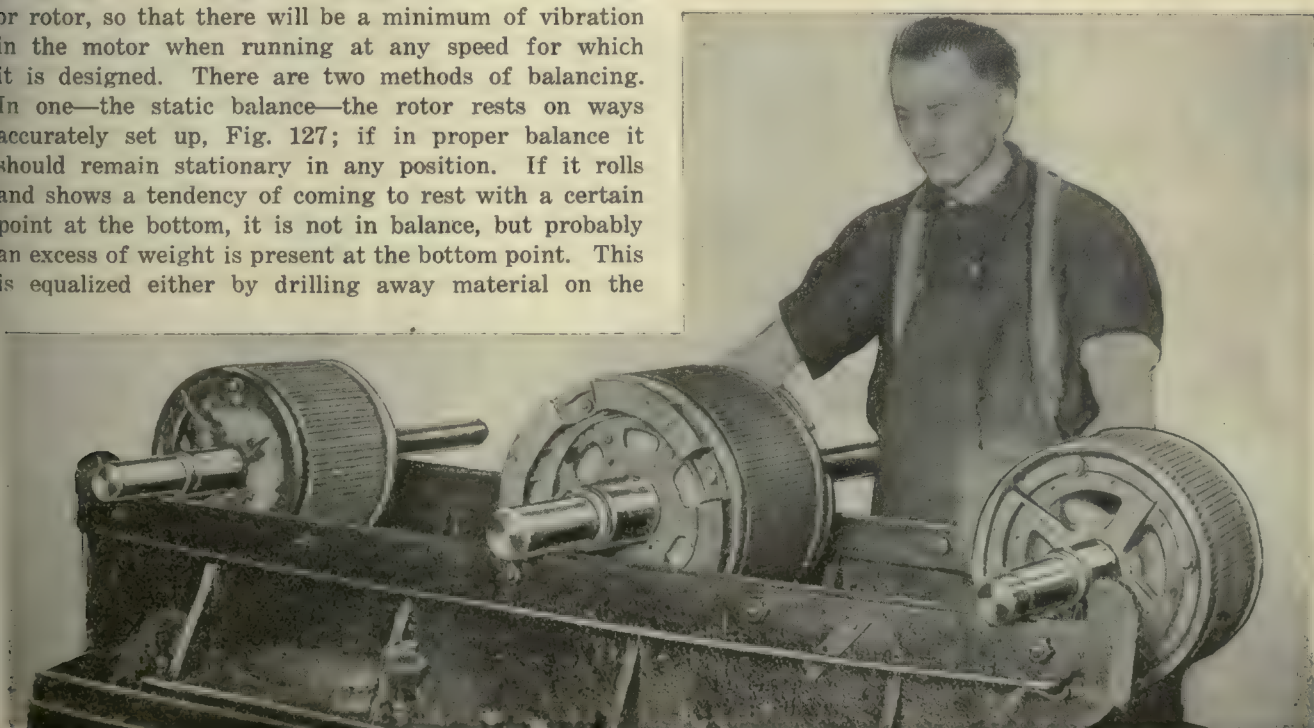
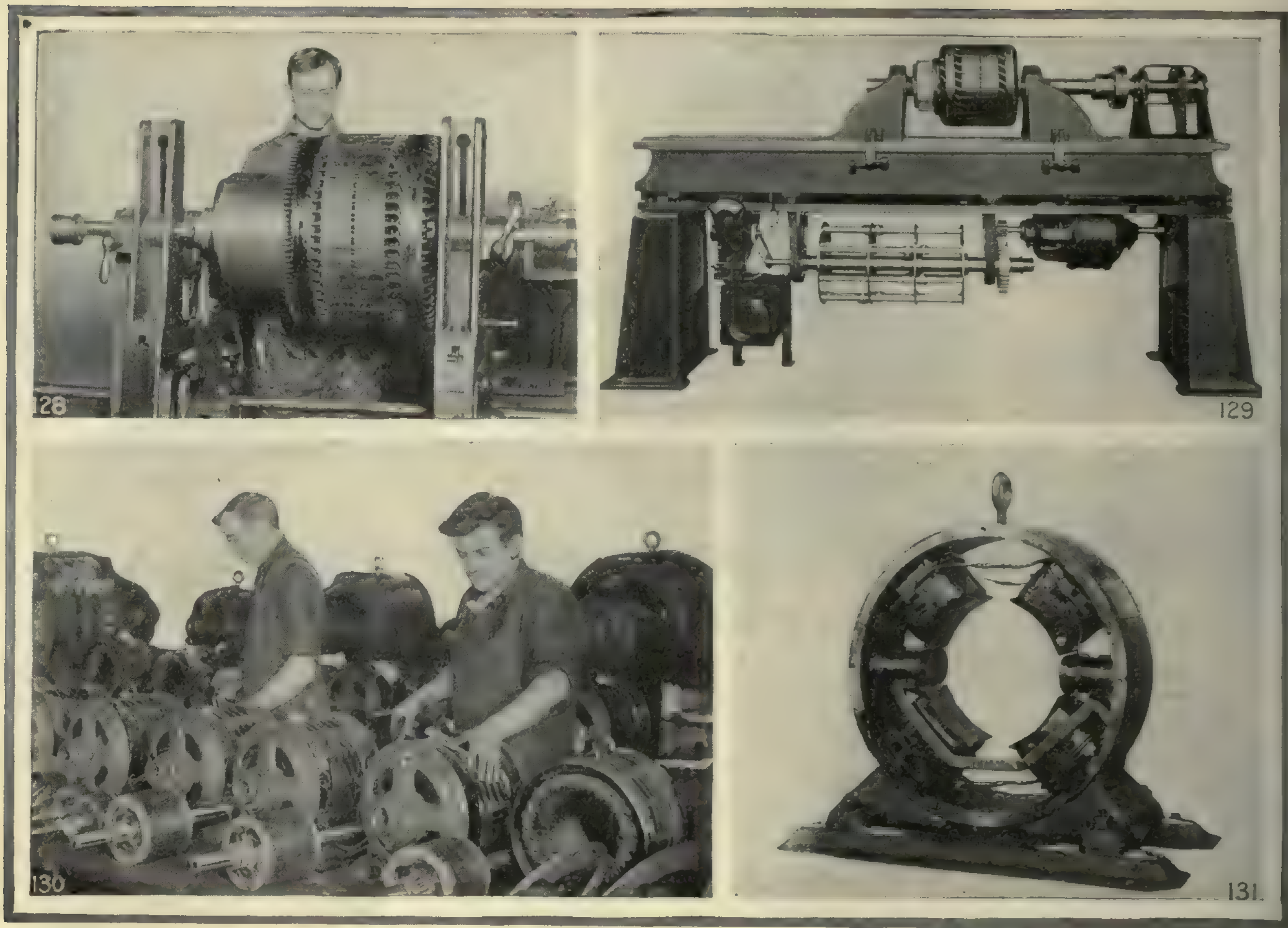


FIG. 127. STATIC BALANCING OF REVOLVING PARTS



FIGS. 128 TO 131. BALANCING AND ASSEMBLING OPERATIONS

Fig. 128—Dynamic balancing. Fig. 129—Special machine for dynamic balancing. Fig. 130—Assembling standard alternating current motors. Fig. 131—Direct-current stator with poles and field windings asembled

Dynamic balancing therefore is an operation requiring both time and skill. Of late special machines for dynamic balancing, Fig. 129, have been placed on the market. They have a device in which weights are shifted along horizontal bars, duplicating, so to say, the armature or rotor to be balanced. By this means not only the position but the amount of weight may be predetermined. Dynamic balancing differs fundamentally from static balancing in that it takes into consideration the crank action of weights angularly displaced.

The assembling of the standard squirrel-cage motor, Fig. 130, is a simple matter, consisting merely in inserting the finished rotor in the finished stator and bolting the bearing brackets in position. After checking for end play and measuring the air gap between stator and rotor all around with a feeler gage, to see that it is within the permitted manufacturing variations, the motor is passed on to the test floor. The assembling is more complicated in direct-current machines, Fig. 131, as the polepieces and field coils must be assembled in place, cable connections made, and brush holders and carbons assembled on the motor. Wiring diagrams are used for making the connections. All these operations of setting carbons, etc., are very important and must be done very carefully. For instance, the spacing of poles is very essential for proper commutation. A manufacturing allowance of $\frac{1}{16}$ in. between the tips of main poles and $\frac{1}{32}$ in. between main and interpoles must be adhered to. The proper means for supporting field coils is also important from a service standpoint. Heating of coils with consequent expansion, together with variations in coil dimensions occurring in manufacture, is best taken care of by a spring support placed between motor frame and coil. This spring and the general construction of the support must be adequate to withstand indefinitely the action of the magnetic field, tending to push and pull the coil along the polepiece with every reversal of the direction of rotation, or starting and stopping of the motor.

The Inspection

After the motor is assembled each unit is given a thorough inspection just as every part is inspected after each operation as referred to in describing the manufacture of the part. If inspection is deferred until an apparatus is completed or even after some of the manufacturing operations on a part have been performed, it will come too late completely to fulfill the purpose; the material used will be spoiled, and the time and money spent in labor will be lost. Inspection must therefore begin with the raw material. For instance: Insulating materials must be inspected and tested before they are used in coils, and sheet steel must be analyzed and tested as it comes from the mill and before it is worked up into punched or drawn parts; for if the material is not up to the requirements, the result will be a large percentage of defectives. Inspec-

tion of materials is particularly called for in the electrical industry, for nowhere else is such a variety of materials required in manufacture. I have before me a card index of approved materials containing over 700 distinctly different kinds, most of which are carried in stock in many different sizes. I do not propose to enumerate them, but just to give an idea of the variety. There are asbestos, steel balls, glass beads, felt, fiber, Fuller board chains, channels, clock springs, marble, slate, soapstone; every kind of wood; nearly all the metals, and many alloys; silk and cotton, canvas in 35 different thicknesses; celluloid, carbons, rubber sheet tape and tubing; mica, rivets, bolts and screws; twine, wire, cables, porcelain, varnishes, enamels, shellac, wax, tallow, gum, oils, grease, lacquers of 100 different finishes; paints, turpentine, glue, plaster,

WESTINGHOUSE ELECTRIC & MFG. CO., EAST PITTSBURGH, PENN.

Process Specification No. Date Changed

BABBITTING

GENERAL—This specification covers the process to be followed in babbitting bearings.

PROCESS—Operations, Cleaning, Machining Shells, Tinning, Babbitting, Peening, Finishing, Marking.

Each operation shall be performed as described in the following paragraph:

(Each operation is described in detail and the following added:)

Care of bearing metal; Separation of turnings.

MATERIALS:

Name: Remarks:

Approved: Approved:

Engineer For Shops.

FIG. 133. PROCESS SPECIFICATION

resin, borax; chemicals such as nitric, sulphuric and hydrochloric acid; alcohol, glycerin and cyanide. Each of these materials is purchased under a strict specification.

A purchasing specification covers the necessary requirements as to chemical composition, physical strength, permissible variation in dimensions, tests to be made before shipment, and so on. For steel and similar materials, tensile strength, elongation, contents of carbon, phosphorus and sulphur are specified. Conductivity; dielectric strength; influence of water, heat or oil; magnetic permeability, etc., come in on other materials and are all carefully checked. A physical laboratory equipped with all necessary testing machines, and a chemical laboratory, Fig. 132, are maintained for this work. Figs. 133 and 134 are facsimiles of specifications used by the Westinghouse Company.

WESTINGHOUSE ELECTRIC & MFG. CO., EAST PITTSBURGH, PENN.

Purchasing Department Specification

Cold Drawn Steel (Automatic Screw Stock)

The material desired under this specification is a free cutting steel of any specified section, suitable for high-speed, screw-machine work, leaving a smooth finish after being machined.

I. MANUFACTURE—The steel shall be made by the Bessemer process.

II. CHEMICAL PROPERTIES—The chemical analysis shall be as follows: Carbon, 0.08% to 0.16%; Manganese, 0.60% to 0.80%; Phosphorus, about 0.10%, not more than 0.13%; Sulphur, 0.09% to 0.15%.

Samples for analysis shall be taken in such a way as to represent the average of a full section of one or more bars.

III. DIMENSIONS—The variation from the specified diameter or distance between parallel faces shall not exceed the following limits:

	Over Size, In.	Under Size, In.	Variation From True Section, In.
Up to ½ in.	0.001	0.002	0.001
½ in. to 1½ in.	0.001	0.002	0.002
1½ to 3 in.	0.001	0.003	0.002

Ordinarily the material will be ordered in 10-ft. lengths, with allowable variations as follows: At least 70% shall be 10 ft. long. 30% may be furnished in shorter lengths, but no rod shall be less than 8 ft. long.

IV. FINISH—All rods shall be cold drawn, so as to leave a bright, smooth, surface.

The rods shall be free from injurious defects, such as cracks, rough surfaces, seams, etc., and shall be straight and true to section. No crop ends will be accepted.

V. PACKING AND MARKING—Rods up to ⅝-in. diameter, inclusive, or other sections up to the same cross-sectional area (0.307 sq.in.) shall be shipped in bundles weighing not more than 125 lb. each.

VI. REJECTION—The Westinghouse Electric and Mfg. Co. reserves the right to reject any portion or all of the material which does not conform to the above specification in every particular, and to return the rejected material to the manufacturer or seller for full credit at price charged f.o.b. point of delivery specified by the purchaser. If the material is to be replaced, a new order will be entered at prices, terms and conditions acceptable to the purchaser.

Approved, June 18, 1906; revised, Nov. 8, 1912; revised Feb. 12, 1913.

B. G. LAMME, Chief Engineer.

FIG. 134. TYPICAL PURCHASING SPECIFICATION

FIG. 132. CHEMICAL LABORATORY

Delivering the Goods

Author Unknown

There's a man in the world who is never turned down
Wherever he chances to stay;
He gets the glad hand in the populous town
Or out where the farmers make hay.

He's greeted with pleasure on deserts of sand,
And deep in the aisles of the woods;
Wherever he goes there's a welcoming hand—
He's the man who delivers the goods.

The failures of life sit around and complain
The gods haven't treated them white;
They've lost their umbrellas whenever there's rain,
And they haven't their lanterns at night.

Men tire of failures who fill with their sighs
The air of their own neighborhoods;
There's a man who is greeted with love-lighted eyes—
He's the man who delivers the goods.

One fellow is lazy and watches the clock
And waits for the whistle to blow;
And one has a hammer with which he will knock,
And one tells a story of woe;

And one if requested to travel a mile
Will measure the feet and the rods;
But one does his stunt with a whistle and smile—
He's the man who delivers the goods.

One man is afraid that he'll labor too hard,
The world isn't yearning for such;
And one man is ever alert—on his guard—
Lest he put in a minute too much.

One has a grouch or a temper that's bad,
And one is a creature of moods;
So it's time for the joyous and rollicking lad—
For the man who delivers the goods.

—From New Departure News

The Value of the "American Machinist" as a College Textbook

BY J. A. DE TURK

Few people stop to think of the permanent educational value of a technical magazine. This article describes how the "American Machinist" is used in one of the great state universities.

THE long, successful existence of the *American Machinist* is sufficient proof that it fills a need in giving information to those following mechanical lines. Considering the value of much of the information given, the circulation would even be larger were more mechanical men better acquainted with its contents. It may be assumed that some mechanics and engineers do not read the magazine for the simple reason that they never started to do so and because they never studied its contents sufficiently to make an analysis of its proper use. This applies mostly to mechanics, as most successful technically trained men do use such a magazine constantly. Generally some little time elapses, however, between the period when a technical graduate leaves college and his textbooks and the time he begins to realize the importance of an enginering magazine and make it serve in much the same capacity as did his books in college. Partly for this reason employers often complain that a man just out of college is of little value because he lacks the commercial view and is often unable to apply his theories to practical problems.

One Textbook

Bearing these thoughts in mind, all of the junior engineering students taking the course in machine-shop practice and management at the University of Illinois have been required for several years to subscribe for and use the *American Machinist* as one of the textbooks of this course. At the beginning of the course some members of the class subscribe with reluctance as they do not yet understand the necessity of keeping in touch with the activities of the current mechanical field. This then becomes their starting point of reading the magazine, and were the lesson not learned now it is likely that it would be several years after graduation before this magazine-reading habit, and the resultant broader view it gives, would be acquired.

In the beginning of the course the instructor points out in detail the reason for subscribing for the magazine, the method of its proper use and the things to be particularly noted. It is explained that college textbooks are indispensable to laying an engineering foundation, but that successful engineers and managers spend more time reading several technical magazines than they do studying standard textbooks; also that if an engineer wishes to be up to date it is vital that he not only reads the editorials and important contributions but also studies the advertisements. The fact is emphasized that the very latest information on modern methods of doing things must be obtained from magazines, and that the manager who learns of a new machine or a more efficient method of doing a job and applies his knowledge will necessarily be more successful than his less-informed competitor.

On account of lack of time the magazine is not studied from cover to cover by every student, but the instructor goes over every issue thoroughly and makes a list of the strong articles and advertisements. This list is then posted as an assignment, and at frequent intervals written quizzes are given on it. This magazine of course is not the only text employed.

The elements of machine-shop practice are thoroughly drilled into the students by lectures and quizzes and by assignments from a text written purposely for the needs of the course.

Manual Training Schools

High and manual training schools are becoming more and more proficient in teaching the arts of pure manual training, and due to this fact it should be the policy of a college or university to lay more emphasis on the problems confronting the executive than those of the mechanic. At the University of Illinois each junior electrical engineering student spends one semester in the machine shop and each junior mechanical engineering student spends a year in the same shop. Each man reports for eight hours' classwork during the semester.

The problem of the shop is the manufacturing of marine-type, two-cylinder, four-cycle gas engines. Generally there are about thirty men in each section, or class, and each class is divided into three equal divisions, or sections. While two divisions work on machines, benches or the assembling floor, the remaining ten men act as executives, and are responsible for the assignment of jobs for those on purely production work, for inspection of parts after each machine operation, for figuring the efficiencies of those on machines, for the cost of each operation and for the proper routeing of parts. Some of the executive squad perform experiments on tools and are given problems on the efficient manufacturing of several parts, while others are required to sketch jigs or fixtures and special tools for machining a part in a different manner from the current method used in the shop. A complete set of limit gages, jigs and fixtures and special tools have been designed and built by the staff of the shops for machining each part of the engine. The building of this engine is carried on in a rather intense manner, not, however, with the desire to build and sell many engines, but for the purpose of approaching the commercial atmosphere as nearly as possible. The real object of the course is not to make artisans, but executives. The sole object of building the engine is to furnish a problem that will at all times bring out the lessons involved in efficient modern manufacturing.

It may not be out of place to give here the analytical method followed in using the *American Machinist* as a textbook, as some points may prove valuable to those in the world's workshops. The editorials are required

to be read, since they record the pulse of the mechanical workshop. Discussions on lighting schemes and the building of electrical machinery are always interesting and instructive to the electrical-engineering student, while the building of intricate or massive machinery furnishes more value to the mechanical student. Each student is encouraged to discuss the views and methods given, and is required to show how the same methods might properly be used on other similar problems. Often mathematical and theoretical articles are given, which may be applied directly to the solution of problems in theoretical mechanics or machine design.

The constant discussion of safety and first-aid problems inculcates in all readers the importance and value of keeping it always in the limelight. Contributions by practical men who discuss the conditions of a practical drafting room or machine shop always make interesting stories and are particularly valuable in giving the typical workshop atmosphere. The more serious discussions on what is required of a successful man, dwelling on character, ambition, viewpoint, etc., are particularly valuable to the youthful engineer (possibly some men would not be in the mediocre position that they are if they followed the indirect advice given). The advertisements must be studied to become familiar with the makers of standard and special machinery. In the problems given the student is often required to select all his equipment from the advertisers and state why he selected a certain machine for making a certain part. In the quizzes given it is often required to mention the names and addresses of half a dozen prominent lathe, drilling, milling machine, etc., manufacturers. In this manner the student becomes familiar with the machine industry. Students are encouraged to write for free catalogs and to study the methods of correspondence of business houses.

Second-Hand Machinery

The list of second-hand machinery is studied and the wise use of that market emphasized. Prices of standard materials are learned and the fluctuations of quotations noted from week to week. The "Searchlight Section" and the help-wanted columns are particularly vital to a student soon looking for a job. The careful interpretation of those advertisements will give a fair idea of the labor market. The recorded movements and location of well-known engineers and business men give a broadening effect to all those who watch them. The announcements of engineering societies' meetings and the review of the activities of important meetings are valuable to all technical men. The value and methods of filing important articles and advertisements is considered. The history of the lives of prominent engineers and manufacturers, as given in the magazine, are studied as examples of successful men. Readers of the magazine are thereby unconsciously encouraged to write.

After using the magazine in this manner for half a semester each member of the course is required to answer the following question, which is included in a list of ten general questions on machine-shop practice: "How has the *American Machinist* helped you thus far in this course?" The examination was unannounced and possibly no member spent more than five minutes on this particular question. Remembering the fact that in the beginning of the course some students hesitated to subscribe, fearing they would not receive full value, it may be of interest to quote several answers: (1) "By reading the *American Machinist* one becomes familiar with machines and tools without realizing it, and when one gets in a commercial shop he recognizes those he has never seen before." (2) "It has modernized my mental vision of machines of all classes." (3) "It has quickened my observation of machine practice and aroused an interest in practical machine operation." (4) "The *American Machinist* has informed me on the problems confronting production men, office men, Government officials and inventors. I never imagined that mechanical problems could be as interesting as the literature in the *American Machinist* proves." (5) "A greater insight into the machine industry and the importance of the work of the machine shop in war times keep one on the lookout for new methods, better ways of doing a job and more desire for accuracy and exactness." (6) "Its discussions of shop management, cost and routeing of materials has been very instructive because I knew so little about those problems." (7) "Encouragement of thought along lines pertaining to machinery and management; realization that the training given in the machine-shop course fills a commercial need and has a considerable market value." (8) "Gives a broader knowledge than can be obtained from local shops." (9) "Indispensable to shop men." (10) "A better understanding of the mechanical profession; has given me a different conception from what I had before. Broadens one's view." (11) "Have always wondered how large castings were machined; the advertisements have constantly helped to clear up this point. One gains a knowledge of the commercial terms of machines, tools, operations, etc. Editorials are broad in scope and instructive on the true progress of the commercial world." (12) "One becomes acquainted with the latest types of tools." (13) "The *American Machinist* has shown me the present need and the importance of efficient work both by men and machines, and has also enlightened me on some difficult problems which the machinist meets in the commercial world." (14) "It gives one an insight into present-day manufacturing and how the work in one shop may be entirely different from that in any other." (15) "Gives me an idea of sizes of machines; how they are built, used, and who sells them." (16) "Brings out the importance of jigs and fixtures and special tools." (17) "Furnishes very good food for thought." (18) "If I ever get into an argument about the qualities of a machine I look it up in the *American Machinist* and let it be the deciding factor. It has broadened my mind so far as to the large variety of machines on the market." (19) "The advertisements furnish a clue to the very latest things in machine design and in modern efficiency methods, things which it would not be possible to get out of a textbook. Access to such a magazine would be an absolue necessity to the man desiring to keep up with the rapid advance in machine-shop practice." (20) "Promotes interest and self-confidence in the shop." (21) "Gives a wider knowledge of machines and methods than can be found in the small shop." (22) "Has proved just as interesting and certainly more instructive than the cheaper story magazines on which students are inclined to spend some time."

How Designs, Specifications and Inspection Affect Production of Munitions

SPECIAL CORRESPONDENCE

There are so many things which affect production that some of them may be overlooked at times, especially when a large output is wanted in a hurry. This is, however, just the time when they should be carefully noted. The following suggestions apply without regard to the kind of work in hand.

THE DESIGN and specification of an article have more to do with the speed at which it can be produced than any other two factors. It is the practice of all manufacturing concerns to have one or more production engineers go over a new machine or other device very thoroughly before it is sent to the shop to be manufactured. It is often the case that the inventor or designer is not thoroughly familiar with the machine equipment or the shop methods in the plant where it is to be made, and that by modifying the design somewhat the piece can be made much more rapidly, which means at much less cost. This modification need not, in fact must not, interfere in any way with its proper functioning.

After this is done the specifications are gone over to insure the product being of sufficiently good material and of approximate accuracy, and cutting out those unnecessary parts which reduce the output.

Such specifications as are necessary to proper functioning should be adhered to in all cases. There have been too many lives lost from premature explosion of shells, from gas getting back through seams in shell bases, from the bursting of guns and similar causes to take any chances on the vital parts. These should be 100 per cent. perfect. But such requirements as extremely accurate bayonet blades; rifle stocks without a flaw; accurate radii on the outside of gun barrels, which fit nothing but the air; oblong holes when round holes will do; unnecessary outside finish which requires hand work, as on machine guns and cannon; close fits where loose fits are equally good or better, and perfectly smooth threads on fuse bodies when they are only screwed into place once should be carefully studied with a view of increasing production. Modifications can be advantageously made in many specifications which will materially assist production at this time.

Inspection

Inspection depends so largely on specifications that it must be considered in connection with them. Here too the great stress should be laid upon proper material and satisfactory functioning of all parts. But the word "perfect" should be used sparingly, as it may be said to be an unknown quality in commercial manufacturing. The terms "perfect casting," "perfect forging" or "perfect finish" leave the way open for an inspector to reject work for minute imperfections that in nowise affect the proper strength or working of the piece. If inspectors are imbued with the idea that it is their job to pass as much work as can be used satisfactorily instead of seeing how much they can possibly reject, production will be increased in many cases.

These suggestions as to production all assume that the design has been decided upon and that dimensions are to be adhered to, at least for a reasonable-sized lot. The changing of dimensions ever so slightly greatly interferes with production. This has caused delay in the turning out of the new field artillery which has been ordered. It also caused delay, now overcome, in starting production on the Enfield rifle.

Nothing interferes more with production than frequent changes of this kind, and they should be avoided except in cases of absolute necessity as material changes may easily tie up production for a long time. No change should be made without careful consideration and the approval of a competent department head who can decide whether the change is of sufficient value to warrant the delay.

Gages: Their Construction and Use

Inspection means the use of gages in large quantities and brings up a difficult problem in which we can utilize to advantage the experience of the Canadian government. That government has found that both gages and inspection should be under one head and controlled by one department. This will prevent duplication, avoid delay due to manufacturers not ordering sufficient gages for their work, secure greater production of gages from fewer plants and save time and money in every way.

When a million shells are ordered the gage department knows more accurately than the manufacturer the number of gages that will be needed to inspect them. It immediately orders (if it has not previously done so) the number of gages necessary, placing the orders for the various kinds of gages with the shops best fitted for that kind of work. This enables the gage-making shops to concentrate on the type of gage which they can make best instead of splitting the orders as in the case where each manufacturer orders the gages he thinks he needs.

By this method a supply of gages can be kept at a central storehouse, all measured and inspected, ready to be shipped to any maker who needs them. This avoids delay and also reduces the cost of gages to the manufacturer.

The cost of gages can also be greatly reduced by avoiding changes, as noted before, and by cutting out unnecessary refinements. I have in my desk a small, flat form gage which is one of 80 made for a certain arms company. The extra and unnecessary refinements made these gages cost $40 each, and they were all discarded before being used because the drawings were changed after the orders had been placed. This instance is typical of hundreds of others during the past three years.

With the gages and the inspection all under one head the work of checking gages is much simplified. This can be done at one control point, the Bureau of Stand-

ards, and saves duplication of checking apparatus and measuring machines. It will also reduce the number of inspectors required and allow a more centralized control to be exercised over them. Each man would of course specialize on some branch of the work and report to the head of that division, but he would be controlled by a central chief of inspection who would work with each department head.

A fetish of modern times is the bugaboo of interchangeability without fully appreciating just what it involves when it is applied in its full meaning to high-grade manufacture. Interchangeability of parts is a great advantage when the requirements of accuracy are not too great. Agricultural implements can be made interchangable in the foundry, but absolute interchangeability of rifles and machine guns is a different proposition.

It is the consensus of opinion among many good engineers that absolute interchangeability of parts requiring close tolerances should be limited to as few parts as possible, and that a reasonable amount of interchangeability on the remaining parts, so as to allow easy repair at a base shop, is all that is necessary or desirable. The number of parts to be made absolutely interchangeable within close limits should be limited to as few as possible. Others on some parts of gun limbers and carriages can be made interchangeable in the same manner as in agricultural machinery; that is, with large tolerances and loose fits.

There are places where a limit of $\frac{1}{16}$ in. is just as effective and more desirable than a much finer measurement. These conditions should be carefully studied and both tolerances and allowances increased where possible. This not only reduces the cost of manufacture, but it reduces the percentage of rejections, which saves material and transportation. It will also tend to offset the effect of decreased skill in the shops as the war goes on, which in itself is quite a factor in favor of such revision or specification.

Rapid Manufacture of Ring Gages

By John Teckeer

The article under the above title on page 253 of the *American Machinist* impresses me as advocating a method not only slow, but one that would invite trouble by the bucket load. Further, the article brings us to the stage wherein the first real operations are done, namely, boring, facing and knurling the rings preparatory to hardening; and there we are left at the very entrance of the manufacturing problem.

To devote a half page to getting the rings cut off ready to bore and then to assert that they are chucked inside and out, hardened, ground to close limits and lapped is giving us the shell but keeping the kernel.

Under favorable conditions, using a parting tool is not a very difficult job, though every one who does it experiences more or less trouble. But using a parting tool $\frac{1}{8}$ in. wide and cutting to a depth of $1\frac{1}{2}$ in.—well, that is another proposition.

Conceding, however, this operation to be comparatively simple, we next find ourselves running a parting tool up the end of the shaft; and while this operation may be quite possible, one must admit that it is far from practical. It would take some of the oldtimers from Sammy's shop to make good. Doubtless it is for this reason that the man shortage is felt so keenly.

Because of the method used, one feels convinced that this ring gage is not an article manufactured in real quantities of standard sizes for the market. Rather are we led to believe the quantities may be in lots of probably 20 to 50 of a kind, and for special purposes.

Viewing the problem from this angle (I certainly cannot see the possibility of it as a standard method of manufacture) one would wonder why go to all this trouble to cut off and get a rough hole in a ring.

Anyone of the several varieties of cold saws or hack saws on the market will keep a boy hustling to feed it with stock, and this, in connection with a self-centering chuck on a drilling-machine table, gives us a quicker, more economical method that neither ties up an expensive machine nor demands the skill necessary to use cutting-off tools in the manner specified.

Assuming that we may want to save the core of the ring, and get even greater speed in production, why not cut them off, as mentioned, with the cold saw or hack saw, then chuck them and run through a core drill, of which there are plenty on the market, and cut the hole, letting the core run up inside the drill?

Either of these methods would be faster as well as simpler and cheaper than the one outlined, and we will the sooner reach the point at wnich the above-mentioned article leaves us, that is, ready to bore, turn, knurl, etc.

Removing Wrinkles from Drawings

By Taft S. Armandroff

Some of our working drawings fell into the water recently and got partly wet, after which they were stretched on the blueprint rack to dry. Care was taken to prevent wrinkling, but without success, and it was thought that they would have to be recopied, which meant a lot of work.

Shortly after it was necessary to have in a few hours' time blueprints of these drawings. Presuming that the wrinkles would flatten out when pressed on the blueprint frame a test was made, but the result was not satisfactory. It seems that although the drawings were pressed as hard as possible there were still enough wrinkles to cause shadows and so ruin the blueprints.

The lines were unevenly broken in some places, not visible at all in others, dimensions and instruction notes were not half shown and only a small part of them could be read. As the drawings were on a small scale, all that mass of lines, figures and words scattered here and there over the sheets brought to my mind camouflage. It seemed that something was hidden behind them. There I could see hills and dales, young mountains, trees, fields, with lines here and there that one might take for fences but not mechanical drawings, as they were supposed to be.

At this time our electric flatiron was hot and working on dry mounting some photos in the salesmen's books. That flatiron made me think a little about laundering and ironing, so I employed this implement to flatten out the wrinkles, with the result that I obtained perfectly smooth drawings. When the blueprints were made there was no camouflage, only plain parts of a motor-driven lathe.

MANUFACTURE of the 75-MM. HIGH-EXPLOSIVE SHELL

Part Two

This installment deals with forging or closing in of the shell nose, finishing the interior of the nose, including the milling of the thread, heat treating, scleroscope testing and drawing or annealing.

By S. A. Hand

THE shell is now ready for the volumetric test, which is made to determine the interior capacity and check it with the specifications. This test is shown in the illustration, Fig. 10, in which it will be seen that eight shells are placed on the bottom of a rack or table fitted to receive them. Over the table is a trough containing eight cups *A*, each of which has a capacity of 31.508 cu.in.; over each of these is a pet-cock *B* connected to an overhead water supply from which the cups are filled. When the cups are filled to the point of overflow, the water supply is shut off and the lower pet-cocks C are opened, allowing the water from the cups to flow into the shells beneath. If the water overflows the shell, it proves that either the bore is not large enough in diameter or is not deep enough, and the shell must be regaged to determine which dimension is at fault. The proper correction can be made by either enlarging the diameter, deepening the bore, or both, within certain limits.

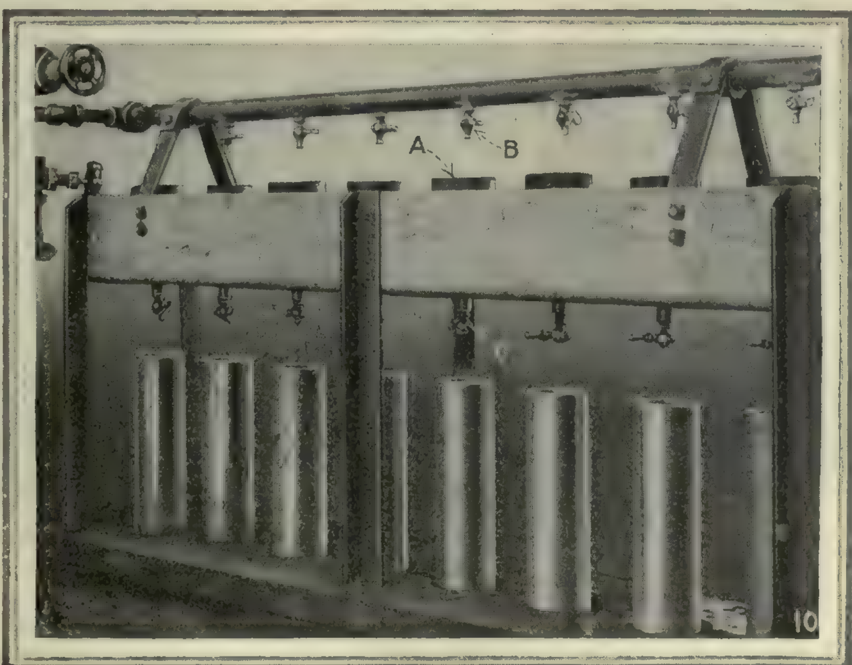


FIG. 10. THE VOLUMETRIC TEST

If the water from the cup will not fill the shell, then the hole is either too large in diameter or too deep. If the bore is of the proper diameter it proves that the shell is too deep and it must be faced off at the open end. On the other hand, if the hole is the proper depth then it proves that the diameter is too large, and as this is not permissible, the shell must be rejected. After the volumetric test and the completion of any necessary corrections, the shell is recentered. The reason this is not done before is that if the shell was centered true with the bore, as finished in operation 6, and had to be rebored to correct it for error found in the volumetric test, there would be some danger of its not being chucked truly with the center. If the centering is done on a true mandrel after the cor rections referred to have been made, then the center will be true or concentric with the bore.

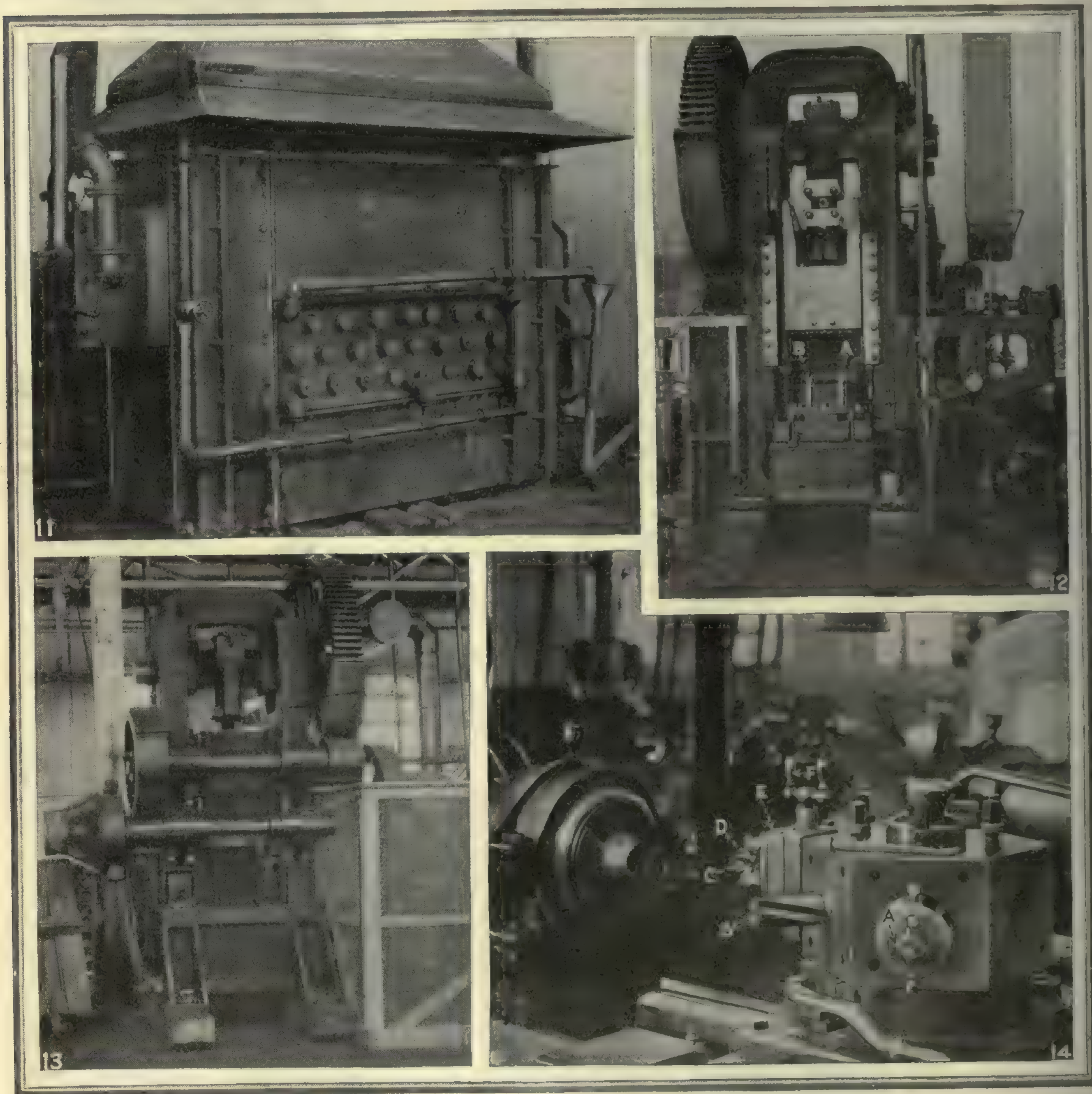
The centering is practically a repetition of the original centering, as done in operation 3.

The next operation is the forging or closing in of the nose, for which it is necessary to heat the shells at their open ends, to a certain distance.

An oil-fired muffle furnace, Fig. 11, is used for this purpose. The water front is provided with 24 holes, in which the shells are placed, as will be seen in the illustration. The distance that the shells project through the water front into the flame is gaged entirely by the eye. This sometimes causes trouble, for if the shells are heated too far along their length they are apt to buckle during the closing operation. This might cause them to stick in the closing dies and result in time lost getting them out.

About eight minutes are required to bring them to the proper heat. From the furnace, the shells are put in a 300-ton press, Fig. 12, for closing in the nose. Two dies are used—one at *A* for roughing, and one at *B* for finishing. Attempts have been made to complete this operation in one die and with one stroke of the press, but they were not successful.

Formerly it was the custom to heat the shells twice, once for each stage of the operation; but it has been found practical to complete both stages with one heating.



FIGS. 11 TO 14. APPARATUS FOR OPERATIONS ON THE NOSE
Fig. 11—Heating for closing in nose. Fig. 12—Press for closing in nose. Fig. 13—One of the new presses. Fig. 14—Machining interior of nose

The speed of the press is 15 strokes per minute; hence, its actual working time for each stage is four seconds; but the time taken for transferring the shell from furnace to press, and from one die to another, will average 16 seconds more, or a total of 20 seconds for the complete operation.

The dies are blown out with compressed air to remove the scale after each shell has passed through, and they are oiled for every second shell.

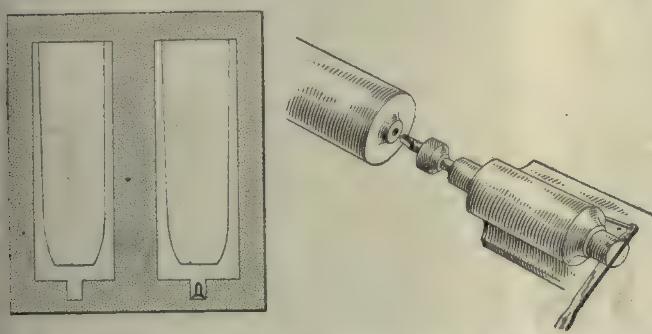
At present there is only one press in use for this operation, but four more are being installed. The one in use was built by the Toledo Machine and Tool Co.; those now being installed were built by E. W. Bliss Co., one of which is shown in the illustration, Fig. 13.

As the shells leave the press they are laid in a shallow, steel-lined box and covered with sand to prevent them from cooling too rapidly.

When cold they are put in a turret lathe and held in an air chuck for boring, reaming, chamfering and recessing the interior of the nose, and for facing them to length.

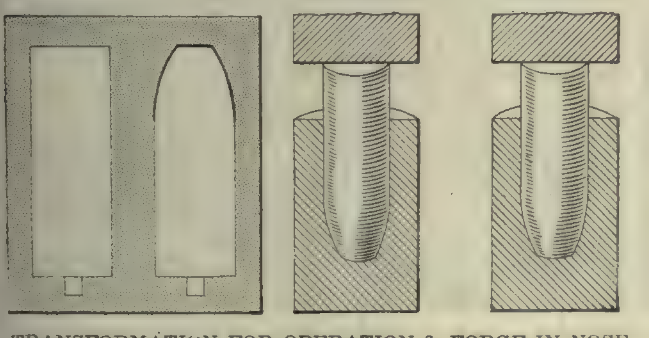
The boring is done with a double-end cutter *A*, Fig. 14, held in the end of a boring bar, and the reaming is accomplished with the two-fluted reamer *B*.

The chamfering and facing are done by two tools, *C* and *D*, held in short cars mounted on a vertical slide *E*. When the turret slide is fed up to the stop, the



TRANSFORMATION FOR OPERATION 7, RECENTER
Machine Used—Lathe. Special Fixtures—Air-operated mandrel. Gages—None

slide *E* is at its bottom position. This allows tools *C* and *D* to enter the nose of the shell far enough to perform their functions. Feeding the tools upward by means of the handles *F* traverses tool *D* across the end of the nose and faces it off, bringing the shell to length. Tool *C* begins to chamfer the outer edge



TRANSFORMATION FOR OPERATION 8, FORGE IN NOSE
Machines Used—Oil-fired muffle furnace with water front perforated to hold 24 shells. Toledo and Bliss 300-ton crank presses. Special Fixtures—Two forming dies in each press. Gages—Length and straightedge. Production—120 per hour

of the hole before tool *D* completes its work, and the two tools complete their work at about the same time. The recess at the back of the hole is cut with a single-pointed tool mounted on a cross-slide on the turret, which is not visible in the illustration.

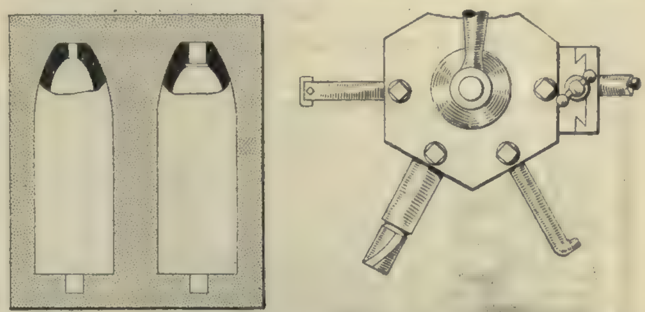
The next operation is milling the threads for the adapters. This is done on Taft-Peirce thread-milling machines, of which a battery of 12 is in use.

The shell is held in the revolving cage *A*, Fig. 15, and is supported at the front by a ring which is ground to fit the nose while the tail center *B* holds it securely in place. The thread is milled with a cutter or hob *C* instead of with a single-pointed cutter.

The hob is without lead; that is, the teeth are formed by circumferential grooves cut the same distance apart as the pitch of the thread to be milled.

As the work is rotated the spindle moves longitudinally in its bearings by means of a guide screw and nut, and in this manner the lead of the thread is obtained.

The cutter is a little longer than the thread to be milled, and one revolution of the work, plus a slight

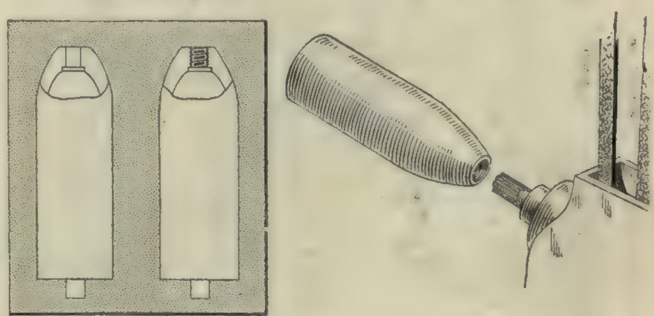


TRANSFORMATION FOR OPERATION 9, MACHINE NOSE
Machine Used—Warner & Swasey turret lathe. Special Fixtures—Air-operated chuck; vertical slide on turret. Gages—Plug, length, depth and machine stop. Production—40 per hour

over-travel to insure a perfectly finished thread, completes the milling. On completion a latch is automatically tripped and the cutter is withdrawn and the feed motion stopped.

The shells are now ready to be put through the heat-treating process.

The equipment for this process comprises a hardening furnace, a quenching tank, conveyors for removing shells



TRANSFORMATION FOR OPERATION 10, THREAD-MILL NOSE
Machine Used—Taft-Peirce thread-milling machine. Special Fixtures—Cave for holding shell. Gages—Male thread. Cutting Tool—Hob without lead. Production—20 per hour

from the quenching tank, a soda tank equipped with a conveyor, a draining table, two grinding wheels for grinding surfaces for scleroscope test, a drawing or annealing furnace and a cooling table.

The hardening furnace is about 20 ft. long, is oil fired and has five low-pressure burners. The combustion takes place beneath the heating chamber, and the products of combustion pass up through flues in the side walls and enter the heating chamber beneath the arch. Five pyrometers are distributed along the furnace to record the heat at different locations.

Four 4-in. seamless-steel tubes, into which the shells are charged, pass through the entire length of the furnace.

Fig. 16 shows the charging end of the furnace, and at *A* may be seen the projecting ends of the four

tubes with shells lying in their mouths. Each tube holds 25 shells.

After the furnace has been charged with its complement of shells and the heat at the farthest zone has reached a temperature of 1650 deg. F., unloading begins. The shells in each tube are pushed in one shell length by means of a wooden bar or club. This puts the shells, seen in the illustration, into the furnace, and pushes one shell from each tube out of the furnace at the rear end.

This is done once every two minutes, and in order that there may be no mistake in timing, an automatic timing device has been arranged that flashes the electric lamp *B* at two-minute intervals. Each time the shells are pushed along in the tubes, fresh ones are laid in the pockets at the charging end, thus rendering heating practically a continuous operation. When the heated shells are pushed out of the furnace they pass into the inclined tubes *A*, Fig. 17, through which they drop into a quenching tank *B* filled with oil. This keeps them from coming in contact with the air and prevents the formation of scale.

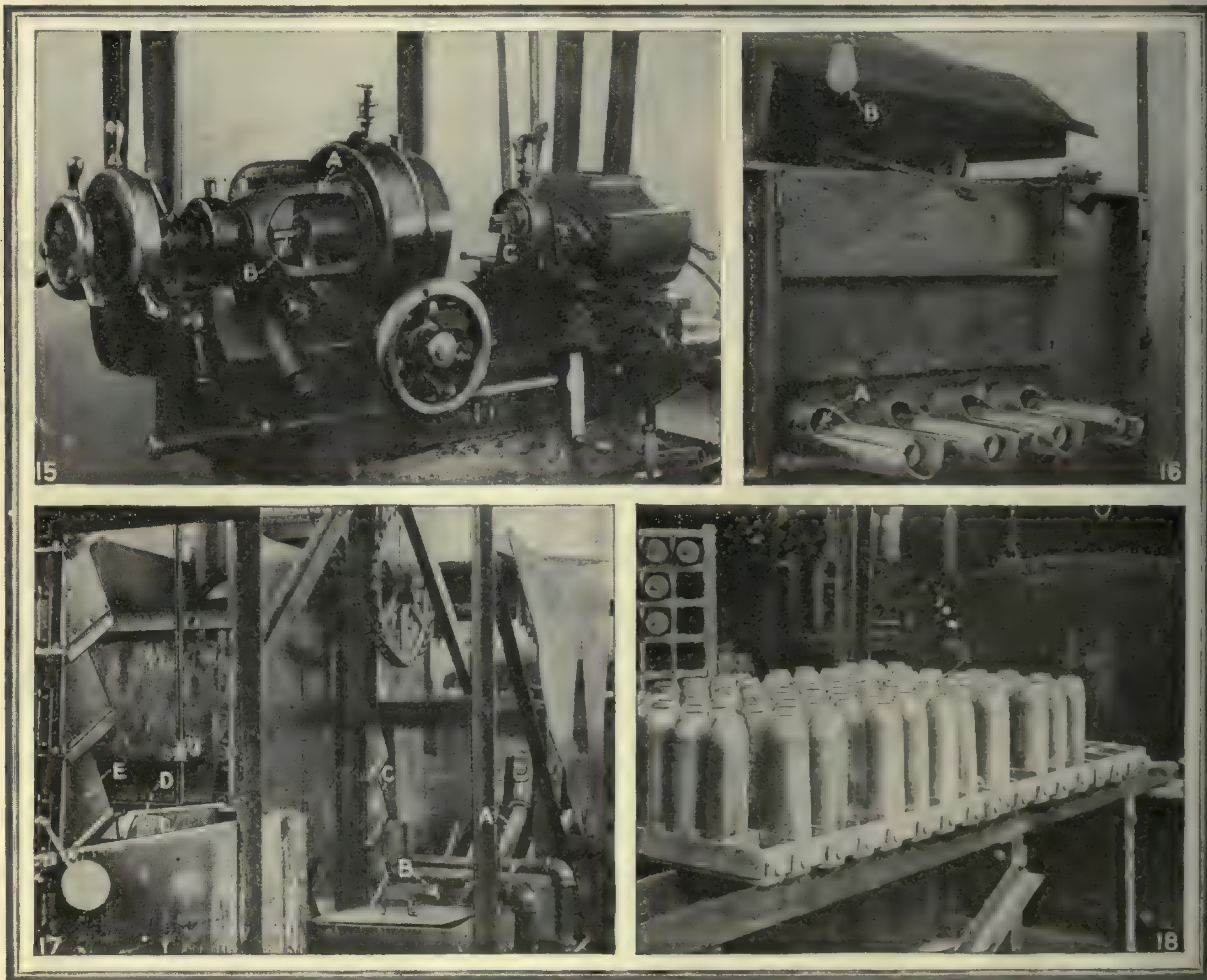
The tank holds about 8000 gal. of oil, which is kept in constant circulation through a refrigerating plant, by means of which the temperature is kept below 100 deg. F.

The shells are lifted from the oil tank by a bucket elevator *C* and dropped into a tank of hot soda water *D* to cleanse them of the oil. They are lifted from the soda tank by another bucket elevator *E* and deposited on an inclined chute above and behind a grinding stand. They are taken out of this chute by hand, and three spots are ground on them to expose smooth surfaces for testing with the scleroscope to determine their hardness.

A scleroscope reading of 32 to 35 has been adopted as a standard for hardness in this case; all shells showing a reading below 32 must be rehardened, and all showing a reading above 35 must be annealed.

As a matter of fact the shells are almost always too hard, and the scleroscope generally shows a reading of from 35 to 60.

The shells to be annealed are sorted into groups according to hardness and are loaded onto traveling racks or trays, each of which holds 64 shells, Fig. 18. Two of these racks or trays can be charged in the furnace at one time. The furnace is oil fired and is kept at a temperature varying from 850 to 1100 deg.



FIGS. 15 TO 18. A NUMBER OF OPERATIONS ON THE SHELLS

Fig. 15—Milling the thread. Fig. 16—Heat-treating furnace (charging end). Fig. 17—Heat-treating furnace (rear end). showing oil and soda tanks and elevators. Fig. 18—Shells ready for charging into annealing furnace

F., according to the hardness of the shells to be annealed.

After the necessary temperature has been reached and the shells are thoroughly heated, the racks are run out at the rear end of the furnace onto the cooling table and the shells allowed to cool in the air; they are again tested with the scleroscope, after which a ringing test is made to determine their soundness. Each shell is tapped on the nose, body and base with a light hammer, and if it does not emit a clear tone when tapped at each of these places it must be rejected. One out of every 1000 shells must be tested for tensile strength after being annealed.

A new and interesting system of pyrometers is about to be installed in connection with the heat-treating furnaces. Each pyrometer will have three incandescent lamps on the top of the case: one red, one white and one blue. Besides being patriotic in color, these lamps will show the condition of the furnace heat and may be seen at quite a distance from the furnace. If the red lamp is lighted, then there is too much heat; if the white light is lighted, the heat is right, while if the blue lamp is lighted, there is not enough heat.

A group of checking instruments, one in circuit with each pyrometer, will be installed in a central position and in sight of all the colored lamps referred to in the previous paragraph. The pointers on these checking instruments will stand at zero when the white lamp is lighted, and will point to the number of degrees the heat may be in excess or below when either the red or blue lamps are lighted. Thus the operator in charge of the furnaces will be able to see their heat condition at a glance.

Ten Munition Districts Established

The War Department has issued the following statement:

In order to bring about decentralization and closer contact with manufacturers of war munitions, General Wheeler, acting chief of the Ordnance Department, has divided the country into munition districts, with headquarters for the different zones at Pittsburgh, Penn., Cleveland, Ohio, Rochester, N. Y., Boston, Mass., New Haven, Conn., Detroit, Mich., Cincinnati, Ohio, Chicago, Ill., New York City and Philadelphia.

In each of the cities where a district office is to be established one of the leading business executives has been selected to be district chief of the production division of the Ordnance Department.

List of District Chiefs

At the head of the Pittsburgh office the production division will have Ralph M. Dravo, a member of the firm of Dravo Bros., steel constructors. Mr. Dravo's offices at the present time are in the Diamond Bank Building at Pittsburgh, but he will establish a central office for the production division of the Ordnance Department within the next few days.

For other district offices the following appointments have been made:

Cleveland District—Samuel Scovil, who resigned as president of the Cleveland Illuminating Co. to take the position offered him by the production division. His present offices as president of the Cleveland Illuminating Co. are in the Plymouth Building, corner of East Twenty-second St. and Prospect Ave.

Rochester District—F. S. Noble, one of the chief executives of the Eastman Kodak Co.

Boston District—Levi H. Greenwood of the Wakefield Rattan Co.

New Haven District—Waldo C. Bryant, president of the Bryant Electric Co. of Bridgeport, Conn.

Detroit District—Fred J. Robinson, president of the Lowrie & Robinson Lumber Co.

Cincinnati District—Charles L. Harrison of the Cincinnati Chamber of Commerce.

Chicago District—E. A. Russell, vice-president of the Otis Elevator Co., with present offices at 600 Jackson Blvd.

New York District—Samuel G. Allen, chairman of the Lima Locomotive Works. His present offices as chairman of the Lima Locomotive Works are in the Albemarle Building, 1107 Broadway, New York.

Philadelphia District—John C. Jones of the Harrison Safety Boiler Works, Philadelphia.

Worked Out by Colonel Tripp

Col. Guy E. Tripp of New York, formerly chairman of the Westinghouse Co. and now chief of the production division of the Ordnance Department, worked out the details of the plan for decentralization and closer contact with the manufacturing districts.

Gen. W. S. Peirce, head of the bureau in which is the finance division of the Ordnance Department, and Col. B. W. Dunn, head of the inspection division, have arranged to follow the same decentralization plan and will have their field forces in the same district headquarters as the production division.

Col. Samuel McRoberts, formerly vice president and executive manager of the National City Bank, who has been at the head of the procurement division of the Ordnance Department for some time, will coöperate with the district officers.

The plan which has been worked out is one of the logical developments of the reorganization of the Ordnance Department some time ago. It not only brings the department into direct contact with the munition industries, so that the work can be followed up more closely, but it also assures better inspection facilities, quicker payment for work done and more exact information as to the progress of the work on all the implements of war.

Territory Carefully Outlined

The territory covered by the different districts has been clearly outlined by the department, and the comparatively few industries which are not embraced in these districts will deal directly with the production division in Washington as heretofore.

The various production division districts as at present established cover territory as outlined below:

The Chicago district comprises the state of Indiana north of the north boundary line of the following counties: Warren, Tippecanoe, Clinton, Howard, Grant, Blackford, Jay, and the states of Illinois, Wisconsin and Minnesota.

The Cincinnati district comprises the state of Ohio north of the north boundary line of the following counties: Darke, Miami, Clarke, Fayette, Pickaway, Fair-

field, Perry, Morgan, Noble, Monroe, and the state of Indiana south of the north boundary line of the following counties: Warren, Tippecanoe, Clinton, Howard, Grant, Blackford, Jay, and the state of Kentucky.

The Detroit district comprises the state of Michigan.

The Pittsburgh district comprises the state of West Virginia and that part of Pennsylvania, except Erie, Crawford and Mercer counties, lying west of the west boundary line of the following counties: Tioga, Lycoming, Mifflin, Juniata, Perry, Cumberland and Adams, and Belmont and Jefferson counties, Ohio.

The Boston district comprises that part of Massachusetts lying east of the west boundary line of Worcester County, and the states of Rhode Island, Maine, New Hampshire and Vermont.

The New Haven district comprises the state of Connecticut and the following counties in western Massachusetts: Berkshire, Franklin, Hampshire and Hampden.

The Cleveland district comprises that part of the state of Ohio lying north of the north boundary line of the following counties: Darke, Miami, Clarke, Fayette, Pickaway, Fairfield, Perry, Morgan, Noble, Belmont and Jefferson, and the following counties in Pennsylvania: Erie, Crawford and Mercer.

The Rochester district comprises the state of New York except the following counties: Green, Columbia, Ulster, Sullivan, Duchess, Orange, Putnam, Westchester, Rockland, Nassau, Suffolk and the greater city of New York.

The New York district comprises that part of the state of New York lying south of the south boundary line of the following counties: Rensselaer, Albany, Schoharie and Delaware, east of the west state line of New Jersey, and north of the north lines of the following counties in New Jersey: Mercer and Ocean, and west of the state lines of Massachusetts and Connecticut.

The Philadelphia district comprises the eastern half of the state of Pennsylvania lying east of the west boundary line of the following counties: Tioga, Lycoming, Mifflin, Juniata, Perry, Cumberland and Adams, and the following counties in New Jersey: Mercer, Ocean, Gloucester, Burlington, Cumberland, Atlantic and Cape May; and all of the state of Delaware.

Indexing Angles on the Dividing Head

By D. E. Mapes

I have found many valuable tables in the columns of the *American Machinist* and I am submitting this simple table, which I find is more rapid and less likely to errors when indexing to minutes, than the one shown in the "American Machinist Handbook," second edition, page 190.

The worked-out problems are carried out further than is necessary, but it shows the accuracy of my method.

In working to seconds it is more advisable to use the method given in the handbook, as it is rather cumbersome to use the large decimals. The standard milling-machine dividing head gives us 9 deg. to one turn of the index crank. 9 × 3600 equals 32,400 or our constant.

From the Handbook we know that the constant of 1 deg. is 0.1111. Reducing this down to minutes we have a constant of 0.0018518; reducing it to seconds we have a constant of 0.0003086. My method is to reduce the total degrees mentally to the number of turns for the crank and work with the remainder.

Take as an example index 39 deg. 20 min.: By reducing this to seconds we have the following (usual method): 30 × 60 = 2340 + 20 = 2360 × 60 = 141600 sec. ÷ 3240 = 4.3703 turns.

My method is to reduce minutes to a decimal if possible. In this case 39 deg. 20 min. = 4 turns with 3 deg. 30 min. remaining; 3 deg. 20 min. with the minutes reduced to decimals = 3.3333 deg., which multiplied by 0.1111 = 0.37032963 turns. Adding the 4 turns necessary for 36 deg., the turns necessary for indexing 36 deg. 20 min. become 4.37032963 or nearly 4 20 54.

Take another example, where the minutes cannot very well be reduced to a decimal as 32 deg. 13 min. equals 3 turns and 5 deg. 13 min. Reduce this mentally to minutes, as 313 min., then multiply by our constant 0.0018518 = 3.5796134 turns.

In all cases reference should be made to the handbook to locate the correct index plate and holes to be used.

Alignment Chart for Herbert's Cubic Law

By A. Lewis Jenkins

Associate Professor of Mechanical Engineering, University of Cincinnati

According to Mr. Edward G. Herbert (*American Machinist*, Vol. 32, Part 1, page 1063) the cutting speed of a lathe tool may be expressed by the formula

$$V = \frac{c}{\sqrt[3]{df^2}}$$

where

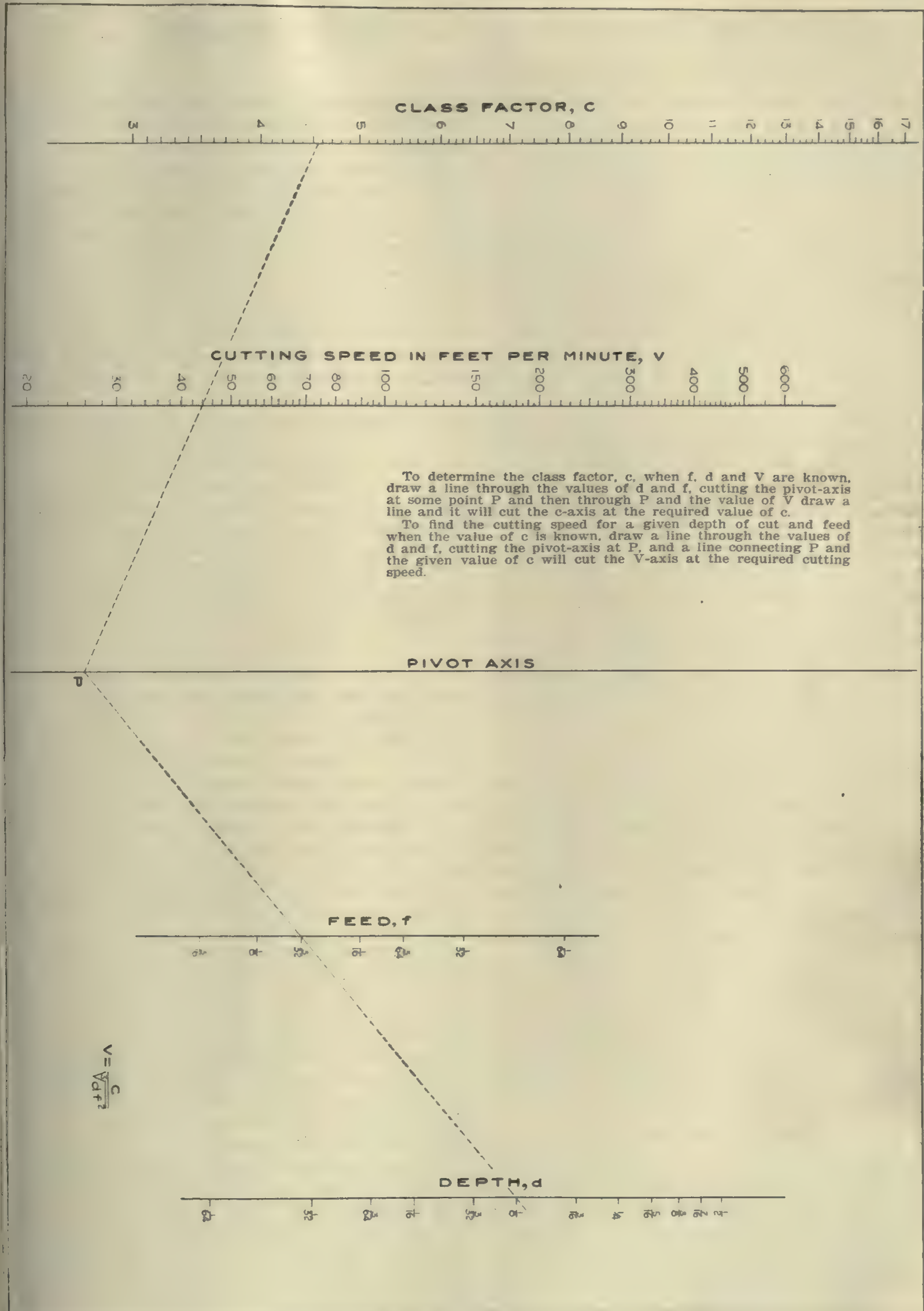
V = Cutting speed in feet per minute;
d = Depth of cut in inches;
f = Feed per revolution in inches;
c = Class factor or constant depending upon the material cut, and the shape and life of the tool.

The value of the class factor for a given material and tool may be found from experiment by determining the permissible speed for a given depth of cut and feed and substituting the values in the equation

$$c = V \sqrt[3]{df^2}$$

Then, according to this theory the cutting speed may be found for any feed and depth of cut for this tool, material and class of work by using this value of c. Values of c may be determined for different classes of work and tools and represented by special graduations on the c-axis.

For a cut $\frac{1}{8}$ in. deep with a feed of $\frac{3}{32}$ in. it is found that the cutting speed is 44 ft. per min. for a given material and tool. The value of c for this condition is found by drawing a line through $\frac{1}{8}$ on the depth-axis and $\frac{3}{32}$ on the feed-axis, cutting the pivot-axis at P, and then through P a line is drawn through 44 on the V-axis, cutting the c-axis at 4.55, which is the desired value of c. For any other feed and depth of cut the cutting speed for this material may be determined by drawing a line through the feed and depth cut intersecting the pivot-axis at some point P and by connecting this point with the value of c = 4.55, the line will cut the V-axis at the desired cutting speed.



ALIGNMENT CHART FOR HERBERT'S CUBIC LAW

The Process of Casehardening

BY E. STANDIFORD

In casehardening articles of wrought iron or mild steel the best results have been obtained by allowing the pieces to cool after cementation and then reheating them before quenching.

THE PROCESS of casehardening consists in bringing the steel or iron articles into contact with carbon in closed boxes or pots and raising them to the requisite temperature for a sufficient length of time; afterward the articles are reheated and cooled by quenching in oil or water. The furnace should be so constructed as to be capable of being raised to a full orange heat (1000 deg. C.) and maintained at that heat with regularity. Neither the fuel nor the direct flame should come in contact with the charge—that is to say the flames should uniformly impinge on the sides and roof of the muffle and the charge should be heated by radiated and not by direct heat; the result is most economical in the matter of fuel. There should be a small peep-hole, provided with a cover plate in the door; a hole 1½ in. in diameter is quite large enough.

In a furnace costing about $175 there should be a small upper chamber, and though this is not necessary for casehardening, it may often be found useful as an annealing oven and used while casehardening is being done on any articles which require annealing. This will add only very slightly to the amount of fuel used. Generally speaking, coal is the fuel employed, but for large works where a number of furnaces are going, gas-fired furnaces should give the required satisfaction. Hardening pots are made in both cast and wrought iron; the latter bear reheating so many times that they are cheaper in the end. The pots should not be of too large dimensions or there might be risk that articles in the middle of a charge are not being cased to a sufficient depth. The pots should each have a plate lid fitting closely inside.

Probably in no part of the process has there been so much difference of opinion as in the question of carbonizing material. The carbonizers in general use at present are animal charcoal, bones and one or two other compositions sold under various names, and consist of mixtures of carbonaceous matter and certain cyanides or nitrates. For very slight hardening, cyanides alone are still found useful, but no great depth of casing is ever attempted with them.

Use of Charred Leather

Theoretically the perfect carbonizer should be a simple and pure form of carbon. The author has found good charred leather to give the most certain and satisfactory results. Charred leather should be bought only from some firm which is actually in the leather or allied business and which prepares scrap leather for casehardening purposes. Even under such circumstances it is important to keep strict watch over the deliveries and especially for traces of copper and steel rivets—a sure evidence of old boots or old belting. Buy the leather coke in lumps and have it powdered in your own works, taking care that it is not contaminated in the process and that it is perfectly free from moisture at the time it is required for use.

As clay must be used as a luting around the pot lid and also frequently used for stopping off portions to be left soft, it is important to see that a good clay is used and that it is free from grease. As all casehardened articles must be reheated before quenching, it is important that a suitable furnace should be employed. It is not advisable that the reheating should be done in the casehardening muffle unless it is run specially for the purpose and at a lower heat than for casehardening. If possible a small gas muffle should be used for reheating for all hardening work. A properly constructed gas muffle can be regulated with great exactness, and this is very important in all hardening.

Details of the Process

The carbonizer having been thoroughly dried and reduced to a fine powder, a layer of not less than 1½ in. in depth is placed in the hardening pot and well pressed down. Upon this are placed the articles to be hardened. Care must be taken to leave sufficient space all around each piece to prevent its touching the others or the walls of the pot; a space of 1½ in. should be sufficient. Another layer of carbonizer is then put in and well pressed down, taking care not to displace any of the articles already packed, and continuing until the pot is nearly full, then finishing off with another layer of 1½ in. at the top.

The object in view must be to make the contents of the pot as compact as possible, consistent with a sufficiency of carbonizer in contact with the articles. The more solidly a pot is packed the more effectually is air excluded; the lid is then put on and the joint well luted all around with clay. By the time the required number of pots have been filled the furnace must have raised steadily to the full working heat. According to my experience the proper heat for casehardening is 1000 deg. C., or a full orange color.

At the close of the carbonizing period the pot is withdrawn from the furnace and placed in a dry place, where it is allowed to become quite cold. It is then opened and the articles taken out and brushed over to remove all adhering matter. If the pot has been properly packed and luted up the articles should be quite white, or at least have only a slight film or bloom of a deep-blue color; the denser and more inclined to redness is the surface the more imperfect has been the packing and sealing of the pot.

The articles are now placed in a muffle furnace and steadily raised to a good cherry red (800 deg. C.) and then quenched in cold or tepid water or oil, according to the purpose of the articles required. They should remain in the cooling liquid until they are cold all through the body of the metal, thus completing the process.

To determine at what temperature we are to work the cementation part of the process there are several points to be strictly observed: (1) The carbon in the case must be about 0.80 per cent.; (2) the case must

be neither too thick nor too thin; (3) the temperature must not be so high as to overheat the mild center; (4) the core must be of the greatest strength possible.

Although I have given separate requirements we must consider them all together. A temperature of 1000 deg. C., if continued to saturation, would yield a carbon percentage of about 1.25; but if interrupted at any stage short of saturation the skin would contain less carbon, and the center still less, on account of the process of diffusion still being in progress.

If we take two pieces of ⅜-in. diameter round mild steel and heat one of them with a carbonizer at a cherry-red heat and the other at a bright-orange heat for six hours, the first will be cased to a depth of about $\frac{1}{32}$ in. and the second to a depth of nearly $\frac{1}{16}$ in., while the amount of carbon taken up will be about 0.50 and 0.80 per cent. respectively, so that, so far as regards the hardness of the skin, the piece cased at the higher temperature gives the best result. From this we learn that a temperature of 1000 deg. C. will give sufficient hardness of case.

Next we have to find which temperature has the least hurtful effect on the mild-steel core. Suppose, for example, we take three pieces, heating them to 1000, 1300 and 1500 deg. C., or full-orange, white and bright white respectively, we will find that those heated to 1300 and 1500 deg. C. break very short and have lost nearly all their original tenacity while the one heated to 1000 deg. C. appears tougher and altogether stronger than before.

Water Hardening

That part of the process where a most important improvement has been made is the final hardening by quenching in water. In casehardening, as in all other methods of hardening, the steel must be quenched on a rising heat. For certain purposes there is some advantage to be gained by quenching direct from the pot if followed by reheating to cherry redness and again quenching. Having made clear the necessity for complete cooling after carbonizing, followed by reheating for water hardening, we may proceed to consider the proper manner of carrying this out.

We must remember that the casehardened article now consists of two kinds of steel, one being mild, of a temper that will not harden in water, and the other capable of becoming glass hard when properly heated and quenched. The critical points of the two steels are not of course the same, that of the hard steel being slightly lower than that of the soft steel. It must be borne in mind that to obtain complete hardness in the skin and the maximum of strength in the core, both skin and core should be heated to their critical temperatures before quenching. Now, as the critical points of the two are not identical and as they must be raised at least to these points, it follows that one or other of the steels will have to be heated considerably above its critical point. We have therefore to find which of the two will result in the least risk. If we heat the article to the critical point of the hard-steel case we do not reach the critical point of the mild core; on the other hand, if we raise to the proper heat for the mild we exceed that of the hard steel.

As our object is to obtain hardness combined with strength, and as the strength lies almost entirely in the core, it follows that we must heat sufficiently to remove the coarse crystallization of the core, thus exceeding the critical point of the case; and in doing so, while we obtain the maximum hardness very nearly, we lose very little of the strength of the case and obtain the maximum strength of the core. I have gone rather fully into this point, and it may be thought without necessity, as the temperature is judged almost universally by the eye; but my object in doing so has been to point out how important it is for the second heating to be sufficiently high so as to obtain the best results.

The carbonized steel as it comes from the pot cannot be rendered hard and strong without a sufficient second heating. If a test piece or finished article when broken shows a more or less coarsely granular fracture and has the casing irregularly defined it is almost certain that the second heating has not been sufficiently high; and this perhaps emphasizes the importance of using test pieces wherever possible.

This reheating should, so far as possible, be rapidly performed, and once the article becomes uniformly of the right temperature it should be immediately quenched in oil or water.

Tempering

It is sometimes desired that the hardness of the case be slightly tempered, but I cannot say anything in favor of it. Generally speaking, the object of tempering is not so much to reduce the hardness as to increase the strength; but we must bear in mind that the strength lies in the core of mild steel, and that even if the strength of this can be increased by tempering, which is doubtful, you can only use the "temper color" shown on the hard case as an indicator, and this can be no guide to the proper tempering heat of the core. Now, supposing that we are able to increase the strength of the mild core by tempering, it is highly probable that the proper tempering heat, instead of being represented by a straw color, would be at least a dark-blue color, and possibly a visible red, which might take away 50 per cent. or more of the hardness of the case.

It may be desirable for special requirements to make extreme hardness the first consideration. In such cases the temperature may be raised to bright yellow (1250 deg. C.) and then, instead of allowing it to become cold, take the pot from the furnace and when the articles have cooled to a full red heat quench in water and oil, afterward reheating to full cherry and again quenching, though by this method the absolute strength is much reduced though considerable increase of hardness is obtained.

Having discussed the process of casehardening it may be useful to consider briefly the principal faults which occur. It is best to put a test piece in every pot and to treat this in exactly the same manner as the articles being hardened, though one of the articles can be used for this purpose. The tests to be applied come under the heads of hardness and strength. The hardness, in the absence of any specific scientific tests, is proved by the use of the file. For this purpose a smooth saw file should be employed, and this is a test too well-known to need repetition here.

We have next to consider the fractures of the test pieces, and I may repeat that the structure of steel as shown either in the fracture or a polished and etched section contains a certain record of at least the last heat treatment through which it passed:

a. Perfectly casehardened steel when fractured will show a case of extremely fine white grain, which is clearly defined and of very regular depth, while the core is finely granular and of a distinctly metallic luster.

b. The case, instead of having a fine, white, dry appearance, is full of minute, brilliant specks and is not so clearly defined; the core is much coarser and more sparkling and the test piece would break easily, being more or less rotten. Such a fracture shows either that the article was quenched direct from the pot or that, if heated a second time, it was not raised to a temperature sufficiently high to rearrange the structure caused by the high temperature of casehardening.

c. The outer zones of the case are coarser, as in (b), while the remainder as well as the core are very little coarser than (a). This is the result of too high a temperature in reheating. An article having such a structure, though of full hardness, would wear into little pinholes and specks, and some articles of small dimensions would break very easily.

d. The case appears as in (b), but the core is gray and fibrous, or when broken laterally shows very marked laminations caused by too high and too long heating before quenching.

The Broad Point of View on the War and the Industrial Situation

By Wingrove Bathon

On every side one hears that Congress is demanding action, reorganization and coöordination. But while Congress is so loudly demanding action, reorganization and coördination, what is Congress doing to keep the war machine moving? Congress has been in session since Dec. 4—about two months, excluding the Christmas recess. In all that time it has done literally nothing. Page after page of the *Congressional Record* is filled with printed testimony of alleged "hearings" on every conceivable subject, private bills galore have been passed; there have been debates on bills such as those providing for the payment of Civil War claims. But in all these two precious months Congress has not placed on the legislative books one single big, constructive act.

Money is needed. The authorization to spend money, to plan, to prepare, to act, to coördinate is needed. There is in the *Congressional Record* page after page of printed testimony showing that one of the reasons why the nation has not been better organized for the war has been because Congress would not listen to and act upon the suggestions of the executive branches of the Government before the war started. It is a fact that as this is being written the House of Representatives has passed but three of the big money-supply bills, and in the larger sense they are not war-money bills—they are the Post Office, the Indian and the agricultural appropriation bills. By the time this is printed the Legislative, Executive and Judicial appropriation bills may be passed by the House. As yet the Senate has not passed any of the appropriation bills. The only measures of consequence so far passed by this body are the coal and oil lands leasing bil and the Shields water-power bill. These have not been passed by the House. In other words, literally nothing has been done by Congress in three months, and this is true in the face of the fact that the industries of the country need the apparently unobtainable passage of the conference report on the Webb bill, which would permit combination for export trade, as well as the passage of a real bill permitting the development of the water powers of the country and countless other measures held up in committee rooms or on dockets or calendars while Congress continues its fight on the executive branches of the Government.

War Finance Corporation Bill

It is still too soon to say what Congress will d with the War Finance Corporation Bill, under which if it is passed as it is framed, the Government wi supervise the issues of capital to private industry wit a capital for the proposed corporation of $500,000,00 in cash, and with the issuance of $400,000,000,000 o short-term notes. The opinion continues that it i necessary to have some form of regulation of capit for industry during the remainder of the war, bu objection is now being voiced to the bill by the financia and economic experts of the Senate on the proposal t issue such a large volume of notes. This objection deal with the proposed authority to be given to the Federa Reserve banks to deal in the proposed notes, using them as the basis of currency issues. That proposal is bein called "printing-press money." It now seems clear tha some form of regulation will grow out of the propose bill. Industry must be served with capital. Develop ment must be allowed, and even a little inflation ma become necessary as we go on and on raising mone

There has been too much of a let-up in many field already. In the highway field the Government has take a negative attitude. Apparently, from the way thing look now in Washington, if there is to be capit granted for the maintenance and extension of the high ways, it will be in exceptional cases only. But th highways must be maintained and developed as a wa measure. With the failure of steam transportatio truck lines are coming more and more into use. I near-by Maryland alone there are now 50 motor-truc lines carrying freight and express, with an averag mileage of the express lines of 100 miles per truc and there are 31 motor-truck lines carrying passenger all operating under the Maryland Public Service Con mission. It will be absolutely necessary to sell bon for the maintenance and construction of highways.

A "war-finance corporation," properly founded ar administered, could see to that. There must be mone for more power plants because of the coal situatio It is not at all certain that the power-from-coal que tion will be solved by the arrival of good weather ar the restoration of steam-traffic facilities. The natio is using much more coal than it ever used before, ar more power plants or expansion of present power plan are indicated. England is talking about expanding b creating five or six "super" power stations to supp all of her industrial-power needs. In any case capit must be obtained.

ORDNANCE DEPARTMENT

How to Deal With the Ordnance Department

By Lieut. Paul A. Curtis, Jr.

OF ALL the large activities conducted by the Government in connection with the War Department the biggest single one is the Ordnance)epartment of the army. Its expenditures are larger han those of any other department, and its problems ire most complex as well as of great magnitude, beause it furnishes most of the tools of war. It is not ufficient for this department to produce the finished quipment, but in many cases it must go back of that nd secure the raw material for the manufacturer to use.

During the month of January the Ordnance Departnent was thoroughly reorganized, and this has conseuently led to some misunderstanding by the public s to the nature of and reason for this reorganization. t is hard for one who has been to Washington and een this great, apparently cumbersome machine in peration to understand the conditions which made it ecessary. The old organization system of purchasing, hich was satisfactory enough when used in connection ith the small army that this country possessed prior) entering the war, was entirely inadequate when we ssumed the responsibility of putting 2,000,000 men i the field in a year and a half.

It was not sufficient to proportionally increase the rdnance Department to supply the needs of such an my in the old way. The action had to be quick. here were practically no supplies on hand, and it was e duty of the Ordnance Department to fully equip i a war footing in one year's time this huge increase ith everything from canteens to heavy field howitzers.

Experts were recruited from almost every industry the country and were commissioned in the Officers serve Corps for the express purpose of handling the ercantile end of outfitting this fighting machine for e front. As a result the Ordnance Department has creased from a personnel of 79 officers and 825 ented men on Apr. 6, 1917, to an organization of 5000 icers and 26,859 enlisted men on Feb. 1, 1918. This mber includes all ordnance field officers distributed roughout the cantonments and arsenals and in France, t does not account for the thousands of civilian emyees in the ordnance offices in Washington or the 00 inspectors in plants throughout the country. turally such conditions made a great deal of reornization necessary before the proper adjustment was nd.

The Washington editor of the *American Machinist* states that there is much complaint among manufacturers, particularly owners of small plants, about the difficulty of getting information in Washington concerning the kinds of material that are needed. There should be no difficulty in securing this information, providing the contractor is sufficiently familiar with the conditions.

If the manufacturer would come to Washington with a complete statement as to the size and productive capacity of his factory, the kind of material which he turns out under normal conditions and the quality and number of machines which he possesses, he will, on applying at the Bureau of Information of the Ordnance Department at 6th and B Sts., be directed to the proper officer of the procurement division of the Ordnance Department for him to see.

These purchasing officers are all experts in their respective lines. They will question the contractor as to the capacity and qualifications of his plant, and are only too glad to encourage prospective bidders. If anyone is turned down by a procuring officer it is safe to say that it is because his plant is not suitable for the work for which the contractor is endeavoring to secure a contract; in that case he will generally be advised to see some other officer who could make use of such a plant. Or, as is very often the case, there are already enough factories that are better equipped to do the work; or the article has been entirely contracted for.

We should not lose sight of the fact that the productive capacity of this country is so great that it is not necessary to call into service all of our manufactories for the purpose of supplying ourselves and our allies with the war material that is needed to carry on this gigantic struggle. However, if the contracts for a certain line of equipment or supplies are entirely ordered and the contractor's plant is suitable for that work, a careful report of its adaptability for some special line is carefully filed for future reference.

Getting at the Right Man

The Council of National Defense assists the Ordnance Department to secure suitable contractors for special requirements. If a contractor is advised to estimate on some equipment he can easily locate the proper officer to see by going to the Bureau of Information in the Ordnance Building. Many contractors spend

hours running around the building looking for an officer whom they want to see when they could quickly be directed to him by going to the Bureau of Information. The 2,000,000 sq.ft. of space in the Ordnance Building are not enough to house the entire Ordnance Department, and in a town of normally 300,000 population it is manifestly impossible to secure floor space in one district for all the divisions and sections. Hence the necessity of having some divisions a considerable distance from the others, an inconvenience that is being overcome rapidly.

A very misleading statement made by the Washington editor is that unless a man is constantly on the job in Washington and knows the ropes thoroughly he has little opportunity to secure a contract unless he engages on a 5-per-cent. basis a Washington broker familiar with the conditions. He further stated that it is not difficult to see how an overworked officer might place orders wholesale to be redistributed later. This statement is groundless and is unfair to the procurement division. There is absolutely no chance for such profiteering on the part of Washington brokers for the simple reason that the purchasing officer insists on dealing directly with the manufacturer of the manufacturer's representative and will not consider the broker. He knows approximately what the minimum cost of production is, and will only allow about a 10 per cent. profit. This he can easily check, as the raw material in almost every case is supplied by the Government in the required quantities to the manufacturer of the finished equipment. Purchasing officers are always pleased when they can make a saving of a fraction of 1 per cent., because on large orders this often amounts to a considerable sum. Evidently no purchasing officer would be so lax as to allow a 5-per-cent. increase in overhead to be added to his estimates.

Russian Rifles Not Needed

Referring to the adaptability of the Russian rifle which the Westinghouse company was making in great quantities when their order was cancelled, it was entirely unnecessary for the Government to avail itself of this source of supply, as sufficient Springfield and Enfield rifles are being secured to supply the initial requirements for the troops that are sufficiently trained for the front. In the week ending Feb. 9, 43,000 finished rifles were produced for the United States Government, and the production is steadily increasing without taking on any new plants. In fact, the requirements for an army of 1,500,000 men will have been delivered in June, and unless further orders are placed the concerns now supplying the Government will have to partly shut down after that date. It can be seen from this that it will be inadvisable to contract for the Russian rifle when by a short delay the well-equipped Westinghouse plant could manufacture a gun more urgently needed and more difficult to make—that is, the Browning-Colt machine gun.

It was not advisable to adopt another kind of rifle, as the 1906 Springfield is acknowledged to be the best military rifle produced by any country, and the Enfield, which was improved by us to bring it up to the same standard, was adopted to quicken production for the draft army. The British government had intended to improve the Enfield just before war was declared, but did not have time to do so. One important military reason for not adopting a third style of rifle is because every different rifle means important changes in the manual of arms and different training for the troops handling them; consequently the officers would require a rigid training in a somewhat different school of musketry.

Subdividing Contracts

The statement was made that as it is not economical for a small shop to make entire articles, such as fuses or shells, it is obviously more economical for each firm to specialize on a part or unit and assemble these parts and units at a central plant. This very simple and successful scheme has been carried out. The boards of trade and chambers of commerce of several cities have undertaken to some extent to assist small local manufacturers in exactly this way.

No small reputable manufacturer is ever overlooked. The equipment division of the Ordnance Department which has a multiplicity of small articles to secure has placed 3155 orders since the first of May. Many orders for canteen covers were let in lots of 100,000; horse covers in lots of from 500 to 20,000, and cartridge belts and intrenching tools in lots of from 20 to 100,000; and while making these purchases for finished equipment they had at the same time to secure the raw material and issue it to the small manufacturer who could not obtain it himself. On the other hand, many large firms, strong financially, supplied nearly all the material for their Government contracts.

Expenditure

In this way, while placing orders for the equipment of 1,500,000 men, the equipment division has expended the sum of $18,653,558.58 for the purchase of 14,719,224 yd. of duck and 112,724,815 yd. of webbing and $23,000,000 for the purchase of 27,500,000 sq.ft. of strap leather and bridle leather and 9,400,000 lb. of harness leather. This material will all be issued to contractors for army equipment. The difficulty was to find factories properly equipped to do the work, as it was not consistent to issue priority orders for heavy web and leather stitching machines for unsuitably equipped plants when factories which were thoroughly equipped could be located to do the work. Some of the largest collar-manufacturing concerns in the country are making rifle covers and grenade covers simply because their light machines were capable of turning out this class of equipment.

The projectile section of the procurement division has placed 925 separate contracts at a sum of $776,467,110.32. These contracts include forgings and machinings, fuses, adapters and booster casings and all other components necessary to make a complete round of ammunition with the exception of explosives.

Orders for steel, 194 in all, have been placed for 1,673,833 tons. This material is to be issued by the Government to manufacturers of finished equipment.

The Ordnance Department now has a finance bureau for the purpose of advancing money to reputable concerns who have insufficient capital to carry on the work required of them. This is conclusive proof that the Government is trying in every way to assist the small manufacturer to help in the present cause.

Sidelights

EDITED BY E. C. PORTER

According to the *Rheinisch-Westfalische Zeitung*, wood is now being largely used in place of ivory, celluloid and other substances in the manufacture of combs in Germany. Excellent toilet combs, it is stated, are made from thinly cut, faultless birch and beechwood. They are light in weight, clean and cheaper than any other kind of comb and prove entirely satisfactory in use. These new "war" combs include ornamental combs, which are frequently carved or painted.

* * *

The woman who has had training as a physical laboratorian is needed for war service. The Civil Service Commission announces a vacancy in the Puget Sound navy yard at $3.28 a day, and future vacancies will be filled by either men or women. The duties at the Puget Sound navy yard require the testing and calibrating of apparatus at the radio laboratory. Competitors are not required to report for examination, but will be rated on general technical education and physical laboratory experience.

* * *

The American Ambassador at London recently reported by cable the regulations for wolfram shipments by way of Hongkong. According to this report, instructions have now been sent to the governor of Hongkong to the effect that any United States firm may receive periodical shipments of wolfram via Hongkong, licenses not to be granted in advance, but only when the ore has been bought and is ready for shipment. British firms must offer the ore to the Ministry of Munitions first, and if it is refused they may then sell to the United States.

* * *

The Post Office Department has requested commercial organizations to impress upon business men the great advantage to be gained by both the department and the public if they will adopt the practice of depositing their mail in the post-office or street collection boxes not only earlier in the day but as frequently as may be feasible. The department states that it would also tend to relieve congestion and facilitate the handling and dispatch of the mails if heavy mailers would make it a regular practice to have all letter and circular mail, as well as catalogs, pamphlets, etc., bearing uncanceled stamps, properly faced for cancellation, with the short and long letters separated.

* * *

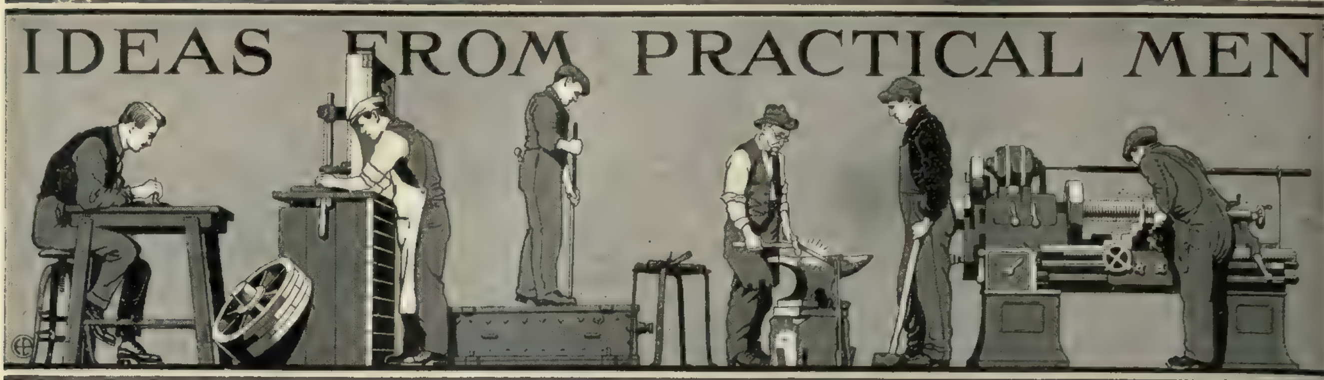
The War Trade Board announces that the regulations requiring shippers who propose exporting goods to their branches or agencies abroad to execute and file with the board a certain form of agreement are suspended in the case of shipments consigned by individuals, firms or corporations in the United States to their branches or agencies located in the United Kingdom, France, the Dominion of Canada, Australia, New Zealand or the Union of South Africa. Before or at the time of filing applications for export licenses for shipments to their branches or agencies located in any other country, exporters should execute and file with the board the prescribed form of agreement.

* * *

The war has brought forth a new kind of ammunition for airplane use in the form of special cartridges containing bullets for armor-piercing, tracing and incendiary purposes. With the progress of the war the more vital parts of the airplane were protected with light armor, so that it became necessary to introduce the armor-piercing bullet. As the gasolene tanks were particularly susceptible to incendiary explosion it was necessary to procure a bullet containing an inflammable substance, ignited upon discharge, which would carry the spark or flame into the tank upon piercing it. As the target, the enemy airplane, was within fighting range for only brief moments at a time, and as there were no means of determining the fire effect as on land, a tracer bullet containing a bright-burning composition, which would indicate the path of the bullet in daylight as well as in darkness, and thereby allow the aim of the machine gun to be corrected, was introduced. The composition is set on fire upon discharge and the bullet flies through the air as a bright spark plainly visible to the machine-gun operator. All of these cartridges are of the small-rifle calibers—caliber 0.30 or thereabout. The $\frac{3}{10}$-in. diameter and short length of this bullet left little space therein for the armor-piercing element or for the tracer or incendiary composition. Nevertheless combinations of armor-piercing and tracer and armor-piercing and incendiary bullets have been made. The bullets developed by the United States Ordnance Department have been tested on land and from airplanes to see if there is any difference in their performance when fired from a quickly moving airplane in the upper atmosphere and when fired on land. The tests have been fully equal to those attained abroad.

* * *

The third Liberty loan, which will open Apr. 6, is to have a distinctive flag of its own. Red border, white interior field, with three vertical blue stripes—this is the design for the honor emblem which will be bestowed on each city exceeding its quota of sales of Liberty bonds. If a city doubles its quota a star will be added to its flag, and a tripling of the quota will be recognized by two stars. Among other features of a system of honors devised for the third Liberty loan, as announced by Secretary McAdoo, is the plan of giving a window card bearing a reproduction of the flag to each purchaser of a bond and of establishing honor rolls in each community or organization of any kind to bear the names of subscribers. It is planned also to unfurl a state honor flag at each state capital after the campaign is ended to bear the names and records of each community which won a quota flag. A national flag to be flown at Washington after the campaign will bear the records of states.

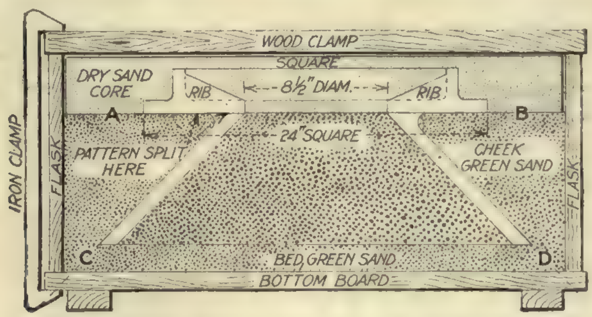


Difficult Job Molded in a Single Flask

By M. E. Duggan

A single casting shown in section in the illustration was required, and the patternmaker had about decided that a three-part flask was necessary, when the molder interfered: "If you make it that way I will have to have special rigging in the cope and cheek flasks, which would make a lot of extra trouble and expense."

After consultation, and an investigation of the foundry's resources for emergency work, the method described here was followed. A single flask, deep enough to cover the complete pattern being available, a bottom board was placed on the foundry floor and a bed of green sand laid upon it. The pattern was then placed and the inside filled up to the parting line AB, and a parting also made at C and D.



A DIFFICULT JOB MOLDED IN A SINGLE FLASK

The flask was then put in place and the cheek filled with green sand up to parting line, the overhanging body of sand being secured by rods laid crosswise in the mold. The flask carrying the cheek sand was lifted off, the pattern drawn and the flask replaced. A cover core was then put on instead of the regular cope, the mold clamped and the cover core secured with wedges placed under the crossbars. The time consumed in the molding was much less than would have been required if the ordinary method of procedure had been followed.

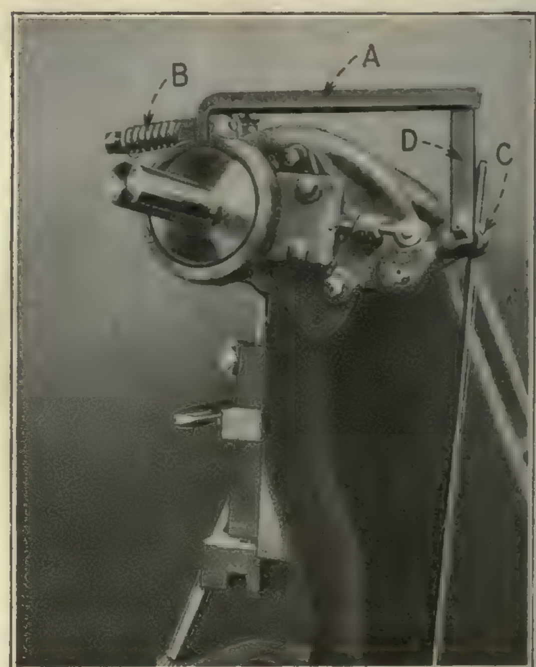
A Punch-Press Brake Release

By Henry Ginsburg

The writer has often wondered why the brake on a punch press is always made to be constantly engaged. To be sure it costs a little less to make it that way, but the additional cost of constructing a brake that is released when the foot is on the treadle is so slight as to be almost negligible, and the advantages are sufficient to warrant the necessary expense. Even for ordinary work—punching one piece at a time—the release of the brake reduces the power required for starting and saves a great deal of the wear and tear on the brake lining.

Where a dial or other automatic feed is used and the press runs continuously, the saving is correspondingly greater. The brake has always been a great source of trouble in such work, heating up, wearing and requiring frequent adjustment. The use of a releasing device permits the tightening of the brake so that the press, especially if running at high speed, may stop without undue shock or strain on the parts of the clutch.

The illustration shows a simple arrangement of a brake release as applied to a V. & O. press. The brake band was removed and the slot made wider to give room for the bent lever A. A longer stud was made to hold the spring B, adjusted by the locknuts, and the pin C was made long enough to hold the connecting link D.



BRAKE RELEASE APPLIED TO PRESS

The band brake is thus held in compression by the spring, released when the treadle is pressed down and held in release while the press is running. The use of this device on our presses has practically eliminated brake trouble and allowed an increase in the speed.

Machine Repairs and Cost Data

By A. L. Nichols

The system here described has been found handy in the repair of machines, in determining their cost and in disclosing weakness in tool design.

A suitable board is prepared and placed in the department handling the machine repairs. This board gives a layout of the shop in which the machine numbers

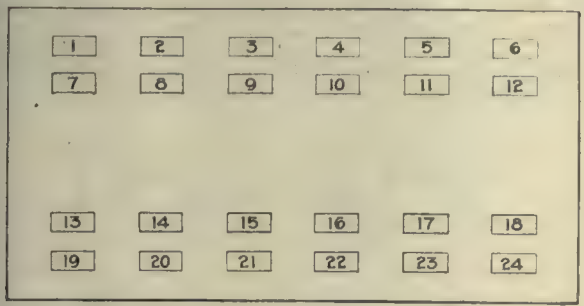


FIG. 1. PLAN OR LAYOUT OF SHOPS

appear as in Fig. 1. In each machine space there is a small hook on which to hang a tag. This tag is printed on both sides as shown in Fig. 2, and is used in the following manner:

When a machine breaks down the operating foreman fills in the tag on the prescribed spaces and tears off

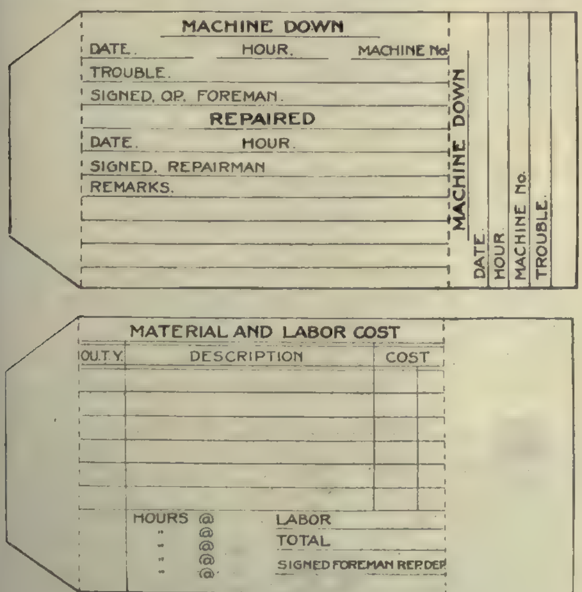


FIG. 2. FACE AND BACK OF REPAIR TAG

the right-hand end or stub and hangs it on the board, face out; the card proper he attaches to the broken machine.

When the repair department starts work on the machine the foreman turns the portion of the tag on the board, face inward. Thus it is readily seen what machines are actually in the workman's hands. On completing the job the foreman in charge of the repair gang, fills in the date and the hour when finished, adding any remarks he has to make as well as memoranda of any material he has used and the hours of labor at the rates paid. This tag is then forwarded to the storeroom and the prices of material and labor entered. After being signed by the repair foreman it is sent to the superintendent's office.

A file is kept and all incoming tags are kept under an index card for each machine. The card which is illustrated in Fig. 3 shows just how much has been

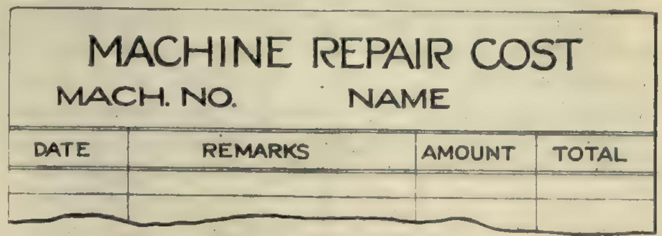


FIG. 3. COST-DATA CARD

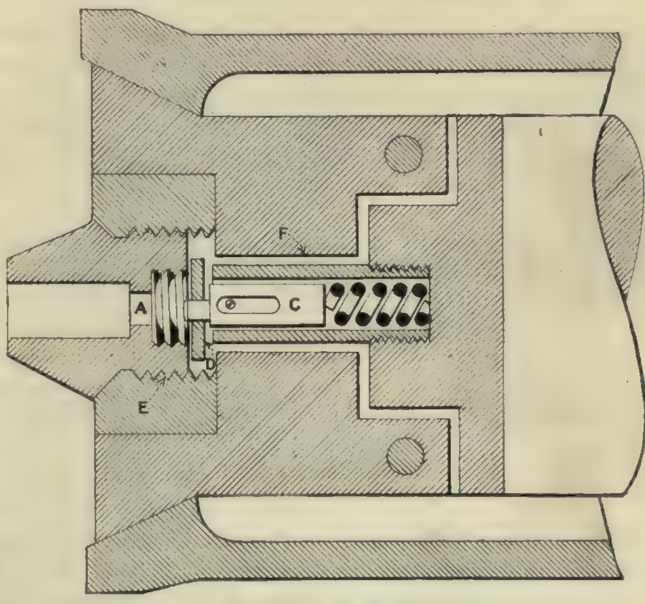
spent in repairs on any one machine, and each time a repair tag comes in the data are entered on this card and the total column is made up in a way always to show the amount spent to date on the machine specified.

By recording the nature of the trouble, weakness in the design is often revealed and the defect remedied. It sometimes happens that the repairs have not been properly made and a second overhauling is necessary. If such is frequently the case with any particular man's work it can be detected by this system.

A Chip Ejector for Hinged Collets

By Howard M. Black

In machining the body of the No. 101 British fuse it was found desirable to drill the hole *A* while the fuse body was chucked for the second operation, as shown in the illustration. This naturally resulted in trouble due to chips being carried through with the



A CHIP EJECTOR

drill and working into the mechanism of the hinged-collet chucks used. The device illustrated entirely eliminated this trouble without introducing any special troubles of its own.

The spring holds the plunger *C* and disk *D* firmly against the base of the fuse, thus confining the chips within the threaded recess and giving the plunger sufficient travel to enable it to follow up the fuse body as it is removed from the chuck. The disk *D*, being

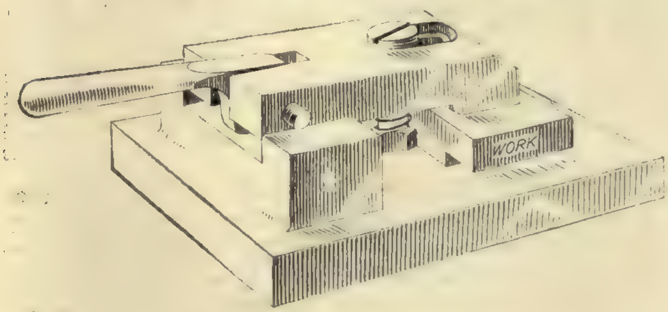
loosely held between the shoulder and the riveted end of the plunger, is free to adjust itself to the base of the fuse body even though the latter be held at an angle when being removed from the chuck.

The only alterations made to the chucks were the drilling and tapping of hole *E* and cutting away the corners of the hinges at *F*. The action of the ejector was entirely satisfactory, making it possible to do away with a separate drilling operation and at the same time better concentricity in the holes was obtained.

Handy Clamping Device for Jig and Fixture Work

By E. H. Cosgrove

A clamping method used extensively on fixtures that require frequent clamping and unclamping movements consists of a bolt and nut, a slotted strap and a block that may be either movable or fixed. The movements involve the use of both hands, as it is necessary to lift the strap and slide it forward, set the block in



HANDY CLAMPING DEVICE

place, and pick up the wrench with which to tighten the nut. If it is necessary at the same time to hold the work in place, as, for instance, holding it against locating pins, these movements become rather awkward, so the cam-operated strap shown in the accompanying illustration was devised to relieve the operator. By grasping the handle of the cam lever all of the movements may be easily made with one hand, leaving the other free to manipulate the work. Adjustment is provided by turning the bolt up or down and locking it in the required position by means of the locknut.

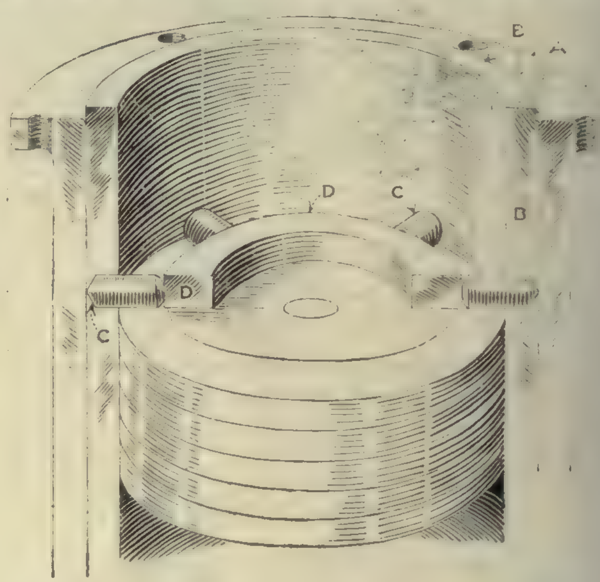
Removing Heavy Steam-Hammer Bushing

By Orville Walton

The illustration shows a method of pressing bushings out of a heavy steam hammer without removing the cylinder. Considerable trouble has been experienced in removing such bushings and the method most commonly practiced is to take down the cylinder, heat same and endeavor to draw or press out the bushing. This often results in a cracked cylinder. The time required to get a hammer in running order by such methods is from two to three days, and five or six laborers are required.

The writer recalls a 3000-lb. hammer that required a new bushing, and the job was done without taking down the hammer. The piston was used as a press, jacks being placed under each corner of the ram. The piston was raised to within 10 or 12 in. of the cylinder top *A*, and six 1-in. holes were drilled in the bushing *B*, 6 in. from the top. The point of the drill just pierced the bushing, and the piston was used to support the drill.

Six pins *C* were placed in the drilled holes, and a steel ring *D* was made to fit inside the pins *C* resting



METHOD OF REMOVING STEAM-HAMMER BUSHING

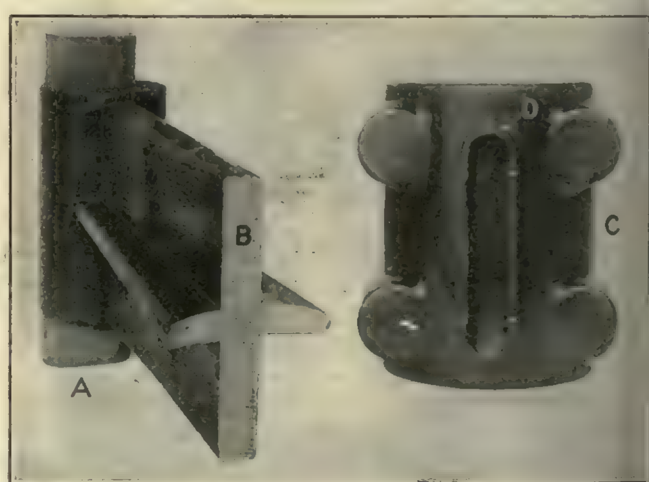
on the top of the piston, preventing the pins from breaking out of the holes. The sketch shows piston in position ready to push bushing out.

Saving Pattern Work

By J. L. Gard

The accompanying illustration shows how the writer economized on pattern work by making one pattern do double duty.

The arm *A* was to be cast with a bearing at *B* to match the cap *C*. The two patterns were made as shown,



THE PATTERN

and castings were made from the cap pattern *C*; after which, the ring *D* forming the oil chamber on the cap was removed, and the cap pattern fastened in place at *B*, completing the arm pattern for molding.

What To Do If We Must Curtail Production

SHIPS are the "neck of the bottle," according to all reports. This neck is so contracted that we may be forced to suspend production on many kinds of munition and other products as the days go by and as they pile up in the factory and at the terminals. It is little use to pile up material which cannot be shipped, as it ties up capital and material which may be needed in other directions.

But the curtailing of production is fraught with possibilities of trouble of various kinds. The high cost of living makes unemployment particularly dangerous; a hungry family is probably the greatest incentive to violence, even on the part of the citizen who is most law abiding under ordinary conditions. With this possibility staring us in the face, steps should be taken at once to prevent such a crisis. There is work enough to be done to keep everyone busy, but it must be planned before the necessity for it arises. A far-seeing program should be adopted, the necessary funds appropriated and plans made for its execution at the proper time. If by any chance ships should be miraculously provided, the plan can simply be postponed until a later date.

AS LONG as we cannot ship across the sea what we make, it is evident that the solution is to encourage industry that will redound to our domestic prosperity. And every law of economics and common sense indicates that this must be something which will become an asset and add to the wealth of the country.

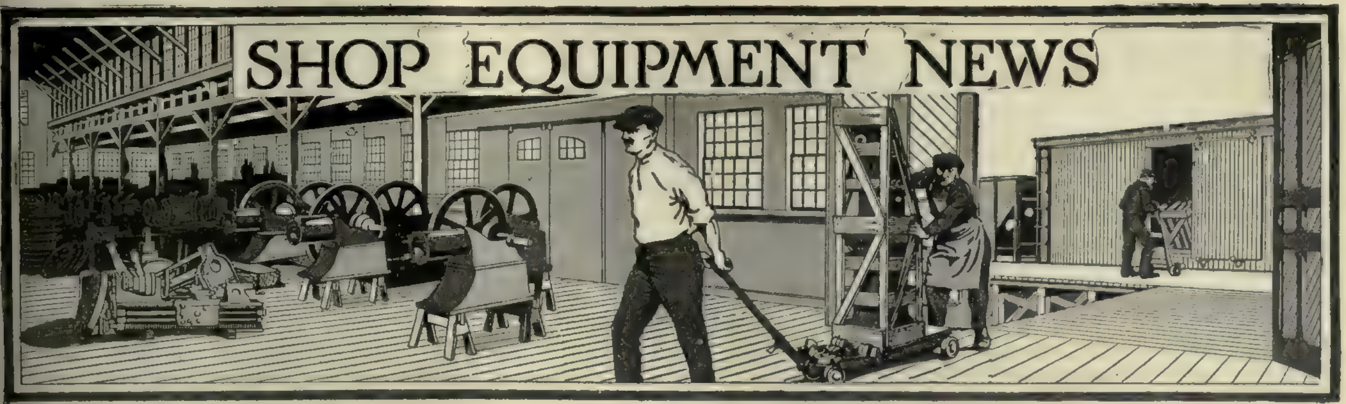
The run-down condition of the railways suggests the first logical field for the employment of a large number of men—more than appears on the surface. Numerous extensions are already necessary; additional tracks need to be laid between important cities; locomotives are badly needed, and cars must be had to go with them. This means far more than the work enumerated; for the laying of track includes the use of grading machinery; of stone crushers; of quarrying machines; of rolling mills for rails, tie plates and spikes; of tie-cutting machinery. And back of all these come the machine tools necessary to make these machines.

IT IS estimated that a billion dollars is needed to put the roads in first-class shape, and this amount of money could not be spent to better advantage than in such a cause, for every dollar thus spent adds to the wealth of the country, regardless of whether the railroads go back to the individual owners or not. If they do, they owe the people of the country whatever money has been spent in rehabilitating them; but that is a detail which does not affect the main problem in the least.

NEXT comes the building of great national highways, which also require a vast amount of labor and machinery, and which also add to the national wealth. Then there is the improving of waterways, the improving of the coal mines and the development of water power in various sections of the country.

Best of all, these are all strictly war measures in that they would render the prosecution of the war less difficult. They are all national assets, and they present a method of absorbing any and all labor that may be thrown out of employment by the necessary curtailment of even essential industries whose products require shipping to be of value.

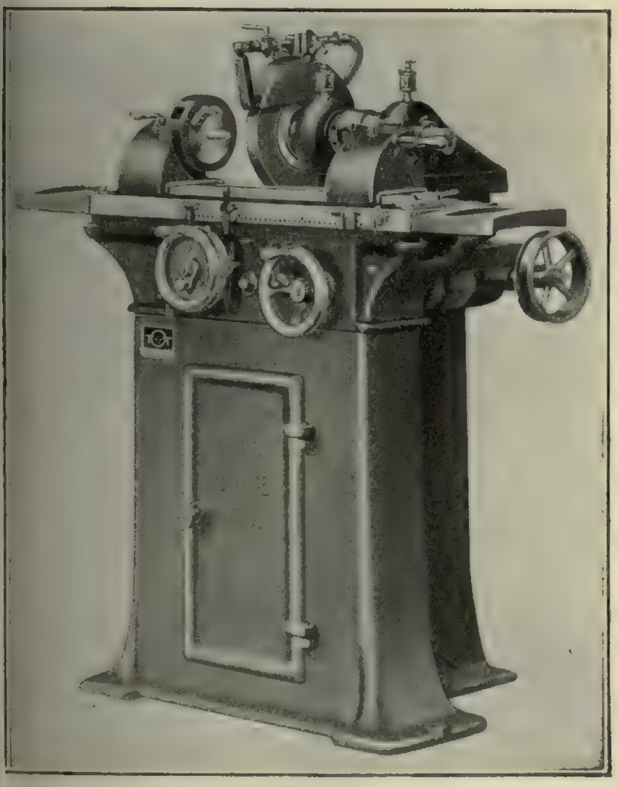
We believe that this program deserves careful consideration by Congress and that immediate action should be taken to prevent the possibility of having great bodies of men thrown out of employment within the next few months. What this might mean, in view of the great unrest in the various parts of the world, should be enough to force prompt action along the lines suggested. Delays are dangerous and may be very costly in more ways than we dream of at present.



This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Ott Plain-Grinding Machine

The illustration shows a 5 x 18-in. plain-grinding machine that is one of the recent products of the Ott Grinder Co., Cincinnati, Ohio. The machine is intended especially for production work on small, straight or taper cylindrical parts. The wheel spindle is hardened, ground and lapped and runs in alloy bronze bearings adjustable for wear, self-feeding oilers being provided.



PLAIN-GRINDING MACHINE

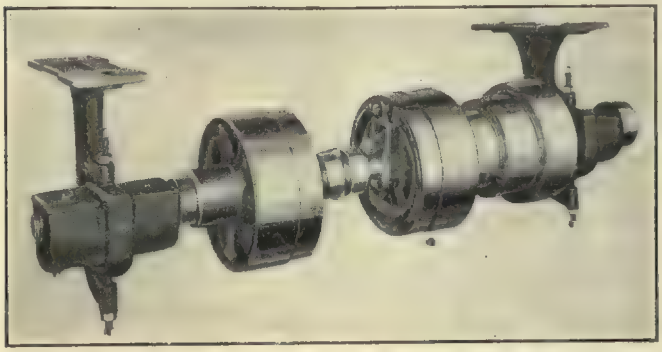
Normal swing, 5 in.; distance between centers, 18 in.; swivel ble graduated to grind tapers up to 3 in. per foot; diameter of ad- and footstock spindles, $1\frac{1}{2}$ in.; centers, No. 6 Jarno taper; ont spindle bearing, $1\frac{5}{8}$ x $3\frac{3}{4}$ in.; rear spindle bearing, $1\frac{1}{2}$ x $3\frac{3}{4}$.; width of wheel belt, $2\frac{1}{2}$ in.; grinding-wheel speeds, 2000 and 00 r.p.m.; minimum reduction of automatic cross-feed, 0.00025 .; maximum reduction of automatic cross-feed, 0.005 in.; numr of work speeds, four, 85 to 425 r.p.m.; table feeds, 20 to 65 . per minute; horsepower required, 5; floor space, 31 x 68 in.; eight, 1700 lb.

ne wheels, which may be up to 10 in. in diameter and in. face, are mounted on the outer end of the spindle d can be easily removed. A wheel stand moves on V- d flat-ways and is controlled by a handwheel. A worm and worm wheel are used for the table drive, the automatic travel being controlled by adjustable dogs. The reversing mechanism is noncentering to insure accuracy of reversal. During power travel of the table the handwheel is disconnected. The automatic cross-feed operates at each reversal of the table and may be adjusted for varying feeds while the machine is in operation. A large hardened and ground stud is used for the movement of the swivel table, which may be clamped at both ends, one clamp being graduated in inches. Dead-center drive is used on the headstock, which is clamped to the swivel table by means of a T-bolt, alignment being secured from the front edge of the table. The footstock is also solid, the spindle being operated by a spring lever, but it may also be clamped rigidly if desired. The footstock is secured to and maintains its alignment on the swivel table in the same manner as the headstock. A water system is provided for wet grinding. The universal back rest has both vertical and horizontal movement. Equipment includes one grinding wheel, universal back rest, wheel-truing device on footstock, center-grinding attachment, one pair of adjustable work dogs, water guards, wrenches and overhead countershaft equipped with Hyatt roller bearings.

Fostei Friction-Clutch Countershafts

The Foster Machine Co., Elkhart, Ind., is now marketing a line of friction countershafts, one of which is shown in the illustration. The device is made in six sizes in the double-friction style and in six sizes in the triple-friction style. The countershaft is of the expanding friction-ring type and Hyatt roller bearings are used on all loose pulleys. To provide for expanding the friction ring there are two radially mounted fingers, pivoted to swing around a tapered stud, provided with ears engaging the slots cut in the expansion rings. The inner ends of these fingers engage and are spread apart by the wedge-shaped part of the dog, which is pivoted on a pin mounted in the driver and is operated by a wedge mounted on the shaft. This wedge is operated longitudinally by a fork, shipper rod and lever in the customary manner. The dog is counterbalanced to counteract the action of centrifugal force at high speeds. The two expansion fingers and the dog are equipped with rollers in order to reduce the friction at the points of contact to a minimum and thereby provide for ease of operation. The adjustment of the friction ring for gripping

power and wear is by means of a tapered screw on which the expansion fingers are pivoted. This tapered screw has a fine-pitch thread for sensitive adjustment and is locked in place by means of a binder screw. The weight of the friction fingers and dogs is counterbalanced. It is claimed that the construction of the internal expanding clutch renders it easy of engagement and secure against slipping. All parts are interchangeable. The friction ring is of the single-expanding type and is held concentric with the shaft by three lugs. It is expanded by two hardened fingers which have as a fulcrum the two points at each end of the friction ring and a tapered

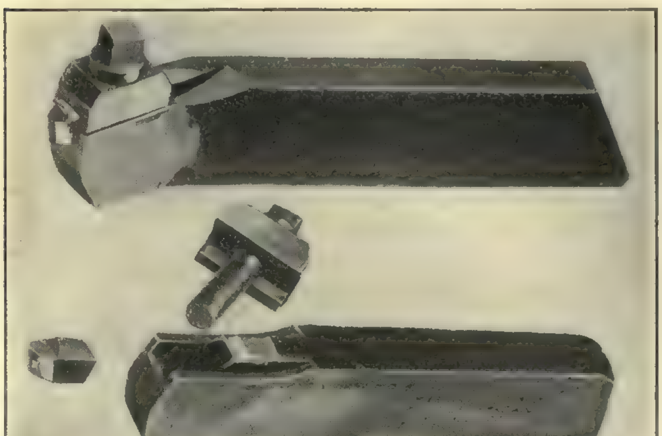


FOSTER DOUBLE-FRICTION COUNTERSHAFT

screw between the ends of the fingers. By the adjustment of this screw the desired starting point of expansion is obtained. Boxes are of the solid, oil-ring type, with two oil rings in each box. The oil, after passing through the bearings, is retained by the same oil cavity, which extends beyond the ends of the bearing and catches the drip. Universal suspension is used to insure a proper alignment of the bearings. Three-step cone pulleys are furnished for both the double and triple countershafts.

Right and Left Toolholders

The illustration shows a new toolholder that has been placed on the market by the Right and Left Tool Holder Co., Jasper and East Willard Sts., Philadelphia, Penn.

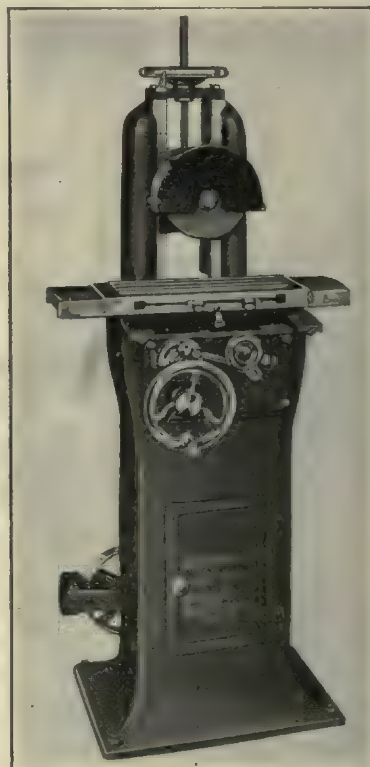


SHORT BIT TOOLHOLDERS

The holder is intended for using up short bits of high-speed steel. The illustration shows one tool assembled and one disassembled, the construction being clearly indicated. The short tool bit is held between the body of the toolholder and the small cap which is clamped dow by means of the square-head screw. It will be notice that this screw has a long thread which decreases th danger of stripping. The holders are made of high carbon steel and can be furnished in straight, right hand offset or left-hand offset, as desired. They ar furnished in eight body sizes from $\frac{5}{16}$ x $\frac{3}{4}$ x $4\frac{1}{4}$ in. to 1 x $2\frac{1}{4}$ x 13 in. and accommodate high-speed bits measur ing from $\frac{3}{16}$ x $\frac{3}{16}$ in. up to $\frac{3}{4}$ x $\frac{3}{4}$ in.

Bridgeport Surface-Grinding Machin

The Bridgeport Die and Machine Co., Bridgepor Conn., is now marketing the surface-grinding machin illustrated, which will handle work up to 5 x 8 x 14 i The machine is intended either for toolroom or manu facturing needs on small parts. The movements of th table are automatic in either direction. Chrome nick steel, hardened, ground and lapped, is used for th spindle, which runs in phosphor-bronze bearings pr



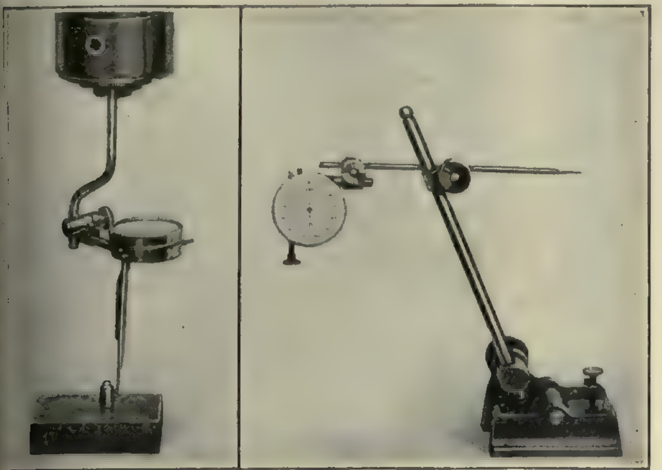
SURFACE-GRINDING MACHINE

vided with adjustment for wear. A handwheel is us for lowering or raising the grinding head, and gradu tions are provided which indicate differences of 0.00 in. The power longitudinal feed is 14 in.; the pow cross feed is 5 in., and the vertical adjustment is $8\frac{1}{2}$ The wheels used are 7 in. in diameter with a $\frac{1}{2}$-in. f and $\frac{5}{8}$-in. hole. The table is 24 in. long and $6\frac{3}{4}$ in. w and has a working surface 14 x 5 in. provided with th $\frac{7}{16}$-in. T-slots. The net weight of the complete mach is 575 lb.

"Atlas" Dial Indicator

The "Atlas" dial indicator illustrated is one of late products of B. L. Gates, 125 South Wells St., C cago, Ill. The device is shown attached to a surf gage and also to a drilling-machine spindle for locat

a button. The connections are universal, the bent connecting-rod being claimed to be very useful. The indicator measures up to 0.130 in., the graduations being in thousandths of an inch. If desired an extension is pro-

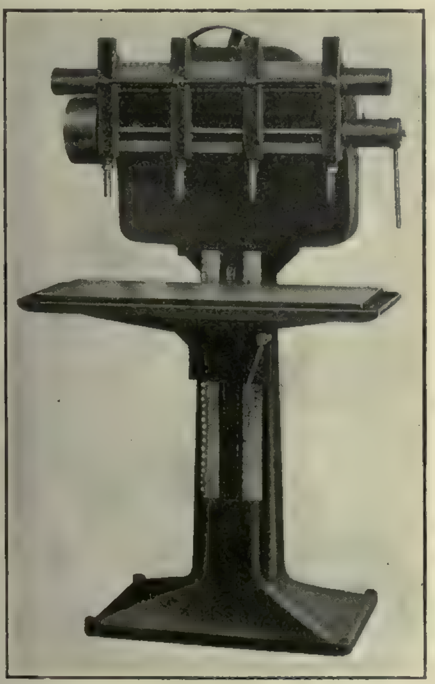


UNIVERSAL DIAL INDICATOR

ided which will enter a small hole and reach to the epth of 3 in. This is made of tool steel and is hardned. The plunger is placed at one side of the dial cen-er, which it is claimed allows the use of the indicator close places, corners, etc.

Defiance No. 50 Valve-Grinding Machine

The machine illustrated is made with 4, 6 or 8 spindles nd is used for grinding-in the valves of gas-engine linders. The feature claimed for this machine is that e oscillating movement is obtained through spur gears, hich decreases the amount of vibration. The table is adjustable for height on the column and is provided with an oil groove around its outer edge. All working parts are inclosed to protect them from dust and to avoid injury to the workman. The machine is the product of the Defiance Machine Works, Defiance, Ohio, and is known as their No. 50 valve-grinding machine.



DEFIANCE VALVE-GRINDING MACHINE

Minimum center distance of spindles, $1\frac{5}{8}$ in.; maximum center tance of outside spindles, 22 in.; distance from spindles to e of column, 7 in.; vertical travel of spindles, 3 in.; maximum tance from nose of spindles to top of table, $21\frac{3}{4}$ in.; minimum tance from nose of spindles to top of table, $9\frac{3}{4}$ in.

Manhattan Universal Grinding Machine

The Manhattan Machine and Tool Works, 42-50 Market Ave. N. W., Grand Rapids, Mich., are now marketing the universal tool-grinding machine shown in the illustration. The table of the machine measures 6 x 42 in., the working surface being 6 x 22 in. Longitudinal movement of the table is 22 in.; transverse movement is 8 in., and vertical movement 12 in. The machine will

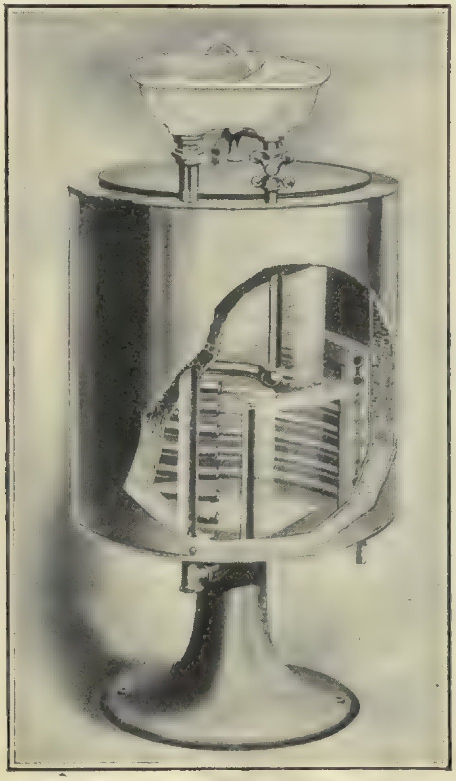
MANHATTAN UNIVERSAL TOOL-GRINDING MACHINE

take work up to 9 in. in diameter, the maximum distance between centers being 21 in. The maximum distance from the center of the wheel to the top of the table is 12 in. The height from the floor to the center of the spindle is 47 in., and the base is 24 x 28 in. Equipment includes internal-grinding attachment, one pair of central head and tail centers, one pair of offset head and tail centers, one faceplate 8 in. in diameter, one chuck for center head, one 5-in. swivel-base vise, six pairs of wheel flanges, six driving dogs $\frac{3}{8}$ to 2 in., one height gage, one tooth-rest socket, seven extension bars, three spring-tooth-rest springs, six T-slot bolts and countershaft complete.

"Ebco" Drinking Fountains

The D. A. Ebinger Sanitary Manufacturing Co., Columbus, Ohio, has recently placed on the market a new form of sanitary drinking fountain. The illustration shows the fountain mounted on a cooler. It will be noticed that the construction is such that the stream of water flows up at an angle from beneath a guard.

this feature making it impossible for anyone to place his mouth on the nozzle. This type of jet also enables one to fill a glass without utilizing an extra outlet. The

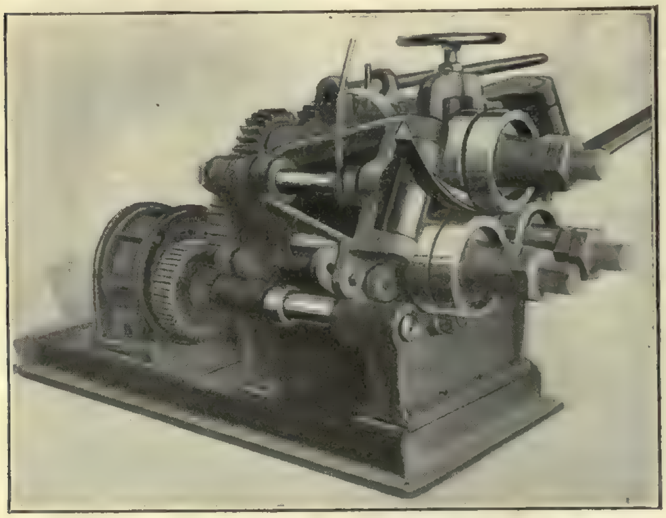


"EBCO" DRINKING FOUNTAIN

angular stream is secured by means of two intersecting jets of varying velocities. The fountain itself is made of vitreous enamel ware, and is also made up in such form that it may be mounted on the wall.

Kane & Roach Angle-Bending Machine

The illustration shows an angle-bending machine recently placed on the market by Kane & Roach, Niagara and Shonnard Sts., Syracuse, N. Y. It is made in three

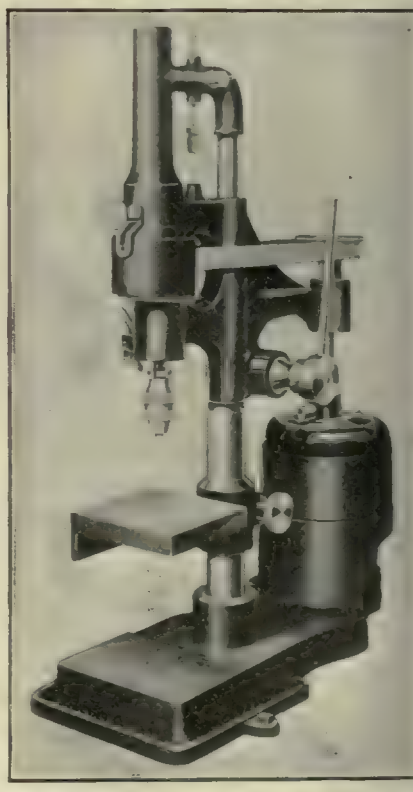


KANE & ROACH NO. 22 ANGLE-BENDING MACHINE

sizes, No. 22 handling angles up to 3 x 3 x $\frac{3}{8}$ in., No. 23 for angles up to 4 x 4 x $\frac{1}{2}$ in., and No. 26 for angles up to 6 x 6 x $\frac{5}{8}$ in. I-beams, channels, Ts, rounds, squares, pipe or flat stock may also be bent by making filling-in collars or rolls to match the work. Either one or two angles may be bent at a time as desired. The machines are made with the rolls close to the floor, which eliminates much lifting. The rolls are also placed close together, which reduces the length of the flat spot at each end. It is also claimed that having the rolls close together allows the bends to be started from the straight piece, thus eliminating hand bending at the start. Another important feature claimed is the sliding gag under the adjusting screw that holds down the top roll. This gag may be slid out from under the screw, allowing the top roll to be raised out of the way so that the work may be placed in or removed from the machine without changing the screw adjustment. The side rolls swivel to any degree, according to the diameter of the circle being bent, and may also be adjusted in or out against the work as may be necessary. This prevents side twisting or buckling of the work. The rolls are of high-carbon steel, the front roll shaft bearings are of bronze, and the driving gears and pinions are cut from steel. The machines are provided with a scale and pointer for indicating the correct position of the rolls for bending circles of the desired size.

High Speed Hammer Co.'s Bench Drilling Machine

The illustration shows the Model E sensitive bench drilling machine that is now being marketed by the High Speed Hammer Co., Inc., Rochester, N. Y. The device is a two-speed machine driven by a high-speed motor, and will accommodate drilling work where the holes do



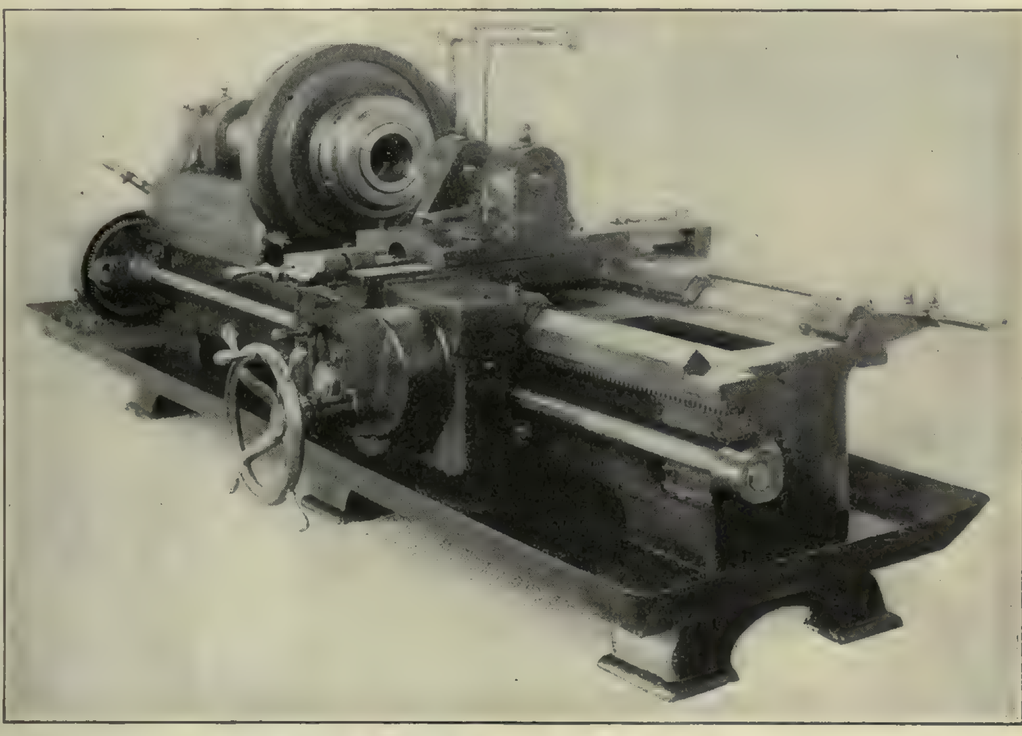
SENSITIVE BENCH DRILLING MACHINE

Capacity up to $\frac{3}{16}$ in.; spindle speeds, two, 2100 and 6000 r.p.m. working surface, $5\frac{1}{2}$ x 5 in.; working surface of base, 4 x 6 in. height, 24 in.; motor, $\frac{1}{10}$ hp.; diameter of spindle, $\frac{7}{16}$ in.; spindl feed, $2\frac{1}{4}$ in.; distance from center of spindle to column, 3 in. height of work accommodated on table, up to $4\frac{3}{8}$ in.; height o work accommodated on base, up to $7\frac{1}{2}$ in.: dimensions of bas $7\frac{1}{2}$ x 18 in.; weight, 60 lb.

not exceed $\frac{3}{16}$ in. in diameter. The standard spindle speeds are 2100 and 6000 r.p.m., but speeds up to 10,000 r.p.m. can be furnished if desired. The main spindle is heat treated and ground to size, and is guided through a bronze quill with an annular ball bearing at each end. End thrust is carried on a ball thrust bearing under the feed arm. The table surface is ground and the table may be quickly adjusted to various positions. The table has a self-cleaning taper which keeps chips and dirt away from the main column. The base is ground and has an oil groove and a self-cleaning support. A feature of the machine is the spindle lock, which enables a quick change of drills without the operator's hands coming in contact with the belts or pulleys to prevent the spindle turning. An idler pulley is provided to take up any stretch which may occur in the endless woven-canvas belt. The front pulley and the upper part of the spindle are guarded by a semi-tubular guard. Either hand or foot control is used, as desired. A depth gage is provided which is adjustable to thousandths of an inch.

Gisholt Heavy-Shell Lathe

The machine shown is manufactured by the Gisholt Machine Co., Madison, Wis., in two sizes, 16- and 25-in., which are especially adapted for boring 3 and 6 in. shells respectively. Their rigid, powerful construction also makes them unusually good machines for a wide range of boring work. While the bar supports shown on the cross-slide are bored to receive a bar 3 in. in diameter they may be bored for any diameter of bar suitable for use in the machine. The cross-slide carriage, which is 24 in. long, bears the entire width of the 18-in. slide. By the use of a former block on the taper attachment a single-point cutter may be used in the boring bar and the shell bored out to any desired contour, or the carriage may be set central and a boring head used on the bar. The 16-in. lathes are made with either 3⅞ or 6¼ in. spindle bore, and the 25 in. size with 6¼ in. spindle bore. The machine when so ordered may be had with either collet or jaw-chuck equipment. Various attachments may also be fitted to the machines, such as tool-carriage, turret or other fixtures. Both bearings of the headstock have split bronze bushings and the caps are adjustable for wear. The end thrust of the spindle is taken by ball bearings. The two-step cone pulley is mounted on the back gear shaft.



GISHOLT 16 AND 25 IN. HEAVY-SHELL LATHE

Specifications for 25 in. size: Standard length of bed, 10 ft., normal swing of lathe, 25 in.; hole through spindle, 6¼ in.; spindle front bearing, 8¾ x 12 in.; spindle rear bearing, 7⅞ x 9 in.; spindle nose, diameter, 12¾ in.; headstock cone, diameters, 20 and 16 in.; width of belt, 8 in.; ratio of back gearing, 8 to 1; spindle speeds, 12, 16, 20 and 27 r.p.m.; countershaft cone, diameter, 17 and 13 in.; friction pulleys on countershaft, 20 x 6 in.; speed of countershaft, standard, 160 and 200 r.p.m.; weight, about 8000 lb.; cu.ft., about 300.

Needham 40-In. Heavy-Duty Lathe

The illustration in this article shows a heavy-duty lathe embodying some unusual features. It combines the range of a fair-sized gap lathe with the rigidity and ease of manipulation obtained with the regular form of

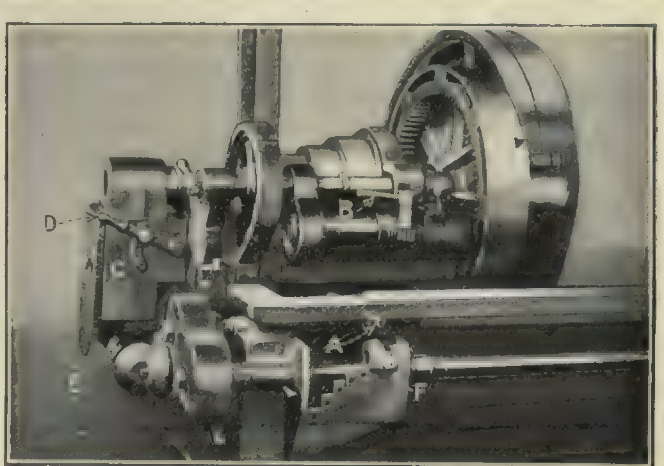


FIG. 1. HEADSTOCK OF LATHE SHOWING DRIVE AND FEED MECHANISM

construction, and in addition its maximum swing is available over the full distance between centers.

The lathe bed is a modified form of box construction in which the back shear is considerably lower than its corresponding shear at the front, this construction being clearly shown in the illustration.

The headstock with the first change gear box, back gears, disengaging clutch, etc., is mounted as a unit upon a transverse slide which moves upon the bed, being

operated by a screw and loose crank at the front, the end of this screw being shown at *A*, Fig. 1. The spindle is hollow and the spindle bearings are of ample capacity. The drive is direct by a 3½-in. belt on a four-step cone locked to the spindle in the usual manner, or through the back gears (which are in front) to the pinion meshing with the 30-in., 3-pitch internal gear shown on the back of the faceplate.

The small lever *B* withdraws the pinion from mesh when direct drive is desired and at the same time releases the back gear clutch. The feed drive is through a pair of miter gears at the back end of the spindle to a vertical shaft in the gear box *C* which is attached to the headstock. In this box there are sliding gears operated by the handle *D*, giving three changes of speed. At the lower end of the shaft a miter gear meshes with two

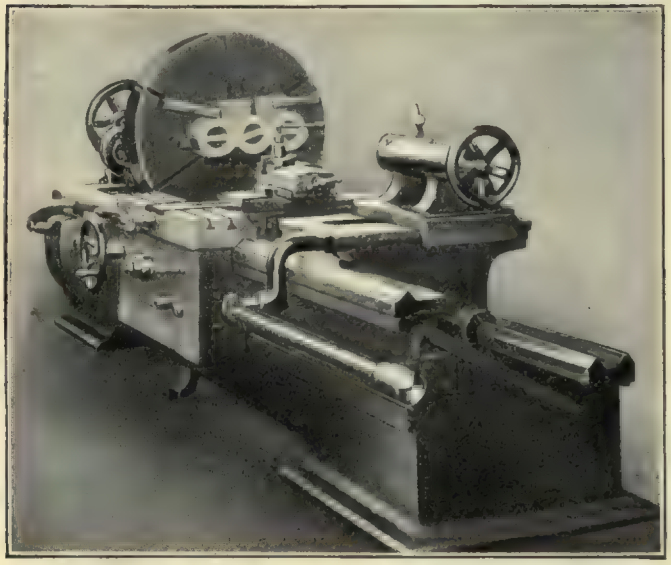


FIG. 2. NEW DESIGN FOR HEAVY-DUTY LATHE

Length of bed, 12 ft.; height from floor to top of front shear, 34½ in.; center to center of shears, 27 in.; height of front shear above back shear, 9½ in.; transverse movement of head and tail stocks, 14 in.; front bearing of spindle, 6 in. in diameter by 8 in. long; rear bearing 4 in. in diameter by 6 in. long; hole in spindle, 2¼-in. clear through; diameter of faceplate, 36 in.; width of faceplate, 5¼ in.; maximum swing, 40 in.; swing over carriage, 14 in. (this is with the carriage extension in place; without this extension the swing in all places is 40 in.); length between centers, 8 ft.; weight complete, 14,000 lb.

corresponding gears loosely mounted on a sleeve which is splined to the transverse shaft *E*, driving the shaft in either direction through the medium of the sleeve and clutches. The only purpose of this reverse is for left-hand threads as feeds are reversed in the apron.

The sleeve carrying the thread-reversing mechanism, being splined to the transverse shaft, is free to move endwise upon it, and therefore requires no attention when the entire head is moved across the lathe. The transverse shaft drives a train connecting with a nest of 24 gears mounted longitudinally in the lathe bed and controlled by the handle *F*. This nest, in connection with the three changes on the vertical shaft, gives a range of 72 feeds. All feeds are through the splined lead screw, which is 2 in. in diameter and 2-pitch single square thread.

The carriage is built to operate entirely on the front rail, being firmly gibbed to it and having a broad bearing upon the front of the bed below the feed screw. When used in this manner the lathe will handle its maximum swing of 40 in. over any part of its length, as the work does not come over the carriage.

There is an extension, however, which can be bolted to the carriage, this extension having a bearing upon the back shear so that in boring operations the tool is solidly supported in all positions. The extension is shown in place in the engraving, Fig. 2. If it is desired to use the front carriage alone, as in turning large diameters, it is the work of but a moment to detach the extension by the removal of two ¾-in. capscrews.

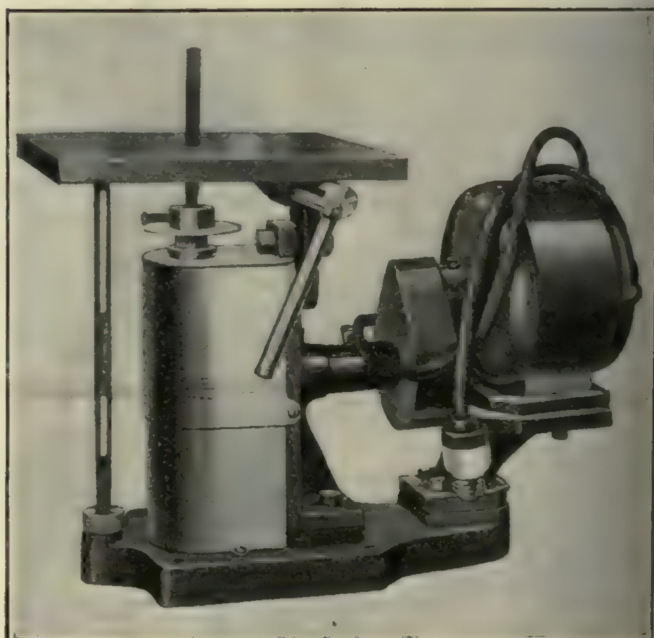
The cross-slide travels either on the main carriage or on the extension, as when the latter is in place there is no break in the cross-slide way. The regular cross-slide carries a compound rest. There is a special cross-slide provided to hold tools for heavy work, such as turning car wheels or for boring large diameters.

The feed is engaged in either direction by a lever on the apron, and this lever interlocks with the lever operating the lead screw nut, making it impossible to engage the nut and the feed simultaneously. A rack and pinion provides for moving the tailstock along the bed.

This lathe is built with a view to securing a rigid machine of moderately large swing capable of producing accurate work under heavy sustained cuts. In the shops of its builder, A. W. Needham, Long Island City, N. Y., it is claimed the lathe has for long periods carried a continuous cut in gray iron of ¾-in. depth with a ⅛-in. feed.

Davis 20th Century Filing Machine

The illustration shows the No. 1 motor-driven, bench-type filing machine that is being manufactured by the W. F. Davis Machine Tool Co., 85 Liberty St., New York City. The machine can also be furnished for



BENCH-TYPE FILING MACHINE

Weight with belt drive, 65 lb.; height from bench to top of table, 13 in.; size of table, 10 x 8½ in.; hole in table, ⅝ in.; spindle, ¾ in. square; hole in spindle, ⅜ in.; stroke, 0 to 2 in.; strokes per minute, 500

belt drive if desired. The spindle is of hardened steel, ground and fitted into adjustable boxes which hold the file in line and prevent twisting. It is constructed with a ⅜-in. hole to accommodate files with round shanks

The stroke is adjustable from 0 to 2 in. and the table may be quickly adjusted and locked at an angle. The driving shaft is supported by an outer bearing, and all working parts are inclosed in a dustproof case with oil cups for all bearings. Where motor drive is used the motor furnished is either for direct or alternating current as desired.

Driver-Harris Pure Sheet Nickel

An important development in this country to replace material formerly manufactured abroad has been the production of pure sheet nickel in various widths and thicknesses. Until a few years ago the advantages of pure nickel had not been appreciated, and in consequence there were no adequate facilities for rolling it into large sheets. The practice for many years was to use nickel supplied by Canadian mines, which was shipped to European manufacturers for fabrication, and previous to the war nearly all nickel-sheet, strip and finished articles of foreign manufactures coming into this country were of American ore worked by foreign concerns.

The superior qualities of pure solid nickel should not be confused with those of metals frequently sold as nickel but which are merely articles of steel, brass or german silver with a thin nickel-plating that in a short times wears through, rendering the ware unsuitable and unsafe for use.

The danger of poisoning by verdigris is eliminated in pure nickel, as it does not rust, oxidize or tarnish, as in the case of some alloys. Corrosion cannot occur even where the surface is injured, and this is an advantage over the plated articles. Acids and other tarnish removers used to clean plated and copper food containers, being poisonous, are sources of danger that are also obviated by the use of pure nickel. It requires no replating, and abrasions on its surface only serve to brighten the finish.

Pure nickel, because of its resistance to the corroding influence of chemicals, is valuable in the chemical-manufacturing field and in the metal world, being superior to copper and bronze and their alloys. It is practically immune to the action of the alkalies in everyday use, and is used in the manufacture of nickel crucibles for chemical laboratories. Numerous parts of chemical apparatus and machinery must be made of nontarnishable, noncorrosive metal, and pure nickel can be used in the manufacture of these products on a commercially profitable basis.

Emphasis is laid on the attainment of producing pure nickel sheets of a high tensile strength, and no individual equipment is required for working the pure nickel in this manner, the same implements and metals being used as with german silver and hard alloys. It is homogeneous, very ductile and easily formed by spinning or stamping.

In order to manufacture sheet nickel the Driver-Harris Co., Harrison, N. J., has provided the necessary facilities and equipment and can supply the product for commercial use.

Bench Lathe Toolholder

The Ready Tool Co., Bridgeport, Conn., is now making a toolholder especially for bench and watch lathes. It is drop-forged, $\frac{5}{16}$ x $\frac{1}{2}$ x $3\frac{1}{2}$ in. fitted with a $\frac{3}{16}$-in. sq. cutter of high-speed steel treated by the Taylor-White process. A wrench is also included as is usual with the larger holders.

"Triad" Heat-Treating Furnace—Erratum

The "Triad" heat-treating furnace illustrated and described on page 469 is the product of W. R. Bennett, Elmwood, Conn. This device was credited to another firm by mistake.

Personals

Henry H. Vaughan has been elected president of the Canadian Society of Civil Engineers.

Thomas Houghton has been appointed factory manager of the Chevrolet Motor Co., Flint, Mich.

G. D. Yeager has been elected president and general manager of the Wagner Axle Co., Anderson, Ind.

W. Whitney Slaght has been appointed experimental engineer of the Pierce-Arrow Co., Buffalo, N. Y.

Milton Rupert has been elected vice president and assistant treasurer of the R. D. Nuttall Co., Pittsburgh, Penn.

E. R. Jacobi, formerly chief inspector of the Reo Motor Car Co., has joined the Mitchell Motors Co., Inc., Racine, Wis.

A. B. Hall, vice president of the Whitman & Barnes Manufacturing Co., Akron, Ohio, will hereafter have supervision of the company's sales.

Thomas J. Cole, formerly master mechanic of the Erie R. R. at Meadville, Penn., has been appointed shop superintendent at Meadville.

Frank A. Hayes, formerly engineer with the Willys-Overland Co., Toledo, Ohio, has been appointed chief engineer of the Willys-Overland, Ltd., Toronto, Ont.

Henry C. Limbach, former production manager of the Zenith Carburetor Co., is now equipment engineer of the Strong, Carlisle & Hammond Co., Detroit, Mich.

Vere Brown, formerly assistant general manager of the Allegheny Steel Co., Brackenridge, Penn., has been appointed general manager of the company.

E. P. Perkins, formerly superintendent of the plate mill of the Allegheny Steel Co., Brackenridge, Penn., has been made assistant general manager.

J. A. Wilson, for many years a member of the sales department of the Vandyck-Churchill Co., Singer Building, New York, has been appointed sales manager.

W. J. Jenks, formerly general superintendent of the western general division of the Norfolk & Western R.R., has been appointed general manager of the road.

N. L. Bean, formerly assistant to the president of the New York, New Haven & Hartford R.R., has been appointed assistant to the general mechanical superintendent.

Joseph W. Gardham, formerly technical representative of the Chalmers Motor Co., is now in charge of tests of motor trucks for the Militor Corporation, Jersey City, N. J.

J. H. Phillips, formerly traveling engineer of the Chicago, Milwaukee & St. Paul R.R., has been appointed division master mechanic of the northern division with office at Horicon, Wis.

R. T. West, formerly president of the Vulcan Steel Products Co., New York, has established himself in the iron and steel business at 141 Broadway, New York, devoted chiefly to export trade.

John S. Agey, for 13 years employed by the Carnegie Steel Co. at Youngstown, Ohio, has resigned to take a position as assistant superintendent of one of the mills of the Donner Steel Co. at Buffalo.

J. K. Booth, formerly general foreman of the Bessemer & Lake Erie R.R., at Greenville, Penn., has been appointed master mechanic, with supervision over the locomotive department shops at Greenville.

Frank L. Eidman, superintendent of the Cowan Truck Co. of Holyoke, Mass., has been allowed an indefinite leave of absence to accept appointment as engineer of tests in the Ordnance Department at Washington.

W. H. Thompson, for a long time with the Westinghouse Electric and Manufacturing Co., has resigned to become works manager of the Fairmont Mining Machinery Co., Fairmont, W. Va., maker of coal-mining equipment.

Harry W. Alexander, director of publicity of the Society for Electrical Development, New York, has resigned to become assistant to the president on sales of the American Writing Paper Co., New York, and Holyoke, Mass.

W. H. Hart, formerly assistant district master mechanic of the Superior division of the Chicago, Milwaukee & St. Paul R.R., with office at Green Bay, Wis., has been appointed division master mechanic, with the same headquarters.

I. E. Edwards, for 12 years chief engineer of the Valley Mold and Iron Corporation, Sharpsville, Penn., has resigned to accept the position of works manager of the ingot mold foundry of the Marshall Foundry Co., Josephine, Penn.

M. A. Stone, general superintendent of the Wolverine Brass Works of Grand Rapids, Mich., has resigned and is now president of the M. A. Stone Manufacturing Co. of Grand Rapids, Mich., manufacturing small cast parts and stampings.

H. O. Bernhardt, formerly production manager of the Harroun Motors Corporation, Wayne, Mich., has received the commission of Major in the Ordnance Department. He will be connected with the central bureau supervision section.

Sidney Diamant, a member of the American Society of Mechanical Engineers, is no longer a partner in the firm of De Mant Tool and Machine Co., 79 East 130th St., New York City, having withdrawn his financial, active and other interests.

J. E. Buckingham, formerly Northwestern representative of the Standard Steel Works Co. with offices in the Northwest Bank Building, Portland, Ore., has been appointed general manager of the Hofins Steel and Equipment Co., Seattle, Wash.

E. W. Dobson has been appointed factory manager of the Standard Motor Truck Co., Detroit. He was formerly in charge of the truck department of the Packard Motor Car Co. and later was with the Continental Motor Co. and the Hercules Motor Co.

S. H. Brenamen, formerly resident engineer on the improvement work done by the Pennsylvania R.R. in Johnstown, Penn., and vicinity, has been placed in charge of the survey for the electrification of the Pennsylvania R.R. between Johnstown and Altoona.

H. D. Webster has been appointed engineer of motive power of the Bessemer & Lake Erie R.R.; **C. C. Richardson,** assistant to the superintendent of motive power; **F. W. Dickenson,** master car builder, and **C. L. Tuttle,** mechanical engineer; all with headquarters at Greenville, Penn.

Paul T. Irvin, who has been associated with the Wells Brothers Co. and the Greenfield Tap and Die Corporation for 12 years, has resigned his position as sales manager of the gage division to accept the position of general sales manager of the Lincoln Twist Drill Co. of Taunton, Mass.

G. R. Munchauer has become president of the Niagara Machine and Tool Works of Buffalo, N. Y., succeeding George Lantz, who has retired. Mr. Munchauer gained promotion in the company through the purchasing department. For a number of years he was manager of the sales department.

Howard W. Dunbar, assistant chief engineer of the Norton Company, Worcester, Mass., delivered an address upon "Grinding Machinery in the War and Its Service to the World," Mar. 12 (Superintendents' Night), at the Machinery Club of Chicago. Charles Norton, president of the Norton Company, made an impromptu speech wherein he gave a definite outline of what constituted "True Patriotism for True Americans." Over two hundred superintendents were guests of the club members.

Loyall A. Osborne of New York, vice president of the Westinghouse Electric and Manufacturing Co. and chairman of the executive committee of the National Industrial Conference Board, has been appointed by the Secretary of Labor a member of a committee on industrial peace during the war. This committee, which consists of five representatives of employers, five labor leaders and two public men, will provide a definite labor program in order that there may be industrial peace during the war, thus preventing interruption of industrial production vital to the war.

William T. Price has resigned as manager and chief engineer of the De La Vergne Machine Co. to become president of the P-R Engine Co. of New York City and second vice president of the Rathbun-Jones Engineering Co. of Toledo, which will manufacture and sell the Price-Rathbun stationary and marine oil engines. The P-R Engine Co. has its main offices at 110 West 40th St., New York, and other offices in Philadelphia, Baltimore and Toledo.

Trade Catalogs

Milling Machine. Dow Mfg. Co., Braintree, Mass. Circular illustrating and describing No. 1 plain cone type.

Spraco Pneumatic Painting Equipment. Spray Engineering Co., 93 Federal St., Boston, Mass. Catalog No. 10. Pp. 8; 4½ x 9 in.; illustrated.

Drop Forgings. Union Switch and Signal Co., Swissvale, Penn. Bulletin No. 88, Pp. 12; 6 x 9 in. This shows the different forgings this concern is producing including axle, crankshaft, war truck, airplane, etc.

Military Camps of Our Allies. The Consolidated Expanded Metal Cos., Braddock, Penn. This is the title of a pamphlet describing the use of expanded metal lath in the construction of various camps in England and France.

Molding Machines. International Molding Machine Co., 2614-2622 W. 16th St., Chicago, Ill. Catalog. Pp. 110; 8 x 10½ in.; illustrated. This is a very fine catalog describing 18 types of machines and contains rules for the selection of the proper machine.

Methods of Cutting Bevel Gears on Bilton Gear Millers. The Bilton Machine Tool Co., Bridgeport, Conn. This is a collection of blueprints with information as to the different methods employed in the cutting of bevel gears and ought to be valuable to users of these machines.

Business Item

The Goddard Tool Co. of Chicago and Detroit has recently opened its third plant at 1145 Diversey Blvd., Chicago, which is given over entirely to the manufacture of gages, dies and tool work.

Obituary

Frank J. Hurley, 29 years old, died at the home of his parents in East Orange, N. J., on Mar. 10, after a long illness. Mr. Hurley was well known in the pneumatic-tool field, having traveled for a number of years out of the New York office of the Independent Pneumatic Tool Co.

New Publications

Machine Shop Practice—By William B. Hartman, instructor of machine construction at Carnegie Institute of Technology. Two hundred forty seven 4½ x 6½-in. pages; 132 illustrations. Published by D. Appleton & Co., New York and London. Price $1.10 net.

The purpose of this book is to set forth the elementary principles of machine-shop practice, and it has been done in a plain way without the use of mathematics beyond ordinary arithmetic. The book as a whole is well and logically arranged, although it does not extend beyond the range of the ordinary apprentice or beginner in machine shop work. The contents include instructions on chipping, filing, scraping, drills and drilling machines, the lathe, straight and taper-turning, thread-cutting, planing- and shaping-machine work, the boring mill and milling machine. Just why 20 pages should be devoted to a general description of the automobile in a work of this kind is not clear, as it has absolutely no connection with rest of the book as it has been handled.

The Petroleum and Natural Gas Register, 1917-1918—By Holland S. Reavis. Five hundred forty-eight 8½ x 11¾ in. pages; numerous illustrations. Published by the Oil Trade Journal, 120 Broadway, New York City. Price $2.

In this book the various branches of the oil trade in the United States, Canada and Mexico are coördinated for the first time. The information presented represents a great amount of labor and is unusually accurate and complete. Names of officers, capital stock, location of properties and other valuable data are given. The text includes the following important divisions: Refiners of petroleum; manufacturers and compounders of lubricating oils, greases, petrolatum, etc.; marketers and jobbers, Eastern states; marketers and jobbers, Central and Southern states; marketers and jobbers, Western states; producers of petroleum, Eastern and Central states; producers of petroleum, Oklahoma and Kansas; producers of petroleum, Texas and Louisiana; producers of petroleum, Western states; oil pipe line companies; casing-head gasoline manufacturers; natural-gas producers and distributors; manufacturers of and dealers in equipment and supplies of all kinds for the oil and natural-gas industries. The text also contains a directory of the officers and members of the oil and gas associations and clubs in the United States. The book is well printed on high-grade paper and bound in cloth.

Forthcoming Meetings

The American Gear Manufacturers' Association will hold its second annual convention at White Sulphur Springs, W. Va., Apr. 18, 19 and 20, with headquarters at the Green Brier Hotel. The secretary is F. D. Hamlin of the Earle Gear and Machine Co., 4701 Stenton Ave., Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

The sixth annual meeting of the Chamber of Commerce of the United States of America will be held in Chicago, Apr. 10, 11 and 12, 1918. Elliot H. Goodwin, Riggs Building, Washington, D. C., is general secretary.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

The National Gas Engine Association will hold its eleventh annual meeting at the Hotel Sherman, Chicago, Ill., June 3 and 4. The headquarters of the association are at Lakemont, N. Y.

The spring convention of the National Machine Tool Builders' Association for 1918 will be held Thursday and Friday, May 16 and 17, at the Marlborough-Blenheim Hotel, Atlantic City, N. J. Charles L. Taylor of Hartford, Conn., is secretary.

The National Metal Trades Association announces the following program of its forthcoming convention, which will be held at the Hotel Astor, New York City: Monday, Apr. 22, 10 a.m., executive committee meeting; 7 p.m., secretaries' dinner. Tuesday, Apr. 23, 10 a.m. to 5 p.m., council meeting; 10 a.m., meeting of local secretaries; 6:45 p.m., alumni dinner. Wednesday, Apr. 24, 9:30 a.m. and 2 p.m., convention; 12:30 p.m., buffet luncheon; 7 p.m., banquet. Thursday, Apr. 25, 9:30 a.m., and 2 p.m., convention and meeting of the incoming administrative council. Homer D. Sayre, People's Gas Building, Chicago, Ill., is the secretary.

A joint convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held at Cleveland, Ohio, May 15-17. Among the important subjects to come up for action will be Government control of fuel, transportation and shipping of materials and price fixing. The coöperation of labor in war activities will also be discussed at length.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1785 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Lathe, 60-in. Triple-Geared "Fifield"

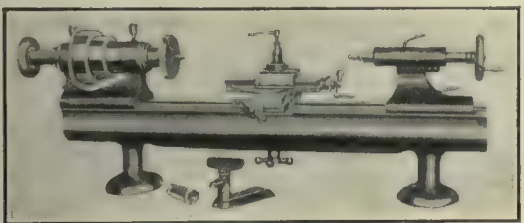
David A. Wright, Chicago, Ill.

"American Machinist," Mar. 14, 1918

Made in two styles, standard and heavy. Distance between centers with 14 ft. bed, 5 ft.; swing over carriage, 45 in.; ratio of back gearing, 13 to 1; ratio of triple gearing, 42 to 1; threads cut, 1 to 12; weight with 14-ft. bed, standard type 24,000 lb., heavy type 30,000 lb.; extra weight per extra foot of bed, standard type 1000 lb., heavy type 1500 lb.; feeds of toolpost, 0.050, 0.096 and 0.137 in.; spindle speeds, nine, 1.48 to 120 r.p.m.

Lathe, Precision Bench

DeMant Tool and Machine Co., 79 East 130th St., New York City



"American Machinist," Mar. 21, 1918

Swing, 7 in.; length of bed, 32 in.; distance between centers, 16 in.; capacity of chucks, 1/64 to 3/4 in.; capacity through spindle, 15/16 in.; diameter of tailstock spindle, 13/16 in.; diameter of spindle nose, 1 5/8 in.; width of belt, 1 1/4 in.; taper of centers, No. 3 Jarno; speed of countershaft pulleys, 400 and 800 r.p.m.

Drilling Head, Multiple-Spindle Fixed-Center

Heinkel Machine Tool Co., Sandusky, Ohio

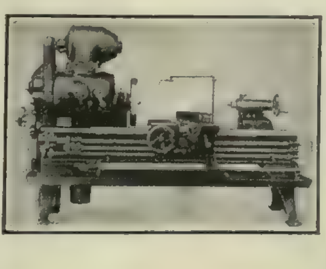
"American Machinist," Mar. 21, 1918

The illustration shows one of a line of fixed-center drilling heads manufactured by this company. These heads are made up in various styles and sizes with center distances according to customers' specifications

Lathe, Geared-Head

Springfield Machine Tool Co., Springfield, Ohio

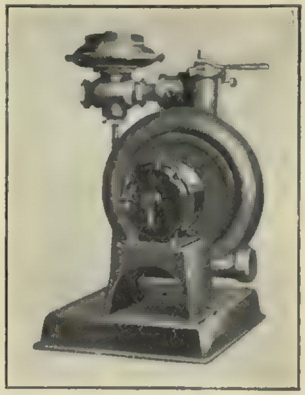
"American Machinist," Mar. 21, 1918



Made in 14-, 16-, 18- and 20-in. sizes, for either motor or belt drive. Dimensions of 18 in. lathe: Swing over bed, 19 in.; swing over carriage, 13 in.; distance between centers with 6 ft. bed, 1 ft. 6 in.; front bearing, 3 3/4 x 7 in.; rear bearing, 2 3/4 x 5 1/4 in.; hole in spindle 1 9/16 in.; diameter of spindle nose, 2 3/4 in.; threads on spindle nose, Acme; number of spindle speeds, twelve, 9 to 380 r.p.m.; diameter of head pulley, 14 in.; width of belt, 4 in.; horsepower recommended for motor drive, 3 to 5; speed of motor, 1200 r.p.m.

Gas-Mixing Valve (McKee Proportional Mixer)

Eclipse Fuel Engineering Co., Rockford, Ill.



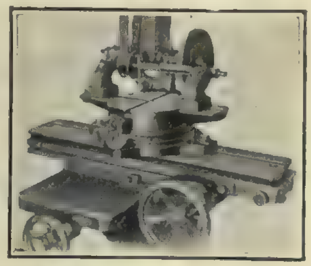
"American Machinist," Mar. 21, 1918

This device delivers the gas and air mixed in any predetermined proportions and is claimed to effect savings in fuel, power and piping. It is also claimed to give any type of flame desired—reducing, oxidizing or neutral—and to make the quality of the flame self-adjusting when turned down. It may be applied to any device in which a gas flame is utilized for heating. Made in three sizes, with outlets of 1 1/2, 2 and 3 in.; motors of 1/8, 1/6 and 1/4 hp., and gas capacities per hour of 600, 1000 and 2000 cu.ft.

Chord Plate, "Hanton"

R. W. Beckam Co., 920 Hume-Mansur Bldg., Indianapolis, Ind.

"American Machinist," Mar. 21, 1918



This device is intended for use in grinding tapers on the grinding machine. Is made in two sizes, 3- and 6-in.; and in two styles, horizontal and vertical. Consists of a base plate carrying a revolvable upper plate upon which the work is mounted by any suitable means, such as angle plate, vise, centers, etc. The two pins shown at the front, one on the upper and one on the lower plate, act as the measuring points. The angular setting is determined by measuring the chord of the arc by means of a micrometer used over these two measuring points. A chart is furnished with the device, giving the micrometer settings for various angles and for tapers per foot

Drilling Head, Fixed Center

Garrison Machine Works, Dayton, Ohio

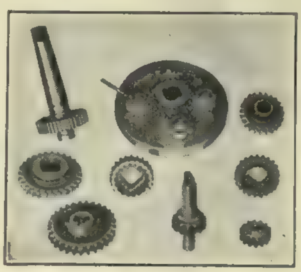
"American Machinist," Mar. 21, 1918

One of a line of multiple-spindle drilling heads. Spindles of steel, machined all over, and all bearings and seats for gears are ground to size. Bearings are bushed, the bushings being so made that they may be replaced at any time. Force-feed lubrication is used, the oil returning over and through the gears to a dust-proof reservoir. Spindle speeds are arranged to give the correct cutting speed for the size of drill used. The case is made of gray cast iron, and the drive is through a taper shank engaging the end of the drill spindle. The heads are made in a number of styles and sizes as may be desired.

Gear Chuck, "Johnson"

Garrison Machine Works, Dayton, Ohio

"American Machinist," Mar. 21, 1918



It is claimed for this chuck that it will hold gears with such accuracy that holes or other integral parts may be machined concentric with the pitch diameter with errors not exceeding 0.001 in. With one set of members will hold all gears of a given pitch. It may be applied to any machine the same as an ordinary chuck, and indicates over a range of 0.030 in. the amount the pitch diameter is over or under size. The outside diameter of the chuck, which is made in various styles, is not less than the sum of the pitch diameter of the largest gear to be chucked plus the outside diameter of a 24-tooth gear of the same pitch. It is claimed that the chuck will automatically compensate for any distortion of the gears due to heat treatment and that the work may be chucked accurately in from 4 to 6 seconds.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Mar. 21 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	$27.00
No. 2 Southern Foundry, Chicago	37.00	33.00	35.50
*Bessemer, Pittsburgh	37.25	37.25	36.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia	33.75	33.75	34.75
*No. 2, Valley	33.95	33.95	36.00
No. 2, Southern Cincinnati	35.90	35.90	29.90
Basic, Eastern Pennsylvania	33.75	30.75	30.50

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Mar. 21, 1918	One Month Ago	One Year Ago	Mar. 21, 1918	One Year Ago	Mar. 21, 1918	One Year Ago
Structural shapes	$4.20	$4.20	$4.10	$4-4.04	$4.10	$4.20	$3.75
Soft steel bars	4.10	4.10	4.00	4-4.04	4.00	4.10	4.00
Soft steel bar shapes	4.10	4.10	4.00	4.14	4.00	4.10	3.75
Plates, ¼ to 1 in. thick	4.45	4.45	5.15	4.39	5.00	4.45	4.75

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Mar. 21, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York	4.70	3.75
Warehouse, Cleveland	3.98½	3.95
Warehouse, Chicago	4.10	3.75

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Mar. 21, 1918	New York One Month Ago	New York One Year Ago	Cleveland Mar. 21, 1918	Cleveland One Year Ago	Chicago Mar. 21, 1918	Chicago One Year Ago
*No. 28 black	5.00	6.445	6.445	6.00	6.385	5.50	6.45	5.40
*No. 26 black	4.90	6.345	6.345	5.90	6.285	5.40	6.35	5.30
*Nos. 22 and 24 black	4.85	6.295	6.295	5.85	6.235	5.35	6.30	5.25
Nos. 18 and 26 black	4.80	6.245	6.245	5.80	6.185	5.30	6.25	5.20
No. 16 blue annealed	4.45	5.645	5.645	5.45	5.585	5.20	5.65	5.45
No. 14 blue annealed	4.35	5.545	5.545	5.35	5.485	5.10	5.55	5.35
No. 10 blue annealed	4.25	5.445	5.445	5.30	5.385	5.05	5.45	5.30
*No. 28 galvanized	6.25	7.695	7.695	5.25	7.635	5.00	7.70	5.20
*No. 26 galvanized	5.95	7.395	7.395	8.00	7.335	7.25	7.40	7.50
No. 24 galvanized	5.80	7.245	7.245	7.70	7.185	6.95	7.25	7.20

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Mar. 21, 1918	One Year Ago
New York	List plus 10%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Mar. 21, 1918	One Year Ago
New York	$15.00	$9.50
Cleveland	15.00	7.50
Chicago	15.00	6.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

3/8, 11/32, 5/16, 1/4, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
1/8	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

¹Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
1/4 by 19 in. long	14.00
3/8 by 19 in long	12.00
1/2 by 21 in. long	12.00

*Special Welding Wire

1/8	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Mar. 21, 1918	Cleveland Mar. 21, 1918	Chicago Mar. 21, 1918
Tire	4.10	4.00	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel	7.50	8.00	8.25
Spring steel (crucible analysis)	11.00	11.25	11.25
Coppered bessemer rods	9.00	8.00	7.00
Hoop steel	4.95	4.75	4.95
Cold-rolled strip steel	9.00	8.25	8.25
Floor plates	6.19½	6.00	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Mar. 21, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	37.00
Tin, in 5-ton lots	85.00	85.00	54.50
Lead	7.75	7.25	10.75
Spelter	7.75	8.00	11.00

*Government price.

ST. LOUIS

Lead	7.10	7.10	10.50
Spelter	7.75	7.75	10.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Mar. 21, 1918	New York One Month Ago	New York One Year Ago	Cleveland Mar. 21, 1918	Cleveland One Year Ago	Chicago Mar. 21, 1918	Chicago One Year Ago
Copper sheets, base	31.50-33.00	32.00	44.00	32.50	46.00	36.00	43.00
Copper wire (carload lots)	32.00	32.00	39.50	28.50	44.00	33.50	39.00
Brass pipe base	36.50	36.50	47.50	38.00	52.00	38.00	47.50
Brass sheets	30.75	30.75	45.50	32.00	45.00	33.50	43.50
Solder ½ and ½ (case lots)	62.00	62.00	45.50	48.50	33.50	40.00	33.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Mar. 21, 1918	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	35.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:
Carload lots f.o.b. mill 19.00

	In Casks Mar. 21, 1918	In Casks One Year Ago	Broken Lots Mar. 21, 1918	Broken Lots One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	20.00	23.00	20.50	23.25
Chicago	21.50	22.50	22.00	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Mar. 21, 1918	One Year Ago
New York	13.50	31.00
Chicago	16.00	32.00
Cleveland	16.50	34.00

ment to American Machinist

A Southwestern Repair Shop

BY FRANK A. STANLEY.

The work in this repair shop includes the overhauling of ore crushers, copper roasters, mining equipment, locomotives and cars and other apparatus required in copper and lead smelters and in ore mines.

ONE of the important departments of the El Paso Smelting Works, El Paso, Tex., is the repair shop which takes care of the equipment of the smelting plant, overhauls mining apparatus and railroad rolling stock, and builds special machinery of various kinds essential to the operations carried on at the works.

The repair department is responsible for the upkeep of locomotives and cars, and the methods of the shop have an especial interest because there are comparatively few mine-and-smelter shops where railroad work must be handled along with the customary line of repairs peculiar to ore-handling plants.

The company operates both standard and narrow gage equipment, and engines for both classes of service are taken care of by the shops at the smelting works. The repair plant consists of two buildings proper: one housing the machine shop, the electric shop and the tin shop; the other containing the blacksmith shop and the structural department where columns, girders, chords and other members are prepared for use in the erection of new buildings required by the plant or at the mines.

The purpose of the present article is to show the important features of the machine shop with its well-arranged equipment, and to describe a number of characteristic operations along with some of the special tools utilized in this department. The equipment and methods of the blacksmith and structural shop will be illustrated in another article.

The illustration, Fig. 1, is presented in order to convey a clear idea of the interior appearance of the shop and the arrangement of the tools in one of the main bays. This illustration in conjunction with that in Fig. 2 will show the character of the equipment, the relative positions of different tools, the method of driving the machines, and the general system of handling work about the shops.

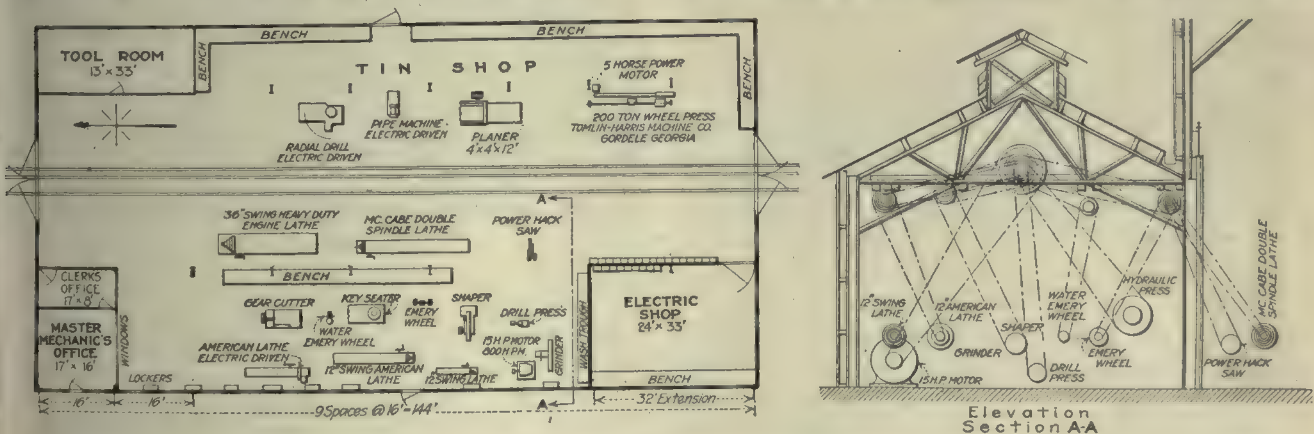
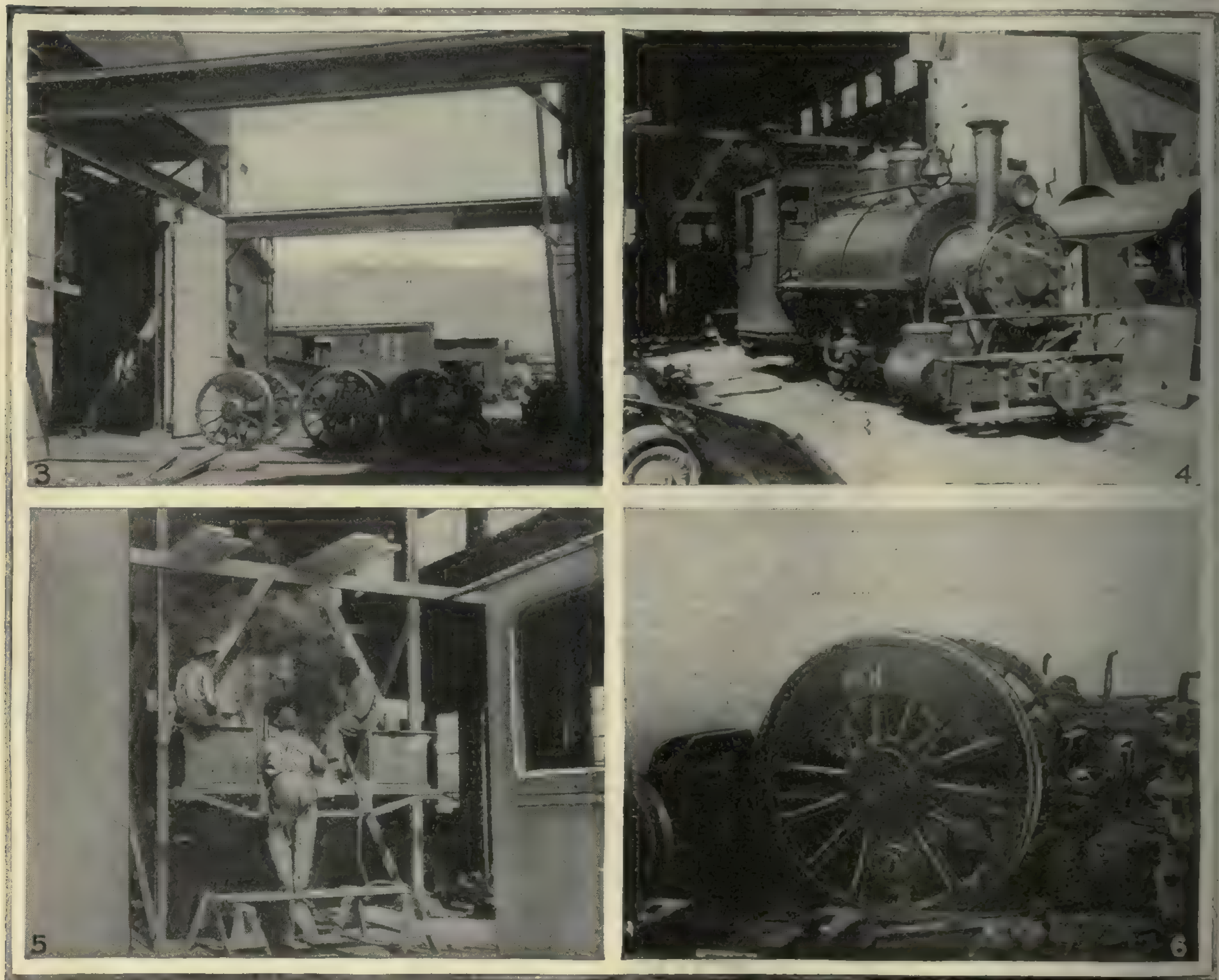


FIG. 2. FLOOR PLAN OF MACHINE SHOP AND ARRANGEMENT OF TOOLS

In connection with Fig. 1, it should be noted that the lathe in the immediate foreground is a 36-in. swing, heavy-duty tool taking 20 ft. between centers and driven independently by a 15-hp. electric motor. The radial drilling machine shown beyond the lathe in one of the lower shop bays is a 5-ft. machine with 7½-hp. motor drive. In the same bay, but at the extreme right, will be noticed the housing of a planing machine with driving motor mounted at the top. This is a 48 x 48-in. tool with 12-ft. bed, the motor being 20 hp. Between the radial drilling machine and planing machine is shown a 6-in. pipe-cutting machine with a 4-hp. motor drive. Over the main aisle in the high portion of the shop structure will be seen the ways for the heavy traveling cranes which serve the machine shop and the blacksmith and structural shops located directly north of the machine shop. The crane ways extend from one shop to another as in Fig. 3, so that material and work may be handled conveniently and directly from one shop to the other. These crane ways also extend for a considerable distance beyond the opposite or outer ends of the two main factory buildings and considerably facilitate the loading and unloading of work outside the shops.

In addition to the main cranes traveling overhead, various jib cranes are located at different points to handle work in and out of machines and a double line of railroad tracks run through the building to receive both standard- and narrow-gage locomotives and cars. These tracks are shown in illustration, Fig. 2, which gives the positions of the tools and shows the floor area, while the end elevation in the same illustration gives an idea of the structural features of the building, with monitors along the main structure and over the bays. The building is of steel throughout, including not only frame and roof but side and end enclosures as well. Its length over all is 144 ft. and its breadth one-half the length, or 72 ft.

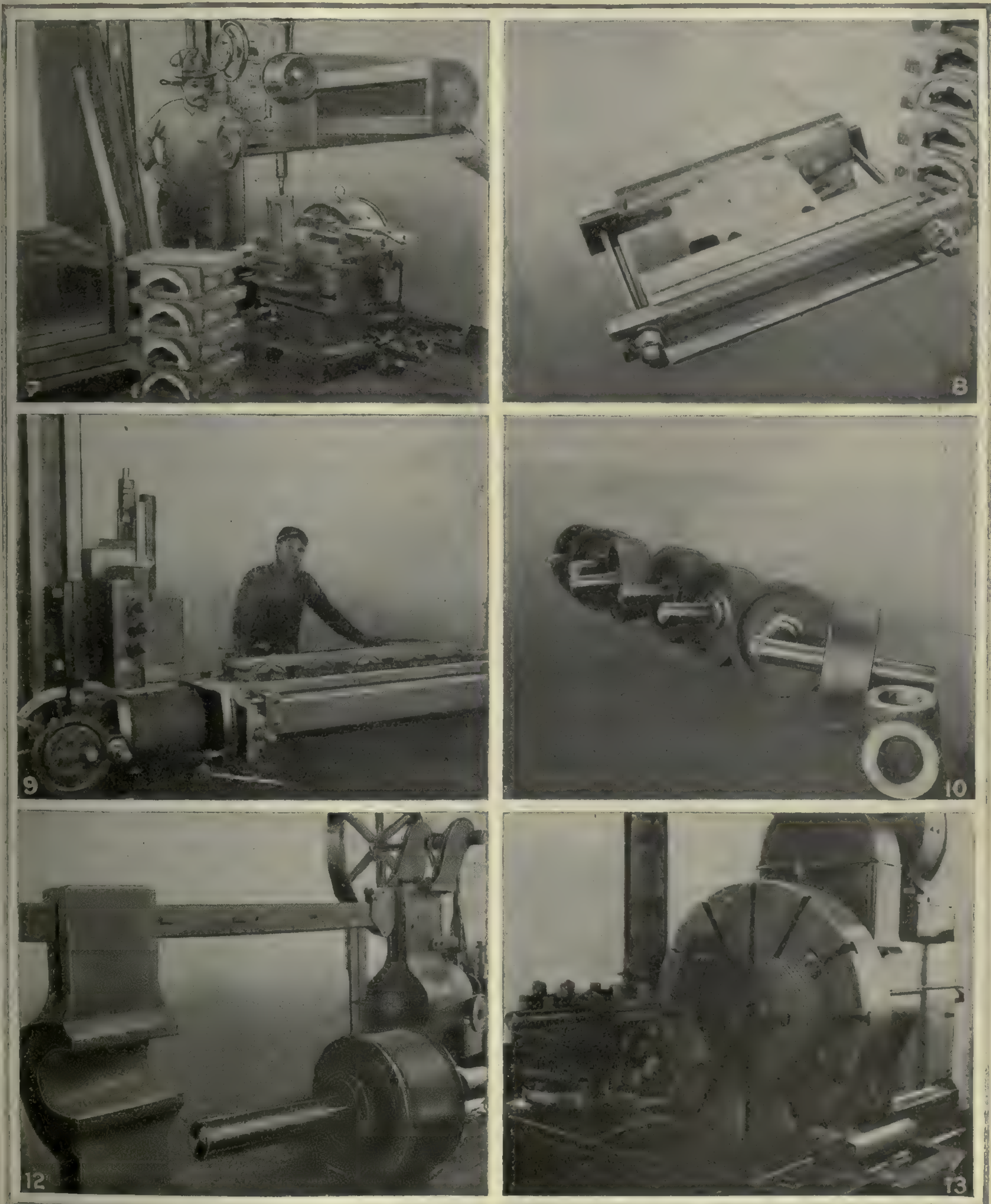


FIGS. 3 TO 6. SOME OF THE LOCOMOTIVE WORK PERFORMED

Among the important machine tools in this shop are the following: One 24-in. lathe, 7 ft. between centers, driven by 6-hp. motor; one 36-in. heavy lathe, 20 ft. between centers, driven by 15-hp. motor; one 5-ft. radial drilling machine, driven by 7½-hp. motor; one 4 x 4 x 12-ft. planing machine, driven by 20-hp. motor; one 23-in. stroke keyseating machine, driven by 5-hp. motor; one 6-in. pipe-cutting machine, driven by 4-hp. motor; one 200-ton wheel press, belted to 5-hp. motor.

In addition to these machines with individual motor drives, there are a number of tools which are group-driven from one 15-hp. motor. These tools include the following: One 12-in. lathe taking 5 ft. between centers; one 18-in. lathe, 11 ft. between centers; one 26-

and 38-in. double-spindle lathe, 17 ft. between centers; one 20-in. upright drilling machine; one 26-in. stroke shaping machine with 20-in. side travel; one knife-grinding machine with 4-ft. bed and head travel; one wet tool-grinding machine with wheel 16 x 2-in. face; two wheel-grinding machines with wheels of 8-in. diameter by 1½-in. face; one power cutting-off saw and one gear-cutting machine.



FIGS. 7, 8, 9, 10, 12 AND 13. SOME OF THE VARIOUS OPERATIONS IN THE SHOP

The tin shop is fitted up with 36-in. bending rolls of 1½- and 2½-in. diameter, 36-in. gap shears and 36-in. folding machine. The toolroom carries a full line of small tools, lathe and planing-machine tools, boilershop tools, pneumatic apparatus, etc., all of which is issued to the shop as required, upon a simple checking system.

Reference has been made to the care of standard- and narrow-gage locomotives which constitute impor-

tant items in this shop. Fig. 3 shows three pairs of heavy locomotive drivers rolled out from under a standard-gage engine undergoing general overhauling. In Fig. 5 the rear end of the locomotive is seen with the engine over the shop pit, the cab removed and men at work on the boiler and firebox. This illustration shows among other things, the simple staging and platform erected, upon which the men work conveniently along the side and over the top of the boiler. A typical narrow-gage locomotive, whose upkeep also devolves upon this department, is represented on the tracks just outside the shop doorway in Fig. 4. Fig. 6 shows locomotive and other work in progress. The truck wheels and drivers are from the engine represented in Fig. 5. A number of journal boxes are shown in the foreground of Fig. 7, drilled for their bolts and ready for babbitting for the journals. They are for use under heavy roasting apparatus for copper ore, the shafts which they receive being pressed into conical rolls upon which the roasting apparatus revolves.

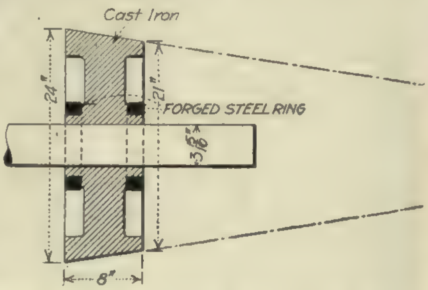


FIG. 11. DETAIL OF ROLL AND AXLE

The radial drilling machine in Fig. 7 is represented in the operation of drilling the ends of wedges for locomotive driving boxes. This work is done with the wedge secured to the vertical face of the drilling-machine table. A support for the wedge is provided in the form of an angle iron bolted near the bottom of the table and forming a ledge upon which the lower end of the wedge rests, so that the work may be in an upright position when held by the U-clamps in the manner indicated.

Fig. 8 shows a number of shoes and wedges, and in the foreground a crosshead assembled and ready for drilling the holes for the bolts that hold the slippers.

Parts for Copper Roasters

The journal boxes for use on the copper roaster mentioned above are illustrated in Fig. 9 on the planing-machine table, ready for the machining of the flat base surfaces. This planing machine is used extensively for finishing strings of boxes, crossheads, shoes, wedges, etc. To facilitate the setting up of such work, a long heavy parallel is tongued and bolted to the platen. The nuts for the T-slot bolts are dropped flush with the top of the parallel and out of the way, through the provision of counterbored seats in the top face, large enough in diameter to permit the use of a socket wrench on the nuts.

A number of conical rolls on their short shafts about ready for mounting under the copper roaster, are shown in Fig. 10. There are six of these conical rolls in a set, and in operation upon their suitably shaped guide they constitute a very heavy series of bearing rolls. The copper roaster which they carry weighs in operation from 150 to 165 tons, and it will be understood that both the rolls themselves and their bearings are constantly subjected to very heavy service

Fig. 11 gives a section through one of the conical rolls as made and used in this plant. The roll measures 24 in. in diameter at the large end, and is 8 in. wide, the circumference having a taper of ⅜ in. per inch, or 4½ in. per foot. The roll is of cast iron and weighs nearly 300 lb. Its hub is bored to receive a 3 15/16-in. shaft or axle which is forced into place under a pressure of 35 to 50 tons; this is an average of a little over 10 tons per inch of diameter of axle. In addition to this heavy press fit and as further security for the rolls on their axles, the hubs are turned down slightly to receive a pair of forged steel rings which are shrunk tightly in place as indicated in the illustration.

The weight of the apparatus carried upon the set of six rolls has been mentioned as weighing as much as 165 tons. This means that there is a load of 330,000 lb. imposed upon the series of rolls, or over 50,000 lb. per roll. Further to be considered is the fact that the heat of the roaster is held to a temperature of about 1100 deg. F. In addition to the heavy pressure upon these rolls, they are subjected to this high temperature transmitted from the body of the apparatus, so that even with axles and rolls assembled under very tight fits as described, there is more or less tendency for the rolls to work loose. Obviously, severe wear is imposed upon the boxes in which the roll axles are fitted, which necessitates an occasional replacement of these members.

Other Heavy Work

The layout of the machine-shop floor, Fig. 2, shows a 200-ton wheel press located midway between the railroad tracks and the east wall of the building, where there is ample space for dismounting and mounting wheels and axles and for doing much other work required to be handled in and out of the press; for example, such work as assembling the roaster bearing rolls and axles described above.

Among the numerous heavy jobs coming to this machine is the one illustrated by Fig. 12, which is an ore-crusher roll and axle worn down and requiring dismounting and replacement. This crusher roll has a cast-iron hub carrying a heavy chrome-steel tire; the roll itself, independent of its axle, weighs 1800 lb. The axle has a diameter of 7 in., and the outside diameter of the roll is about 28 in. with a face-width of about 16 in. In fitting up new axles and rolls, press allowances are made that require from 25 to 30 tons to force the roll upon its axle, or approximately half the pressure that would be called for in forcing railway axles of the same diameter into their wheels.

It has been found that after months of service when the outside of the crusher rolls have become so worn as to require replacement, a pressure of at least 50 tons is necessary to force the axle out of the roll.

An interesting piece of work performed on the faceplate of the lathe is illustrated in Fig. 13. The machine shown has a swing of 36 in., and the work secured to the faceplate consists of a pair of shoes for a mechanical brake used on a converter motor. The shoes are bored out to a diameter of 18¾ in. Before they are placed on the faceplate, a locating circle is described on the plate with a piece of chalk, to facilitate the setting of the shoes to the approximate radius desired, so that after they are mounted on the plate very little adjustment is necessary to assure cleaning up and boring out as required.

A Liberty Loan Campaign in a Prominent Machine-Tool Factory

BY LUTHER D. BURLINGAME
Industrial Superintendent Brown & Sharpe Manufacturing Co., Providence, R. I.

With the Third Liberty Loan at hand everything that will give practical help in the disposal of bonds is of interest. This article covers the subject very thoroughly from the shop standpoint.

THE generous response of the American people to the many financial calls of a patriotic nature which have followed closely on one another since the declaration of war is a feature of the crisis through which we are passing which is especially gratifying. Investing in Government securities has been no exception to the rule, and the growing interest taken in such investments by all classes, and especially by workingmen, indicates that a lesson in thrift is being learned which is not only of great importance at the present time but which will be a valuable asset after the war in offsetting and permanently correcting what our President points out as "America's unpardonable fault of wastefulness and extravagance." Under the spur of duty or the call of patriotism the start made in saving will in many cases lay the foundation for a competence, and perhaps a fortune, later, which never would have been laid except for the war, and a margin of safety has been started against the proverbial "rainy day." It is well known that campaigns such as for securing subscriptions to Liberty bonds do not attain success spontaneously or without effort and organization. It is necessary that the appeal be pressed home not only to the nation as a whole but also to each individual. In addition to the admirable organization throughout the country, which by means of publicity and the enlisting of the services of the banks, business men and financiers gave vitality to the campaign in every local center, organization was also required for local work in the industries, and it is the purpose of this article to tell of this campaign as conducted in a machine-tool factory employing about 6600 persons.

Liberty Loan Subscription

..........................1917.

TO BROWN & SHARPE MFG. CO.

I hereby subscribe for $............ United States Liberty Loan bonds at their face value, and will pay for same in successive weekly installments of $............ each week. To cover these payments I hereby authorize you to withhold $............ a week from my pay until the bonds are paid for in full.

It is agreed that I shall receive these bonds with all coupons attached only when paid in full.

....

Witness..............................

FIG. 1. BLANK USED IN OBTAINING SUBSCRIPTIONS

The campaign for the First Liberty Loan in this factory was considered successful when bonds to the value of about $100,000 were subscribed for by the employees. At the time these subscriptions were secured it was realized that with the continuance of the war other bond issues would be called for, and in order that the way might be clear to obtain further subscriptions part payments were required in such amounts as would fully pay for the bonds within four months. The company coöperated by assuming responsibility for the bonds and made deduction from the workman's pay at the rate of $3 a week for each $50 bond, allowing him full interest from the date of issue.

As many factories and neighboring institutions were accepting payments of $1 a week some employees who could not pay the larger amount subscribed through those agencies; but influence was used to have as many as possible subscribe through the company. It was realized that the total thus subscribed was less than would have been the case had smaller weekly payments been required; but when the call for the Second Liberty Loan came the wisdom of this policy became evident. Through special efforts the bonds for the first loan were secured for delivery a few days before the canvass began for the second loan, and the psychological effect of distributing $100,000 worth of such bonds with their accompanying interest-bearing coupons among the workmen, many of whom had no knowledge of what a bond looked like, and at least had had no experience in "coupon-chopping," was a decided stimulus toward a larger subscription for the second issue. At the time of the call for subscriptions for the Second Liberty Loan it was thought that many might have run in debt during their payments on the first loan, or might be so tied up financially that they could not continue, and that with the many other appeals for war charities that they would be tired of being solicited. Some predicted that in spite of all efforts it would be difficult to exceed the amount of the First Liberty Loan. However, the fact that $262,000 worth of bonds was subscribed for by 4542 employees in the second canvass was evidence that those fears were not well founded.

The secret of the success of this campaign lay, first, in a personal "everyman" canvass and, second, in competition between departments. The personal canvass was made by foremen, themselves enthusiastic and earnest for success, who did not hesitate to press home the argument that those at home should be willing to make a money sacrifice to match in small measure the sacrifices our troops were ready to make at the front. The competition between departments was stimulated by offer-

ing banners and included the working out of a handicap plan by which varying conditions would be given weight, so that the prize banners may be awarded to the most deserving, all things considered.

A spirit of competition was also encouraged between different alien races, testing to that extent their loyalty.

Details of Organization

As has been stated the company coöperated by arranging for part payments, although some workmen were able to pay cash. Foremen were furnished a list of all employees in their deparment to be canvassed, together with application blanks (Fig. 1) to be filled out by the applicants.

A notice was put in the pay envelope of each employee, and this notice together with a poster which had been issued by the *American Machinist* for the First Liberty Loan was placed on the bulletin boards side by side with the forceful and inspiring posters furnished from headquarters, the latter being moved every day or two so that every department could have the benefit of them.

After the canvass had been started prize banners were offered by the company, a notice (Fig. 2) being posted announcing the offer of these banners, and the appointment of a committee of three to decide the awards.

In order to show the departments where they stood at the end of the first week of the canvass a notice (Fig.

Second Liberty Loan of 1917

THE Liberty Loan should have the coöperation of every employee of the Company. In order to stimulate an increased interest, the company offers to donate a banner, appropriately inscribed, to be awarded to that department which will make the best showing in the number of men participating. While the award will be made generally on the basis of percentage of men participating, there are a number of considerations to be passed upon as between very large and very small departments, the general make-up of the different departments.

Well authenticated subscriptions, made through banks, stores or other agencies, will be accepted by the committee as evidence of participation in the loan, and will so count to the credit of the particular department.

The award will be made at the close of the Liberty Bond Campaign by a committee consisting of:

....

....

....

Brown & Sharpe Mfg. Co.

Oct. 19, 1917.

FIG. 2. NOTICE POSTED ON BULLETIN BOARDS OFFERING PRIZES

3) was posted explaining what was necessary for them to excel in the competition for the banners, and also to shame the delinquent departments into doing better. Prints from an effective cartoon were also put on the bulletin boards.

While the canvass was in progress it was found that certain nationalities were not responding as readily as others. Where this appeared to be an organized opposition such men were brought together and given a forceful talk by an official of the company, who pointed out to them that they should be ready to serve the country in which they had made their homes and were bringing up their families, and that if they were not ready to give it loyal support it was their duty to pack up and leave at the earliest opportunity. This not only brought over large numbers who had held off, but in addition gave rise to discussions among the men, making many an American feel that he should not be outclassed by aliens even if it meant a sacrifice on his part to subscribe.

In several cases men who were somewhat of leaders in their departments and who did not respond at first

Second Liberty Loan

Standing of departments up to Saturday noon, Oct. 20. Where will your department stand next Saturday?

Department	No. of Subscribers	Average Subscription	Per Cent. of Men Subscribing
Electricians	19	$52.62	90.4
Boxing	49	52.04	74.2
Hardening	92	52.71	65.2
......	..	.....	...
	2145	$58.15	32.2

Subscriptions placed through banks, stores or other outside agencies will be given credit in the contest if you will bring in your receipt and have it shown to Mr. ...., Supply Dept.

While this will be credited to your department it will be rated lower than subscriptions made through us.

Brown & Sharpe Mfg. Co.

October 22, 1917.

FIG. 3. ADVANCE NOTICE SHOWING STANDING OF DEPARTMENTS

were urged by foremen and those in authority to subscribe because of the influence it would have on others. Some of these men were watched with great interest by the other employees, and when they finally subscribed many others followed, it being considered a joke and highly complimentary to the persuasive powers of the foreman who had finally induced them to subscribe, many saying, "Well, if he has, I will."

Excuses

Before the war, when propositions requiring payments by the workmen (for example, taking out group insurance, which was being encouraged by the company) were urged upon them, their excuse, often seconded by the foreman, was that they were already carrying all the expenses they could, and with the high cost of living, etc., they had no money left, even for necessary insurance. Nevertheless it was interesting to note that when the patriotic appeals came these men could not only subscribe liberally to the Red Cross, Red Triangle, Liberty loans, etc., but often they had the cash with which to do so, or could easily find a way to meet the payments.

"I can't buy a Liberty bond. It takes every cent I earn to live," said an employee when asked to subscribe during the canvass for the Second Liberty Loan.

The next day he went to his foreman and stated he had decided to buy a bond, saying that when he went home his wife asked him if he had subscribed and when she was told that he had not she said: "Don't you think we could give up going to the theater Saturday nights? That would save quite a bit toward our payments, and I think we could manage the rest." "I had thought of that," he answered, "but did not dare mention it. I thought it would mean your giving up so much."

Another workman who averred he could not afford to buy one of the first bonds, but who eventually bought one, said when the appeal for the second loan came: "I did not find it as hard to pay for the first one as I had thought it would be. I will take two this time." It was found in many cases that the wife held the purse-strings, and it was not until after many consultations with her that the men would subscribe.

A boy who had declined to buy a bond, saying he could not afford to, on being challenged by another boy took up the challenge and brought in $50 the next day, and the other boy had to make good and also subscribe.

Prize Banners

The offer of prize banners during the campaign encouraged foremen, clerks and workmen in the strenuous struggle for the coveted honor, and to appeals for loyalty to their respective departments were added appeals for loyalty to the country. When the struggle was over, so many departments had made a fine showing and the leaders were so closely grouped that the committee found difficulty in deciding on the winners.

While at the beginning only one banner had been offered it was afterward decided to divide the works into a large and a small department, and to offer two banners—one to be awarded in competition between departments having more than 75 employees and the other to those having 75 or less. This handicap was adopted so as to give all as far as possible an equal chance, due regard being taken of the percentage of employees subscribing, the amounts subscribed and the size and relative ability of the departments to help.

Subscriptions that were placed outside of the works and requiring a longer period to pay were rated at one-half the money value, although given full value in number of subscriptions. Small departments were required to average a larger amount of money per subscriber in order to have equal standing with the larger departments.

Several of the smaller departments had 100 per cent. in that every employee had subscribed for bonds, and different departments excelled in different ways. Thus among the large departments the hardening room had the highest percentage of subscribers, while the small-tool department had the largest amount of money subscribed; the foundry subscribed the largest amount directly through the company, while the offices had the largest amount per subscriber. When, however, all these matters were taken into consideration the milling-machine department came in ahead, with 369 men subscribing $19,700, this being over 90 per cent. of the force, giving the highest rating, with handicap allowance, among the large departments. Accordingly this department was awarded the first banner suitably inscribed.

In the small departments the group including pipers, steamfitters and sheet-metal workers took the banner, everyone of the 38 employees subscribing for bonds through the company to an amount averaging $75 each. The two banners were of silk, one blue and the other red, with gold lettering and fringe. The standing of the departments was posted and it can be imagined with what eagerness the leading departments looked for this announcement.

Lapses—Reselling Bonds

It is not definitely known how many lapses have occurred among subscribers making payments outside of the works, but among those employed in the works there have been very few. In some cases, such as sickness or other good reason, loans have been made to help the men bridge over a hard period and thus enable them to hold their bonds. After the distribution of the 3½ per cent. bonds, of the First Liberty Loan arrangements were made to aid those who did not have safe places in which to keep them and also to make provision for the cashing of coupons, the following notice being posted:

ARRANGEMENT FOR SAFEKEEPING OF LIBERTY BONDS

Realizing that there are many employees who do not have the means of properly protecting their bonds against loss from fire, theft or accident (when a bond is lost it is like losing a bill or banknote) this company has made arrangements with the Providence National Bank, for the duration of the war, whereby the bank will accept all bonds deposited with it by the employees of this company and will remove and cash all coupons as they become due (June 15 and Dec. 15) and transmit such sum to this company for payment to accredited owners at the general office of this company.

All Deposits of Bonds with the Providence National Bank Will Be Made Through This Company as Agents

It was found that there was an active and insidious movement, evidently instigated by enemy interests, to encourage men to dispose of their bonds. In order to offset this the company posted notices as follows:

PAYMENTS OF COUPONS

Coupons may be cashed any time after June 15 and Dec. 15 at any of the banks or large stores.

They may also be cashed at the counter in this company's general office during any noon hour.

Brown & Sharpe Mfg. Co.

BEWARE

We would caution our employees against exchanging their Liberty bonds for stocks offered at an apparently higher rate of interest by persons whose interest may not be to coöperate with the Government.

United States Government Liberty bonds are absolutely secure. That is why some persons are willing to exchange a stock less secure for these Liberty bonds.

When you are parting with your bond you are practically parting with cash.

Brown & Sharpe Mfg. Co.

It was found that this was not fully checking the sale of the bonds, so the company consented to pay full value for them if the men deemed it necessary to sell them. This gave the company an opportunity to discuss the matter with the men, and induce them, if possible, to avoid selling their bonds. With this object in view the following notice was posted:

WE WILL BUY LIBERTY BONDS

It is unnecessary for employees to sell their Liberty bonds below par. We advise against their selling them at this time, as we believe that they will later sell at a premium.

In order to accommodate those who feel that they must sell, this company will buy the 3½ per cent. Liberty bonds at par and interest.

Those desiring to sell their bonds may do so at the general office of this company during the noon hour.

BROWN & SHARPE MFG. CO.

Conclusion

While what might be called "forceful persuasion" was permitted and even encouraged in soliciting subscriptions for Liberty bonds, in the last analysis each employee decided for himself as to whether or not he would subscribe. Many who subscribed to the First Liberty Loan, perhaps somewhat grudgingly or unwillingly, said when they received their bonds: "If I had not subscribed I would not have saved a cent, and now I have just this much ahead and have hardly felt the payments." It is believed that when the bonds for the Second Liberty Loan are delivered there will be a still larger number who will repeat this expression.

Other Contributions

That this campaign for the Second Liberty bonds represented a growing spirit of loyal helpfulness and service and proved that lessons of thrift are being learned and was not a spurt or supreme effort is shown by the response to still later appeals. The last American Red Cross canvass, following shortly after, resulted in a large membership among the employees of the company, a check for $5498 having been sent to headquarters for memberships secured directly in the Brown & Sharpe works.

It is believed that the spirit shown in this factory is typical of the spirit of the American workmen, and that whatever are the sacrifices they are called upon to make they will not be found wanting, but will be ready to do their full share.

Clearance Angles on Lathe Tools

BY ADOLPH STARR

I read with interest the article on clearance angles on lathe tools by John T. Kilbride on page 252, in which he stated that 6 deg. is ample clearance for practically all lathe tools. This broad statement, in my opinion, is erroneous. I grant that he has given a very good account of the theory on this point, but I question the correctness of his statement that 6 deg. is ample for all lathe tools, for the reason that all lathe tools are not used under like circumstances.

Let us take, for instance, a forming tool for an irregular form of about 2 or 2½ in. long to be used in a hand-screw machine on 1-in. tool-steel bar. This would require at least 12 to 15 deg. clearance in order to get the maximum efficiency from the tool and machine. It is not practical to have any top clearance or rake on a forming tool because it would require too much time and skill to keep the form correct, and the life of the tool would also be shortened.

Where real efficiency is required we must not stick too close to theory, efficiency being applied common sense, and a point like the one in question is a good place to apply it. In my 23 years of mechanical experience I have found that the clearance on lathe tools or turning tools for boring mills has quite a little to do with the size and the material being cut.

In cutting soft metals, such as copper, brass, Tobin bronze or babbitt, the tools for forming the above metals would require a much different cutting angle than for tool steel, machine steel, or cast iron; and in cutting fiber, wood or rubber we would again have to change the cutting angles in order to reach the highest degree of efficiency.

If Mr. Kilbride will look up this subject in machinery handbooks he will find that form tools for lathes or screw machines vary in clearance from 8 to 20 deg., which in my opinion is correct. This is not one of those small points in the trade in which the average workman follows tradition, as is stated in his article, but long years of practical experience have proved it to be a fact.

The Pratt & Whitney Co. of Hartford, Conn., has found through long experience that 15 deg. is the best practical clearance on its patent thread tool for all purposes. It has kept this tool on the market for the past 25 years, to my knowledge, and so far as I know no one has averred that the company is wrong.

Standardizing is not always efficiency. We are trying to standardize too much on such points of the trade as the one in question, and by doing so we are inclined to suppress the initiative of the younger generation. We are filling our youngsters up with too much theory and not enough practice, and this, in my opinion, is one of the reasons why the better and more practical mechanics are getting so scarce.

Recutting Files

BY H. D. MURPHY

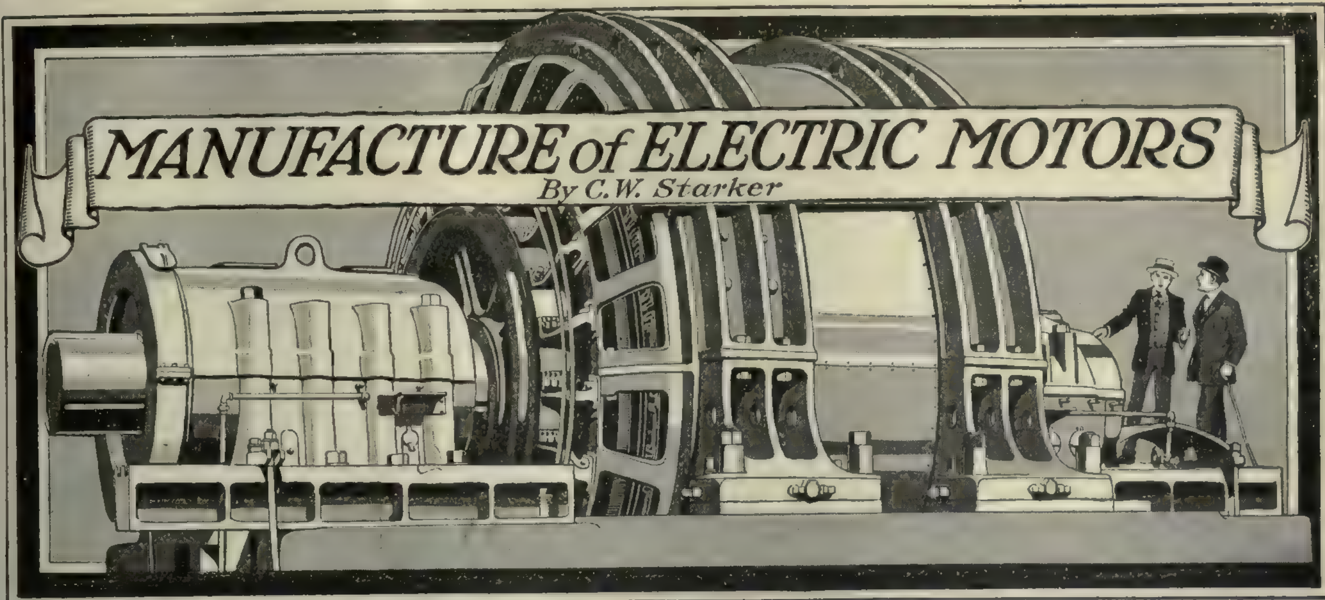
We were recently in receipt of a request from a correspondent for information in regard to recutting files. Prompted by our own experience we advised him against the practice.

For some time our files were sent out for this purpose, but it finally became such a frequent practice that we were led to do a little investigating. The conclusion reached was that most of the files were returned to us without any cutting having been done; they were simply cleaned off. Furthermore, it was observed that every time a man tackled a new piece of work he threw aside his old file and asked for a new one. This resulted in an overstock of files, as it was not practicable to send them out until a considerable quantity had accumulated, and in the meantime the men had to have new ones.

We then discontinued the recutting and cleaned the files in our own plant by the simple process of dipping them in acid. They were then put back in stock as new and handed out on the usual requisition. As there was no complaint made it is evident that the men desired for each job not a *new* file but *another* file. The filed surfaces of castings show up just as good as ever and the pile of discarded files does not accumulate any faster.

Of the toolmaker it may be said that he is not so fickle-minded. He studies his files, humors them and hangs on to them like grim death. Woe unto the man that ever borrows a toolmaker's file. Each file is valued for its adaptability to certain work and used to the limit. When the toolroom requisitions new files you may safely conclude that they are really needed.

The difference in treatment lies in the fact that the toolmaker looks upon his file for what it really is, a cutting tool, whereas the other workers regard it as simply a metal remover.



XIII.—Testing, Painting, Shipping

No motor is ever shipped either to the warehouse or to the purchaser without first being given a running test. A description of these tests will be of interest to the user of motors, and particularly to those who maintain their own repair shops for electrical equipment.

The manufacturers of motors use three classes of tests: the commercial test, the complete test and the endurance test. To these may be added special tests, such, for example, as noise test made on motors where absolutely noiseless operation is demanded, as in certain classes of elevator service.

The commercial test is applied to motors manufactured regularly in large quantities, and is the simplest form of test. A complete test on every standard motor, as will be seen, would be useless and wasteful. However, one motor out of a certain number of standard motors is given a complete test as a check on material and workmanship. For direct-current motors both tests begin with a check of the size, make, grade and number of carbons, and a check of the field bore (air gap). Then a reading is taken of the field current at the rated voltage, as a check for resistance of the winding. The neutral position of the brushes is determined and marked, so that the motor has the same speed for either direction of rotation, within the limit of the 5 per cent. variation allowed on ordinary sizes, or 7½ per cent. on small sizes, allowed by the Electric Power Club rules. An observation of the commutation is taken, and finally an insulation test is made in line with an insulation testing specification and the rules adopted by the American Institute of Electrical Engineers. The further tests differ according to the characteristics of the motor; for example, in a shunt-wound, constant-speed motor they consist of the following:

The motor is belted to a direct-current generator which feeds back into the line, and a check is made on the stability of the motor speed at a 125 per cent. load, and at a 60 per cent. overspeed, by running the motor in both directions at that load. This is a check on the possibility of a rising speed curve, which under conditions of varying load may lead to instability of speed or hunting. Readings are then taken at full load, and at rated voltage of armature and field current, as a check on the speed. An observation of magnetic noise in the motor is also made under full-load conditions. In the same way readings are taken at no load—that is, with the motor running light, at rated voltage for both armature and field current. Here the commercial test ends. A complete test made on every motor differing from standard includes, in addition to the above test, a temperature run at full load until constant temperature is reached—usually about 5 hours. Where a motor is designed for overload, the temperature test is made at the specified overload for 1 or 2 hours as the case may be. Determination of the losses in iron and copper bearing friction and windage (air resistance) and of brush friction conclude these tests. Fig. 135 gives a general view of the testing department for medium-size, direct-current motors.

Alternating-Current Motors

For alternating-current motors the commercial test consists in taking readings of the magnetizing current and watts at full voltage, taking the resistance of the primary winding when cold and checking the motor speed at no load. Then the rotor is locked (prevented from turning) and a reading taken of both current and watts at approximately half voltage. The object of this test is to check the data obtained with the records of previous tests on the same rating. The complete test includes in addition to the above a so-called running saturation test, measuring both amperes and watts up to about 150 per cent. normal voltage. The saturation test is to obtain separately the losses in iron and copper of the machines, and in friction and windings, as referred to in connection with direct-current motors. The primary resistance is measured hot and cold; and speed readings are taken at full load, measuring amperes, watts, volts and frequency. The load is applied to the motor by means of a water-cooled Prony brake or an electrical brake. Then follow 3 or 4 brake readings for pull-out torque at reduced voltage, and 3 or 4 readings

for starting torque at reduced voltage; that is, by applying the brake the torque is determined at which the motor pulls out (comes to a stop) also the turning effort developed by the motor in starting.

Next follow temperature runs similar to those described for the direct-current motors. The temperature rise over surrounding air of primary and secondary iron and copper is determined at the end of a five-hour run or until the temperature has become constant under full load. And again, at the end of two hours at 125 per cent. load. This temperature rise is checked with the usual guarantees of 40 or 50 deg. C. adopted by the American Institute of Electrical Engineers and the motor manufacturers. Performance curves, showing efficiency and power factor at various loads, are prepared for the approval of the engineer.

In cases where guarantees on contracts require certified test sheets to be submitted, running-saturation curves and lock-saturation curves are furnished, together with performance curves and diagrams and also temperature records.

Special tests as referred to above may also include so-called witness tests in presence of a representative of the purchaser or a Government inspector in case the motors are for the U. S. Government. Special moisture-proof of water tests according to Government specifications may be in addition to the electrical tests. Fig. 136 gives a general view of the testing department for medium-size, alternating-current, industrial motors.

In the case of new lines of standard motors, particularly thorough endurance tests are made before any motors are marketed, in order to establish both electrically and mechanically the ability of each rating to stand up permanently under severe service conditions. The principal point to observe on these motors during the endurance test is the commutation and the appearance of the commutator and brushes after a long period. Motors are run therefore under full load or at certain overloads for weeks or months continuously, at the rated voltage, and at voltages 10 per cent. above or below normal, which latter may have an influence on the points under observation. So-called cycle tests are made on motors for service, such as crane or hoisting work. In these a cycle of operation, that is starting, stopping and reversing, is gone through repeatedly by means of automatic controlling devices in order to duplicate in exaggerated form the conditions of this class of service.

Mechanical endurance tests are designed to duplicate in days or months, what may happen to a motor in unusually severe service and abuse during many years. The testing devices are therefore arranged in such a way as greatly to exaggerate conditions of vibration, influence of quick reversals and so on, by purposely using poor mounting, poor gearing, loose chains and similar means. A description of some of these testing arrangements will be of interest, as the same tests are applicable to other machinery and useful in bringing out weak spots in a short time. Fig. 137 shows a test motor back-geared to a heavy rotating eccentric weight. In this test, first made in 1909, the direction of rotation of this weight was reversed every 12 sec. and the test continued day and night for a year and a half. This test first established the reliability of the forged-steel motor construction, which later proved so successful in service.

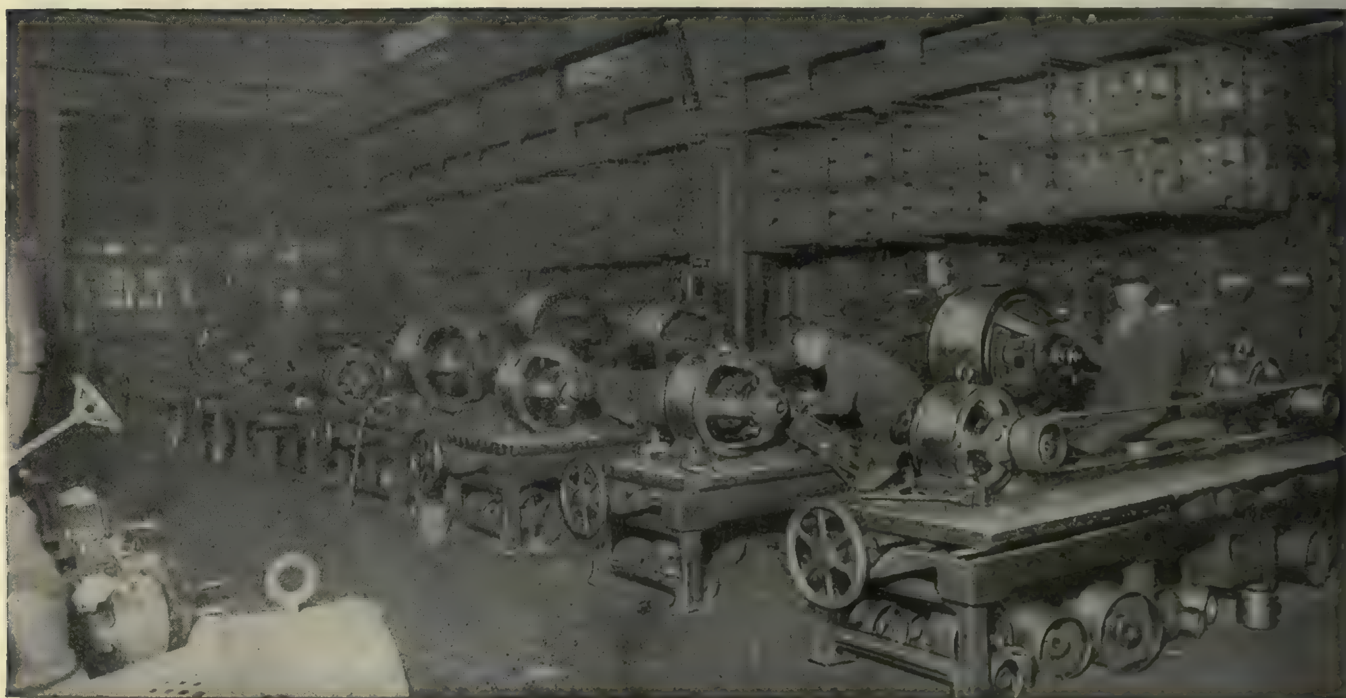
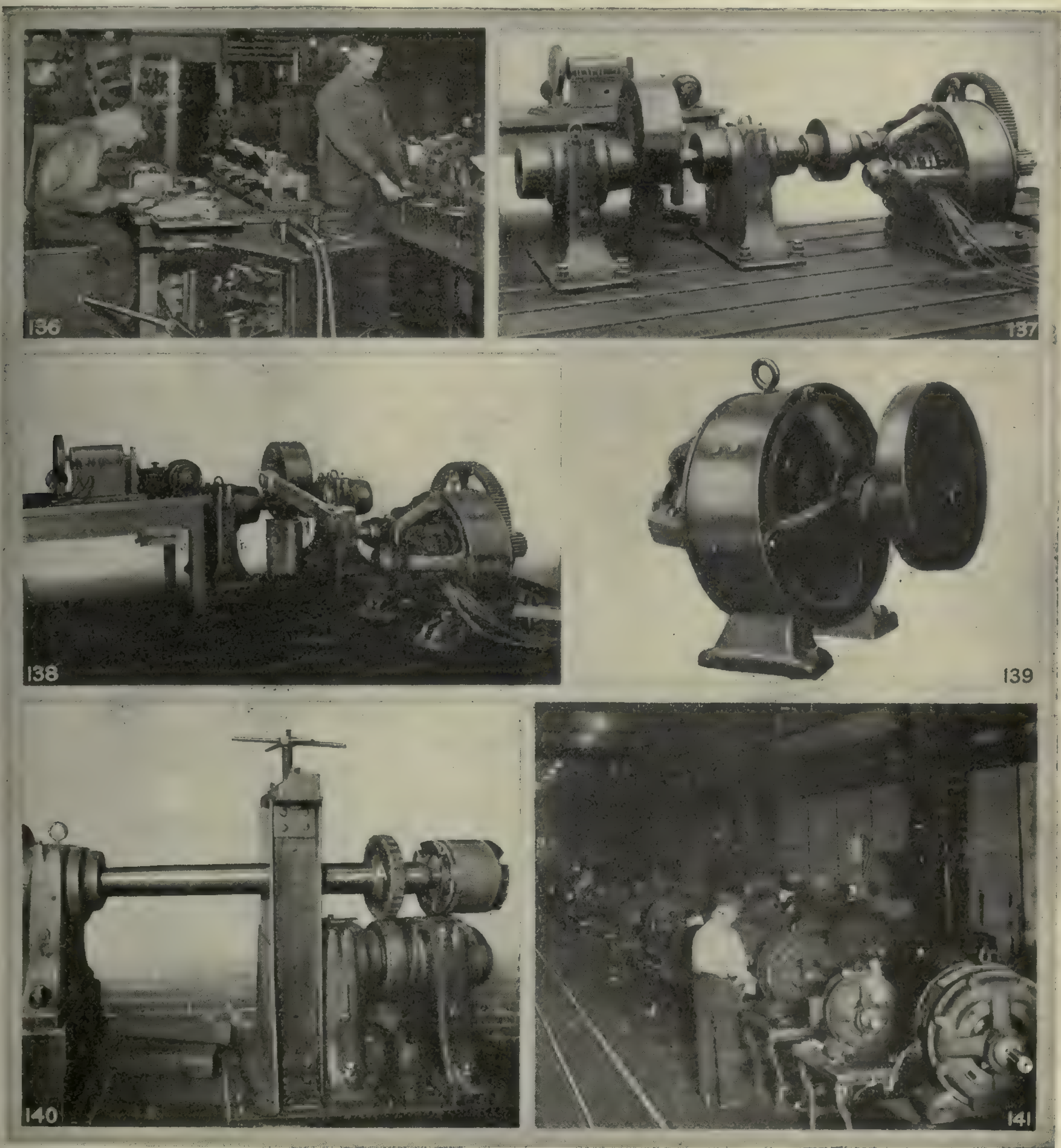


FIG. 135. TESTING DEPARTMENT FOR DIRECT-CURRENT MOTORS

A second testing device is the oscillator test, Fig. 138, in which the heavy eccentric weight tended to produce a strong rocking motion by oscillating to both sides of the vertical center line without making a complete revolution. During the several months' run most of the auxiliary parts failed in turn; the driving rods, countershaft and their bearings had to be replaced, but no part of the motor under test failed, aside from normal wear of brushes and commutator.

In the arrangement, Fig. 139, an eccentric weight was mounted directly on the motor shaft; the motor was run at various speeds, principally with a view of testing possible hammering out of the bearing metal. A later

and particularly effective device, the so-called shaker test, Fig. 140, is used principally for subjecting revolving motor parts to severe vibration—which is an excellent proof of the quality of proposed new constructions of such parts as rotor windings, blowers, collector rings, brush-holders, etc. In this arrangement, projections are provided on the wheel *A*, which is mounted on a shaft supported only by one bearing at the opposite end, and carrying at its extreme other end the part to be tested. In the center, this shaft is kept from excessive jumping by springs. The wheel *A* runs on another wheel which has a smooth face and is solidly mounted on a short shaft supported between sturdy bearings. The device is belted to a motor of variable speed, and the projections on the periphery of the wheel *A* may be increased or decreased in number as well as in height, so that when the device is running we may obtain either a large number of vibrations of low amplitude or a lesser number of greater amplitude. This test may be made so severe that even parts which are known to stand up under the hardest conditions in service, can be shaken to pieces in a few hours. It is possible then to compare the relative endurance of different constructions of the same apparatus by testing them on this de-



FIGS. 136 TO 141. SOME OF THE VARIOUS OPERATIONS ON MOTORS

Fig. 136—Testing department for alternating-current motors. Fig. 137—Endurance test, eccentric weight. Fig. 138—Oscillator test. Fig. 139—Eccentric-weight test. Fig. 140—Shaker test. Fig. 141—Painting tables.

vice under the same conditions: by comparing the time required for their destruction. This test, for example, brought out the fact that the brazed rotor construction referred to in a previous installment is superior to all the other constructions used heretofore for rotor windings of squirrel-cage motors.

The thorough working out experimentally of a new type of motor, including the service and rating tests outlined, the enormous expense involved in designs, tools, equipment, etc., necessary to bring out the line, all constitute an assurance to the prospective user of this type of motor of its efficiency and durability.

All the commercial and complete tests are submitted for approval to the engineer in charge of the line, also to an engineering inspector of that type of apparatus, and these men particularly satisfy themselves that all guarantees (which may be included in contracts) are met, and that the apparatus is perfect, electrically as well as mechanically.

In case of new standard lines of motors, further safeguards are provided by making allowance for the approval of all apparatus by a division engineer and a verification committee consisting of the chief engineer and the works manager. The reader will see how in motor manufacture most careful provisions have been made to have only first-class products go out into service.

After testing, the motors pass over to the painting tables, Fig. 141, where a finishing coat only is applied, as all parts have received one or more priming coats at some stage of the previous manufacturing operations. After they are stamped and the nameplate is attached, the motors are checked by the inspector, and pass to the shipping department.

Breaking in Green Help

By Entropy

The expression "war emergency education" is very expressive to college people, but apt to lead practical men off the path. Education has so long been understood to be an accumulation of more or less useless knowledge that we should not be surprised if the expression is taken to mean more of the same prescription.

The country needs more trained men and women. It needs men and women trained to think as well as to act; but it if cannot have both it is better to have people able and willing to do than to have none. In other words, we must have a large number of people who can do something toward winning the war whether they understand what they are doing or not.

Our usual way of doing this is to stand a man in front of a machine and tell him to do thus and so (knowing full well that it is impossible for him to understand our language, much less our meaning) and then leave him to find out how to operate it by watching the man on the next machine. Naturally, he breaks something or spoils the work, so we eject him and put on another. This other man has just been ejected from our neighbor's shop across the street for doing exactly what our first man did; but he has learned something from experience and he gets along very nicely until he runs into something else which we have to explain to him, and the cycle is repeated and he goes to another shop.

If there is anything more inefficient than this the writer has overlooked it. It is not merely inefficient but it is stupid. Anyone with half a pint of common sense knows that it is all wrong, and yet very little is done about it. In every city there is one shop, and usually only one, where men are given help and made into mechanics, but the labor turnover in that shop is at least as great as in the other shops. Why? Because the other shops all know where to go to get well-trained men and where to get men who approach their work in a proper spirit. And they get them too. The man who runs this shop seldom catches on to how he has been worked until he lands in the bankruptcy court. Now, if instead of letting him quit business the other shops in town chipped in and subsidized him and let him keep on training men for them the whole community would be better off; in fact they would be still better off if they beat him to it and subsidized him just as soon as they found out what he could do.

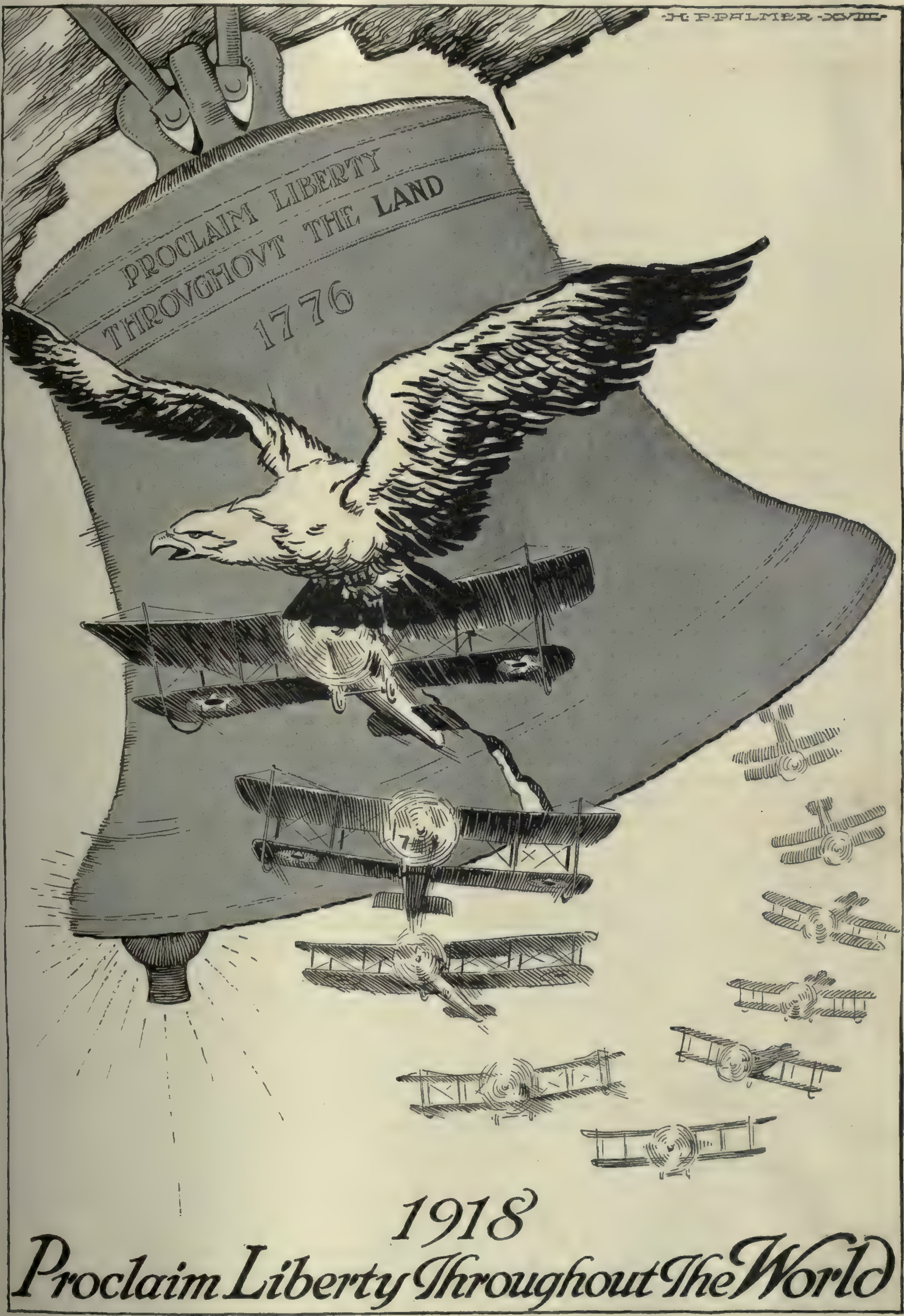
Natural Teachers

In other words there are a few people who just naturally cannot help showing other people how to do things and showing them why, just as there are a great many more men who are totally incapable of imparting knowledge. The few there are of the first kind should in these times of need be rounded up and taken away from production of machinery and put to producing efficient men, and women for that matter, for we have to consider the whole question.

Some of the standardized trades like that of machining are so widely practised that it would be justifiable for them to ask the Government to step in and do some part or all of this training of young men in any community who wish it; but the specialized work—teaching a man to do a certain job in a certain way peculiar to our own shop without making him of greater value to a neighbor—that is something that we must each do for ourselves.

Chordal was responsible for the remark that you should do all your manufacturing and profit making on one side of a brick wall and all your high and mighty inventing and improvement on the other. In his day there was no need for any special place for training men because they all came in as boys, and gradually absorbed in several years' time what we must now impart in a few weeks. The principle applies just as well, however, for we should keep production entirely separate from the training of men or ideas. In fact we really ought to keep books on the production end of the trade, and after having determined our profits and paid our dividends we should appropriate some of the surplus to building up a reserve of men and women who some time will become the leaders in our shops.

There is no special reason to expect greater loyalty from employees than we get, for we neglect many opportunities to make more of our men. Education, or rather training, is the one way in which one may "eat his cake and still have it"; that is, after having taught a thousand men how to do something you still have as much and usually more knowledge than you had at first. The more of it we give our subordinates the more they are worth to us and to themselves and the more they are impressed with our real friendship and our interest in their welfare.


H. P. PALMER XVIII
PROCLAIM LIBERTY
THROVGHOVT THE LAND
1776
1918
Proclaim Liberty Throughout The World

British Reconstruction Plans

The following article, written by Consul General Robert P. Skinner at London, England, will give an idea of the vast reconstruction plans the British are making to meet after-war conditions. In it is much that we can follow with profit in planning our future work.

THE British Ministry of Reconstruction has just published a complete list of the various commissions and committees that have been set up within that ministry and other ministries and departments of the British government to deal with questions which will arise at the close of the war.

These commissions and committees, which have been appointed at different times since the war began, now number 87 and fall into 15 groups:

I. Trade development, under which grouping are five committees dealing with general aspects and nine dealing with specific phases of the situation.

II. Finance, with two committees.

III. Raw materials, with six committees.

IV. Coal and power, with two committees and four subcommittees.

V. Intelligence, with two committees.

VI. Scientific and industrial research, with two research boards, five standing committees, seven research committees, four inquiry committees, and three provisional organization committees.

VII. Demobilization and disposal of stores, with eight committees.

VIII. Labor and employment, with two committees.

IX. Agriculture and Forestry, with four committees.

X. Public Administration, with six committees.

XI. Housing, with four committees.

XII. Education, with eight committees and commissions.

XIII. Aliens, with two committees.

XIV. Legal, with three committees.

XV. Miscellaneous, with three committees.

An idea of the many matters which it is believed will require careful consideration upon the cessation of hostilities may be gained from a summary of these commissions and committees; directed in each case by the department indicated in parentheses after the name of the committee.

The Development of Trade

Commercial and Industrial Policy Committee (the Prime Minister).—To consider the commercial and industrial policy to be adopted after the war, with special reference to the conclusions reached at the economic conference of the Allies and to the following questions: (a) What industries are essential to the future safety of the nation, and what steps should be taken to maintain or establish them? (b) What steps should be taken to recover home and foreign trade lost during the war and to secure new markets? (c) To what extent and by what means the resources of the empire should and can be developed? (d) To what extent and by what means the sources of supply within the empire can be prevented from falling under foreign control?

Dominions Royal Commission.—To inquire and report upon (a) the natural resources of the five self-governing dominions and the best means of developing these resources; (b) the trade of these parts of the empire with the United Kingdom, each other and the rest of the world; (c) their requirements and those of the United Kingdom in the matter of food and raw materials, together with the available sources of supply; (d) to make recommendations and suggest methods consistent with existing fiscal policy by which the trade of each of the self-governing dominions with the others and with the United Kingdom could be improved and extended.

The Development of Industries

Industrial Development Commission (Government of India).—To examine and report upon the possibilities of further industrial development in India and to submit its recommendations with special reference to the following questions: (a) Whether new openings for the profitable employment of Indian capital in commerce and industry can be indicated. (b) whether, and if so, in what manner, the government can usefully give direct encouragement to industrial development (1) by rendering technical advice more freely available, (2) by the demonstration of the practical possibility on a commercial scale of particular industries, (3) by affording, directly or indirectly, financial assistance to industrial enterprises, or (4) by any other means which are not incompatible with the existing fiscal policy of the government of India.

Belgian Trade Committee (Foreign Office and Board of Trade).—(1) To inquire into all matters relative to trade between the British empire and Belgium with a view to increasing and developing that trade by every desirable means; (2) to investigate as far as possible all means to be adopted in order to attain the object set out in par. 1. The committee will examine into the supplies and requirements of the respective countries (in so far as they have relation to its scope) and give advice as to how trade between them can be best established, developed and increased. It will obtain information and evidence from all available sources and endeavor to render all possible assistance in regard to shipping, manufactures, imports and exports, and trade generally between the empire and kingdom; (3) the committee will consist of three representatives appointed by the Foreign Office and three representatives appointed by the Board of Trade. A chairman and secretary will be chosen from their number. The committee shall have power to add to its numbers by the appointment of such persons of experience in the matters with which it has to deal as it may think expedient, and it will also consult from time to time other representatives of commerce having special knowledge of Belgian trade, shipping and finance; (4) it is particularly laid down that the purpose of this committee shall be a general one and that it shall not be part of its duties to foster the advancement of the trade of any particular individual or firm nor to devote its assistance

to any special branch of trade or industry except in relation to the general principles for which it is established.

Trade Relations After the War Committee (Board of Trade).—To investigate the general questions of trade relations after the war with a view to the successful promotion of British trade, and also with the object of devising measures for the prevention of the effective resumption of Germany's policy of peaceful penetration.

Committee on the Chemical Trades (Ministry of Reconstruction).—To advise as to the procedure which should be adopted for dealing with the position of the chemical trades after the war, with a view to the creation of some organization which should be adequately representative of the trade as a whole and by means of which the trade may be enabled hereafter to continue to develop its own resources and to enlist the closest coöperation of all those engaged in the chemical industry.

The Engineering Trades

Engineering Trades (New Industries) Committee (Ministry of Reconstruction).—To compile a list of the articles suitable for manufacture by those with engineering-trade experience or plant, which were either not made in the United Kingdom before the war, but were imported, or were made in the United Kingdom in small or insufficient quantities, and for which there is likely to be a considerable demand after the war, classified as to whether they are capable of being made by (1) women, (2) men and women, or (3) skilled men; and setting out the industries to which such new manufactures would most suitably be attached; and to make recommendations (a) on the establishment and development of such industries by the transfer of labor, machines, and otherwise; (b) as to how such a transfer could be made, and what organization would be requisite for the purpose, with due regard to securing the coöperation of labor.

Board of Trade Committees on the Coal, Electrical, Engineering, Iron and Steel, Nonferrous-Metal and Textile Trades, and on the Shipping and Shipbuilding Industries.—To consider the position of these trades and industries after the war, with special reference to international competition, and to report what measures, if any, are necessary or desirable to safeguard that position.

Financial Facilities Board

Financial Facilities Committee (Treasury and Ministry of Reconstruction).—To consider and report whether the normal arrangements for the provision of financial facilities for trade by means of existing banking and other financial institutions will be adequate to meet the needs of British industry during the period immediately following the termination of the war, and, if not, by what emergency arrangements they should be supplemented, regard being had in particular to the special assistance which may be necessary (a) to facilitate the conversion of works and factories now engaged upon war work to normal production; (b) to meet the exceptional demands for raw materials arising from the depletion of stocks.

Enemy Debts Committee (Foreign Office).—To report on the arrangements to be adopted for the liquidation of the commercial, banking and other financial transactions between British and enemy persons, the completion of which was prevented by the outbreak of war, and for this purpose to consider the returns made to the custodians of enemy property, and to the public trustee and the foreign claims office, and any information on matters relating thereto.

Committees on Raw Materials

Central Committee on Materials Supply (Ministry of Reconstruction).—To consider and report upon (1) the nature and amount of the supplies of materials and foodstuffs which in the committee's opinion will be required by the United Kingdom during the period which will elapse between the termination of the war and the restoration of a normal condition of trade; (2) the probable requirements of India, the dominions and crown colonies for such supplies at the close of hostilities; (3) the probable requirements of belligerents and neutrals for such supplies at the close of hostilities; (4) the sources from which and the conditions under which such supplies can be obtained and transported, and in particular the extent to which they might be obtained from the United Kingdom or within the empire or from allied or neutral countries; (5) the question whether any measure of control will require to be exercised in regard to the nature and extent of any such control.

Building Materials Supply

Committee on the Supply of Building Materials (Ministry of Reconstruction).—(1) To inquire into the extent of the probable demand for building material for all purposes which will arise in the country during the transition period and the extent of the available supply and form of such material; (2) to inquire how far the quantities of material now available are capable of increase, what are the difficulties in increasing them, and how these difficulties can be removed, and to report to what extent an increase in production will affect the price of the materials; (3) in the event of the supply of material or labor being insufficient to fulfill the total building demand, to consider the principles and method by which the priority of various claims should be settled, and to report what steps are necessary to insure that the manufacture of the materials, so far as they are at present inadequate, shall be extended in time to secure sufficient quantities for use when required on the cessation of hostilities and to recommend what steps should be taken during the war to facilitate a prompt commencement of building work at that time; (4) generally to consider and report upon any conditions affecting the building trades which tend to cause unduly high prices and to make recommendations in regard to any measure of control which it may be desirable to exercise over the purchase, production, transport or distribution of materials.

Cotton at Home and Abroad

Committee on Cotton Growing Within the Empire (Board of Trade).—To investigate the best means of developing the growing of cotton within the empire and to advise the government as to the necessary measures to be taken for this purpose.

Coal Conservation Committee (Ministry of Reconstruction).—To consider and advise (1) what improvements can be effected in the present methods of mining coal with a view to prevent loss of coal in working and to minimize cost of production; (2) what improvements can be effected in the present methods of using coal for production of power, light and heat, and of recovering by-products with the view to insure the greatest possible economy in production and the most advantageous use of the coal substance; (3) whether, with a view to maintaining industrial and commercial position, it is desirable that any steps should be taken in the near future, and if so, what steps to secure the development of new coal fields or extensions of coal fields already being worked.

Mining, Power Generation and Transmission, Carbonization and Geological Subcommittees.—The question of the application of carbonization to the preparation of fuel for industrial and commercial purposes.

Committee on Supply of Electricity (Board of Trade).—To consider and report what steps should be taken, whether by legislation or otherwise, to insure that there be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, particularly industries which depend upon a cheap supply of power for their development.

Scientific and Industrial Research

The following 21 committees have been established by the department of scientific and industrial research:

Fuel Research Board.—To investigate the nature, preparation and utilization of fuel of all kinds, both in the laboratory and, where necessary, on an industrial scale.

Cold Storage Research Board.—Appointed to organize and control research into problems of the preservation of food products by cold storage and otherwise.

Standing Committees on Engineering, Metallurgy, Mining and Glass and Optical Instruments.—To advise the council on researches relating to the lines of activity named and on such matters as may be referred to the committee by the advisory council.

Joint Standing Committee on Illuminating Engineering.—To survey the field for research on illumination and illuminating enginering, and to advise as to the directions in which research can be undertaken with advantage.

Mine Rescue Apparatus Research Committee.—To inquire into the types of breathing apparatus used in coal mines, and by experiment to determine the advantages, limitations and defects of the several types of apparatus, what improvements in them are possible and whether it is advisable that the types used in mines should be standardized, and to collect evidence bearing on these points.

Abrasives and Polishing Powders Research Committee.—(1) To conduct investigations on abrasives and polishing powders with a view to their preparation and use as one factor in accelerating the output of lenses and prisms for optical instruments not only for peace requirements but in connection with the war; (2) to investigate the preparation and properties of abrasives and polishing powders.

Food Research Committee.—To direct research on problems in the cooking of vegetables and meat, and in bread making, to be undertaken by two scholars of the committee of council.

Building Material Research Committee.—To make arrangements for carrying out researches on building construction instituted by the department at the instance of the Local Government Board Committee or otherwise, to be responsible under the council for the direction of such researches, and to deal with such other matters as may be referred to the committee from time to time by the council.

Electrical Research Committee.—A committee of direction appointed in connection with certain researches affecting the electrical industry.

Committee for Research on Vitreous Compounds and Cements for Lenses and Prisms.—To conduct researches into the preparation, properties and mode of employment of cements for lenses and prisms; to prepare a reference list of vitreous compounds, their composition, densities, refractive indices and dispersive powers.

Tin and Tungsten Research Board.—The Cornish Chamber of Mines has been invited to nominate a representative of the landlords and a representative of the mine owners to serve on the board. A committee of control appointed in connection with certain researches into tin and tungsten.

Lubricants and Lubrication

Lubricants and Lubrication Inquiry Committee.—To prepare a memorandum on the field for research on lubricants and lubrication, which will contain an analysis of the problems involved, together with a suggested scheme of research, which would be most likely to lead to valuable results.

Chemistry of Lubricants Subcommittee.—To collect and review the existing information relating to the chemistry of lubricants and lubricating oils.

Zinc and Copper Research and Inquiry Committee.—To collect and review the existing information as to the copper and zinc industries upon which future research must be based, to formulate proposals for carrying out the research suggested by the Brass and Copper Tube Association of Great Britain into the best methods of making sound castings of copper and brass for tube making and to prepare an estimate of their cost, and to report to the advisory council.

Irish Peat Inquiry Committee.—To inquire into and consider the experience already gained in Ireland in respect of the winning, preparation and use of peat for fuel and for other purposes, and to suggest what means shall be taken to ascertain the conditions under which in the most favorably situated localities it can be profitably won, prepared and used, having regard to the economic conditions of Ireland; and to report to the Fuel-Research Board.

Demobilization and Disposal of Stores

Demobilization of the Army Committee.—To consider and report upon the arrangements for the return to civil employment of officers and men serving in the land forces of the crown at the end of the war.

Officers' Resettlement Subcommittee.—To consider and report what arrangements require to be and can be made on demobilization for resettlement of officers in civil life, and also of men belonging to classes to which in the main officers belong.

Disabled Officers' Employment Committee (India and Colonial Offices).—To assist disabled or invalided officers who may be desirous of obtaining employment in India, Burma, the Eastern colonies and Malay States.

War Office Demobilization Committee.—To consider questions requiring settlement in connection with the demobilization of the army in so far as they fall within the province of the war department; to act as a link with the committee of the Ministry of Reconstruction, and to prepare a draft scheme of demobilization.

Demobilization Coördination Committee (Admiralty, War Office and Ministry of Labor).—(1) To consider how far the proposed special arrangements to demobilize immediately peace is declared men specially required in connection with the work of demobilization can or should be extended to other men belonging to the public services or to similar "pivotal" men in industry; (2) to coordinate the working of the demobilization scheme of the war department with the resettlement scheme of the ministry of labor; (3) to settle, during demobilization, instructions with regard to priority which may appear to be rendered necessary on public grounds or by the sort of employment in the different industries.

Civil War Workers

Civil War Workers' Committee (Ministry of Reconstruction).—To consider and report upon the arrangements which should be made for the demobilization of workers engaged during the war in national factories, controlled establishments and other plants engaged in the the production of munitions of war and on government contracts or in plants where substitute labor has been employed for the duration of the war.

Horse Demobilization Committee (War Office).—To frame proposals for the demobilization of horses and mules in relation to the general scheme of demobilization.

Disposal of War Stores Advisory Board (Ministry of Reconstruction).—To expedite the preparation of any necessary inventories of property and goods of all descriptions held by government departments, and to consider and advise upon the disposal or alternative form of use of any property or goods which have or may become during or on the termination of the war surplus to the requirements of any department for the purposes of that department.

Labor and Employment

Committee on Relations Between Employers and Employed (Ministry of Reconstruction)—(1) To make and consider suggestions for securing a permanent improvement in the relations between employers and workmen; (2) to recommend means for securing that industrial conditions affecting the relations between employers and workmen shall be systematically reviewed by those concerned with a view to improving conditions in the future.

Women's Employment Committee (Ministry of Reconstruction)—To consider and advise in the light of experience gained during the war upon the opportunities for the employment of women, and the conditions of such employment in clerical, commercial, agricultural and industrial occupations after the war.

Aliens Committee (Ministry of Reconstruction).—To consider (a) the questions which will arise at the end of the war in connection with the presence in this country of persons of an enemy nationality and whether the repatriation of such is desirable, and if so, in what cases; (b) what restrictions, if any, should be imposed after the war on admission of aliens to this country and their residence here; (c) whether any changes in the law or practice of nationalization have been shown by the experience of the war to be required in the public interest.

Interdepartmental Conference on Missions in India.—To consider the conditions on which aliens should after the war be allowed to conduct missionary or educational work in India.

Civil Aerial Transport Committee (Air Ministry).—To consider and report to the air board with regard to (1) the steps which should be taken with a view to the development and regulation after the war of aviation for civil and commercial purposes from a domestic and imperial and an international standpoint; (2) the extent to which it will be possible to utilize for this purpose the trained personnel and the aircraft which the conclusion of peace may leave surplus to the requirements of the naval and military air services of the United Kingdom and overseas dominions.

Electric Hoist Manufacturers' Association

The Electric Hoist Manufacturers' Association has been formed with the following members: The Brown Hoisting Machinery Co., Detroit Hoist and Machine Co., Euclid Crane and Hoist Co., the Franklin-Moore Co., Link Belt Co., Roeper Crane and Hoist Works, Shepard Electric Crane and Hoist Co., Sprague Electric Works, the Yale & Towne Manufacturing Co. The officers are F. A. Hatch, Shepard Electric Crane and Hoist Co., New York City, chairman; F. W. Hall, Sprague Electric Works, New York City, vice chairman; and C. W. Beaver, the Yale & Towne Manufacturing Co., 9 East 40th St., New York City, secretary-treasurer.

The association holds monthly meetings for the purpose of studying the specific needs of the hoist user and to develop standardized methods of presenting information to him so that guesswork will be eliminated. It will consider uniform nomenclature pertaining to the types and parts of electric hoists, fix upon a standard by which hoist motors shall be rated and promote the standardization of electric hoists as far as possible. It will also collect and disseminate information and statistics relative to the electric-hoist industry; provide facilities and opportunities for study and education in regard to the economics of the industry; extend the use of their product by pointing out the great number of material-handling problems of different classes that can be solved by the use of electric hoists; promote friendly intercourse and coöperation among the members and circulate the knowledge that long experience has taught is essential to any hoist to insure good results, and to recommend to the members of the assotion well-established principles of construction and equipment that will tend to eliminate inferior goods.

The membership of the association is confined to manufacturers of monorail electric hoists, which have revolutionized the handling and transporation of material in and about industrial plants.

BUY THE BONDS!

By Berton Braley

BUY the Bonds of Liberty, smash the bonds of slavery;
Back the boys who battle with the Huns;
Show them you are with them in their calm, intrepid bravery—
Buy the Bonds that buy the food and guns!
Squeeze the old pay envelope constantly and steadily
In the cause the country's fighting for;
Dig into your bank account, cheerfully and readily—
Buy the Bonds and help to win the war!

"OVER THERE" our army boys fight in shot and shell of it;
When their country needed them they went.
Now the nation asks of you, not to face that hell of it—
But to *lend,* at four or more per cent.,
Money for the soldier boys—every good man jack of them
Out to smash the Hun that we abhor.
Show them you are proud of them; prove that you are back of them—
Buy the Bonds and help to win the war!

FACING countless German hordes mid the battle scenery
Stand the boys who fight for you and me;
We must send them shells and steel, powder and machinery—
Build the ships that bear them oversea.
It is not enough to cheer, not enough to pray for them;
We must give them all they're asking for.
Work and save and sacrifice; make supplies—and pay for them—
Buy the Bonds and help to win the war!

IV. The Receiver—III

Milling and profiling processes are here dealt with following the broaching of a long seat at the bottom of the piston bore which is cut out with roughing and finishing broaches dividing the work between forty cutting teeth. Details are included of a gaging fixture fitted with flush fingers in place of flush-pins which cannot always be applied to surfaces that are undercut or otherwise partially obstructed by projections.

THE first operation to be considered in this section is the broaching at the bottom of the small hole to receive the rack which is attached to the piston and which carries the striker.

Two broaches, one roughing and one finishing, are used in the cuts. These tools and the method of operation are illustrated in Fig. 35. Both of the broaches are long affairs with shanks that fit snugly in the small hole of the receiver. There are twenty teeth on each broach with about 1-in. space between teeth. The depth of cut distributed over the entire series of teeth means about 0.0015-in. cut per tooth. The ends of the broach shanks are slotted crosswise for a key, and the broaches are drawn through the work in the manner indicated in the illustration.

Further Milling Cuts

Following the broaching operation there are numerous milling and profiling processes, and a few of these will be illustrated to show certain types of fixtures and gages and some of the work accomplished by their aid.

The operation shown in Fig. 36 is straddle milling of the under side of the receiver table on both right and left sides. This work is accomplished with inserted tooth cutters secured to the ends of short, rigid arbors. The receiver is located in the fixture by the large hole and by a short plug entering the front end of the small hole so that the receiver-table surfaces may be milled in correct relation to the two holes referred to. Additional support immediately under the surfaces operated on is provided by the cam-shaped rockers at the sides, which are held in contact with the bottom of the work by means of the setscrews shown at the side of the fixture.

The gage for testing the correctness of the milling operation is shown at the front of the machine in Fig. 36. The method of holding the receiver in the gaging fixture by means of through plugs is clearly represented in the illustration. The gage carries four pivoted arms, in each of which is fitted two flush-pins which come in contact with the milled surface when the arms are pressed down by the fingers. In this test, with the arms pressed downward, all of the gage-pins are flush at their upper ends with the top surface of the arms if the work is correctly machined.

Flush-pin Gage

Each flush-pin is normally pressed downward a short distance by a sensitive spring so that there may be no tendency to stick at the uppermost position and so necessitate pushing down individually before each test can be applied.

The several receivers seen in Fig. 36 are represented with a narrow groove milled nearly the entire length of the bottom of the receiver; this groove having been cut in an operation preceding the milling of the table bottom, as illustrated in this view. This groove, or channel, for the guard is gaged for depth in another interesting flush-pin fixture shown in Fig. 37.

This gaging fixture holds the receiver in the same manner as the gage in Fig. 36. It is provided with two sets of flush-pins, three in each set, the middle pin in

each set of three gaging the depth of the cut, while the two outside pins contact with and test the bottom of the receiver body itself so that the depth of the channel is represented by the difference in length between the central and outer flush-pins.

Fixture for Milling at an Angle

One of the interesting milling cuts made before the receiver is ready for going to the profilers is the forming of the ejector clearance slot, which is accomplished with the aid of the fixture shown in Fig. 38. The clearance slot is milled through the top of the receiver. Further operations in connection with the ejector clearance slot are performed under the profiler.

The fixture here shown is of special interest as it brings out clearly the method of locating and holding the receiver by plugs fitting the two holes, an arrangement characteristic of the whole series of tools employed on receiver work. The two plugs in the right end of the fixture are for the front of the receiver, and the work is here located, as in other operations, by its ends E and D, which are held in contact with the stop shoulders on the locating plugs by means of the shouldered plug at the left end of the fixture, this latter plug being slid forward and held positively by the handle A which works in a slot B formed crosswise in the carrying sleeve C.

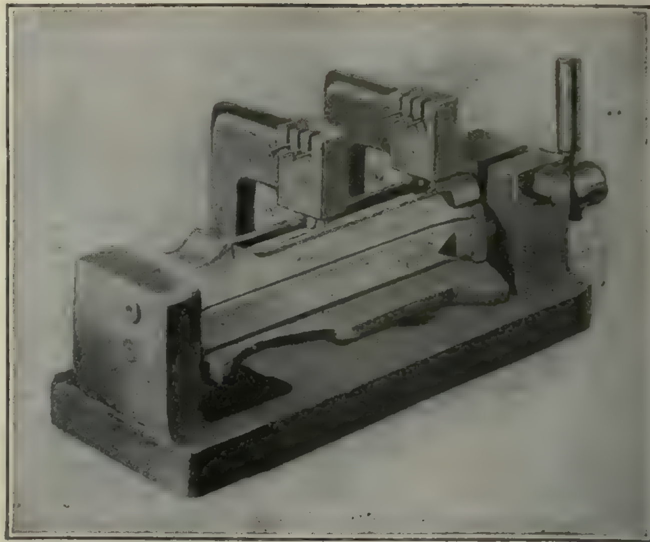


FIG. 37. GAGE FOR TESTING GUARD SEAT

Each of the three hardened plugs is finished to 0.001 in. under the standard size of the holes in the receiver. The two plugs at the right which tilt the work to the desired angle for performing the operations are located at the exact center distance apart of the large and small

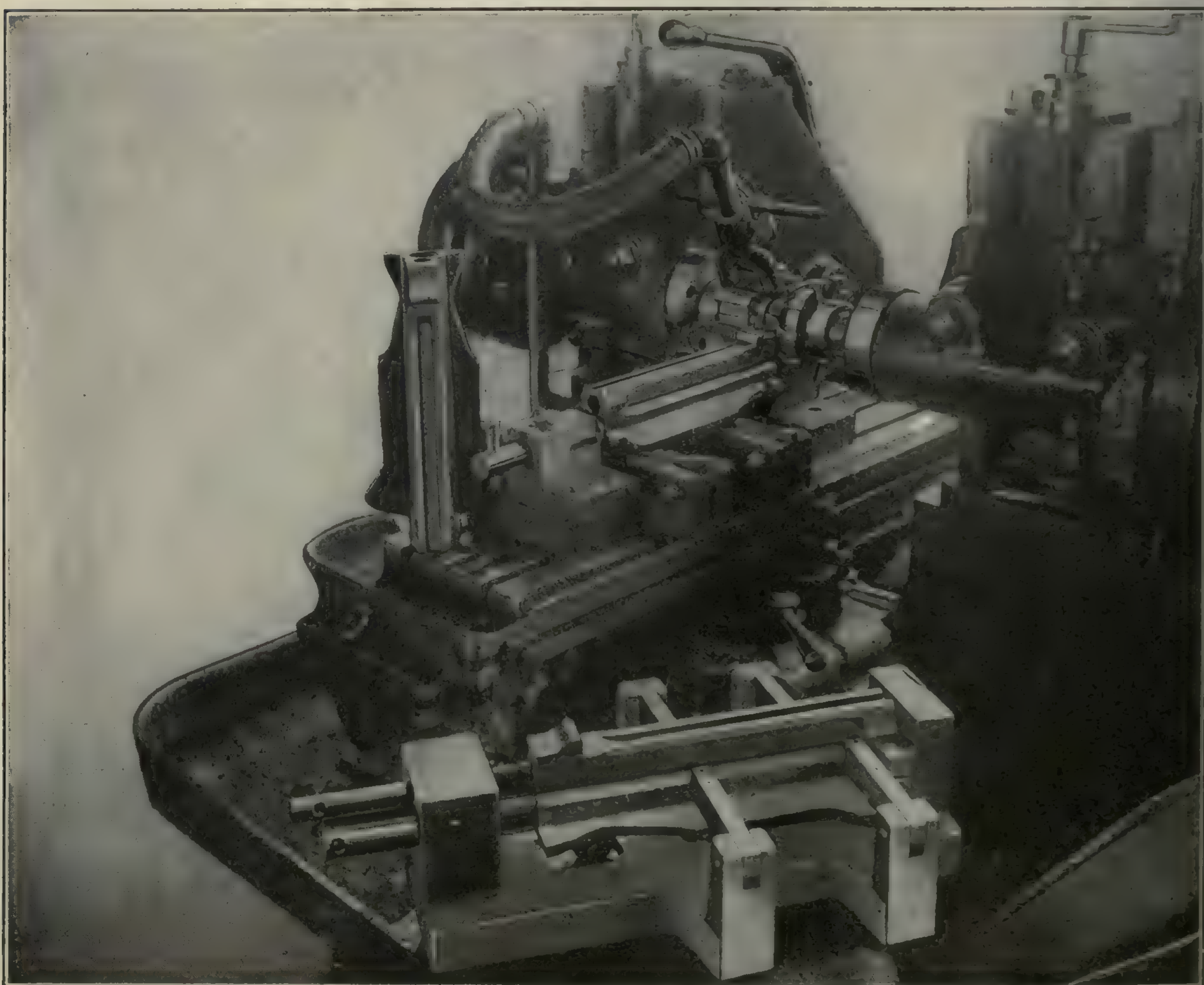


FIG. 36. STRADDLE MILLING UNDER SIDE OF TABLE

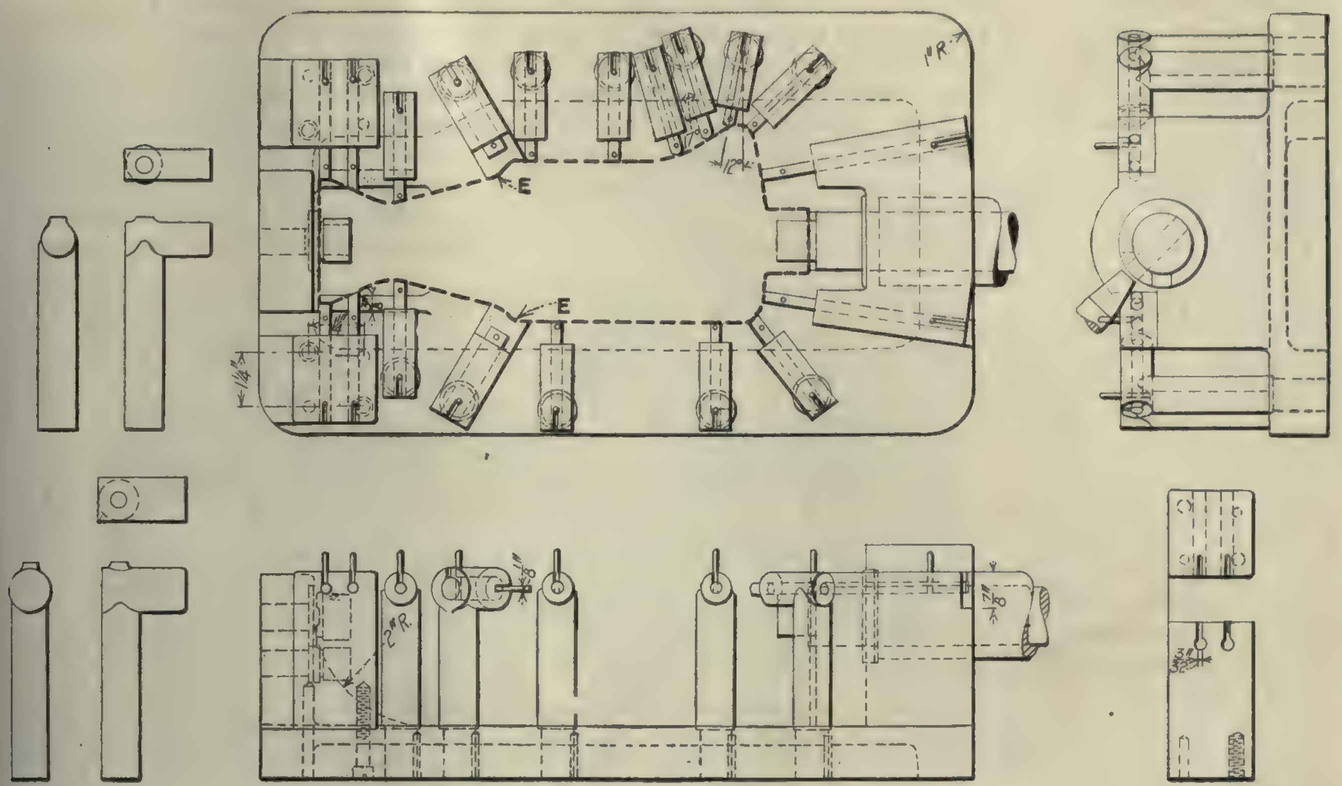


FIG. 40. GAGING FIXTURE FOR RECEIVER CONTOUR

holes which are lapped through the work. With the fixture in closed position, as illustrated, the shoulders on the opposite plugs come to a distance apart, corresponding exactly to the over-all length of the work. Like other tools used in the sequence of operations, this fixture gages the work that has gone before.

The first profiling operation, which is one of some 40 or more performed in the profiling machine, is illustrated in Fig. 39. This represents the profiling of the full outside shape of the receiver, a process in which there are really two similar operations in duplicate fixtures, one for roughing, the other for finishing. On both profilers

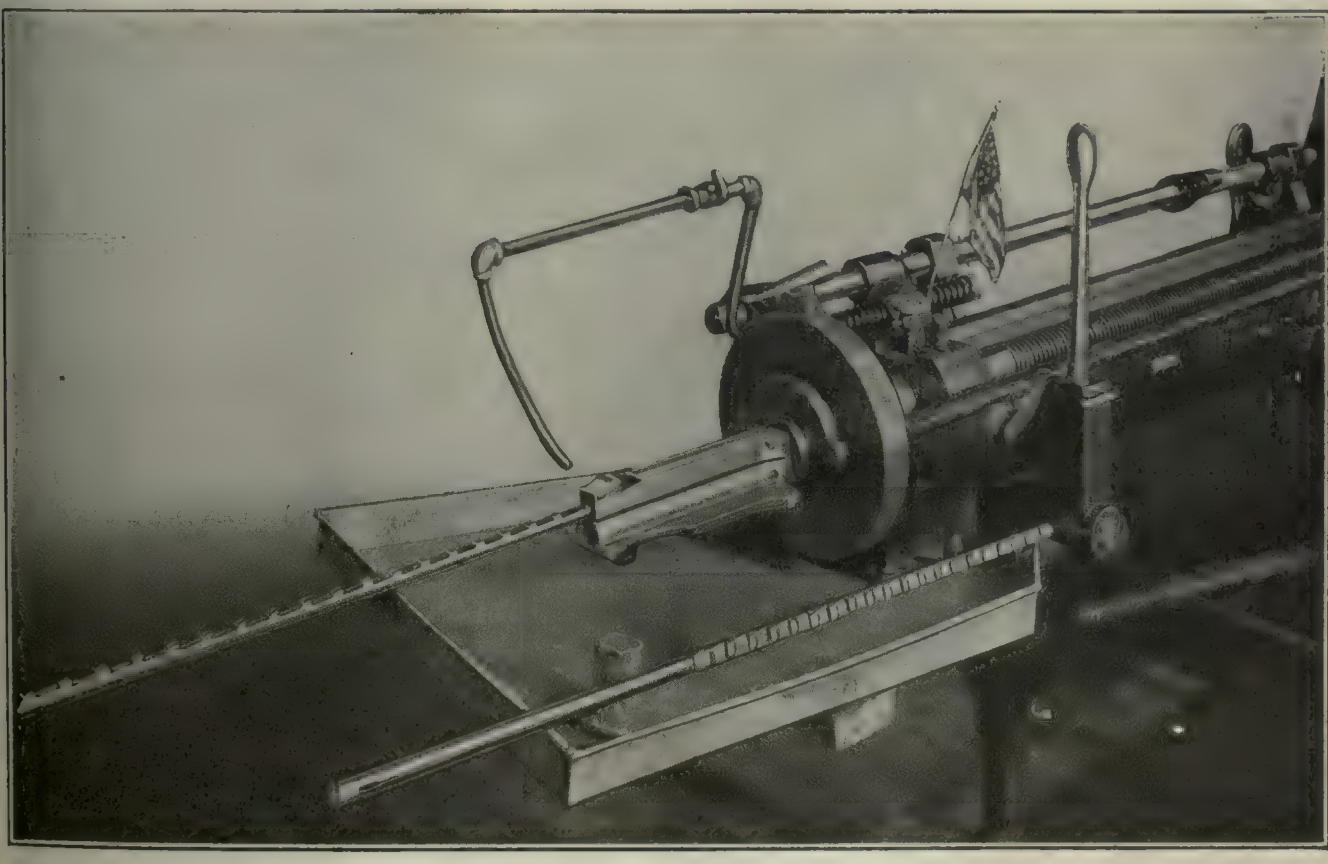


FIG. 35. BROACHING THE SEAT IN THE PISTON BORE

two heads are used, one for roughing and one finishing, so that two separate cuts are taken around the work in each machine.

In Fig. 39 the profiling fixture is shown distinctly with steel-form plate and taper-guide pin at the right of the work. The method of locating and holding the receiver in the fixture involves the use of positively positioned plugs as in preceding tool designs.

The inspection of the profiled contour is accomplished in the gage shown on the stand at the right of the profiler, and is illustrated in detail in Fig. 40. This tool is a most complete flush-pin gage. It carries all told 19 gaging points, 17 of which are of $\frac{1}{4}$-in. drill rod, and two for the curved shoulders at *E* and *E* are of $\frac{1}{8}$ x 1-in. flat gage stock. It will be noticed that several of the flush-pins are ground off at an angle at their front ends to suit sloping lines on the contour, while certain others are beveled off from each side to leave a contact point at the center.

In all cases the flush-pins are prevented from turning in their guides by small pin handles which slide in slots milled in the upright posts. These uprights are all bored out to uniform center height and are all fixed with their heads at the desired angle to the horizontal center line through the fixture by means of $\frac{1}{8}$-in. pins, or "dutchmen," driven into holes drilled half in the fixture base and half in the post bearing.

The lower ends of the posts are reduced to $\frac{3}{4}$-in. diameter, leaving a shoulder which rests squarely upon a seat formed in the fixture base, the seats for the whole series being all in the same horizontal plane and at the exact distance required below the center line through the locating plugs which carry the receiver. A fixture is illustrated in Fig. 42 for profiling the curved front end of the platform top of the receiver, finishing the locking-lug top at the end and profiling the rear end of the platform. This fixture serves for two distinct operations, the guide or form *X* being used for the front end and locking lug, and the form plates *Y* and *Z* for the rear end profiling. The construction of this fixture and the method of mounting the guide forms are clearly shown in the illustration.

A gaging fixture used in conjunction with the profiling fixture just described is shown in Fig. 43. As illustrated, this gage is provided with a series of flush-pins for testing the depth and positions of the various receiver surfaces machined in the fixture, Fig. 42. The points at which the different gage-pins bear upon the receiver will be seen upon inspection of the several views of the illustration.

Considering a little further at this moment certain features of the comprehensive system of gages developed for use on the Lewis gun parts, it should be noted that not all of the flush-gages are of the pin type, several examples of which have just been referred to. The general principle of flush surface gaging devices admits of much broader usage than would be feasible if the design were confined entirely to flush-pins only.

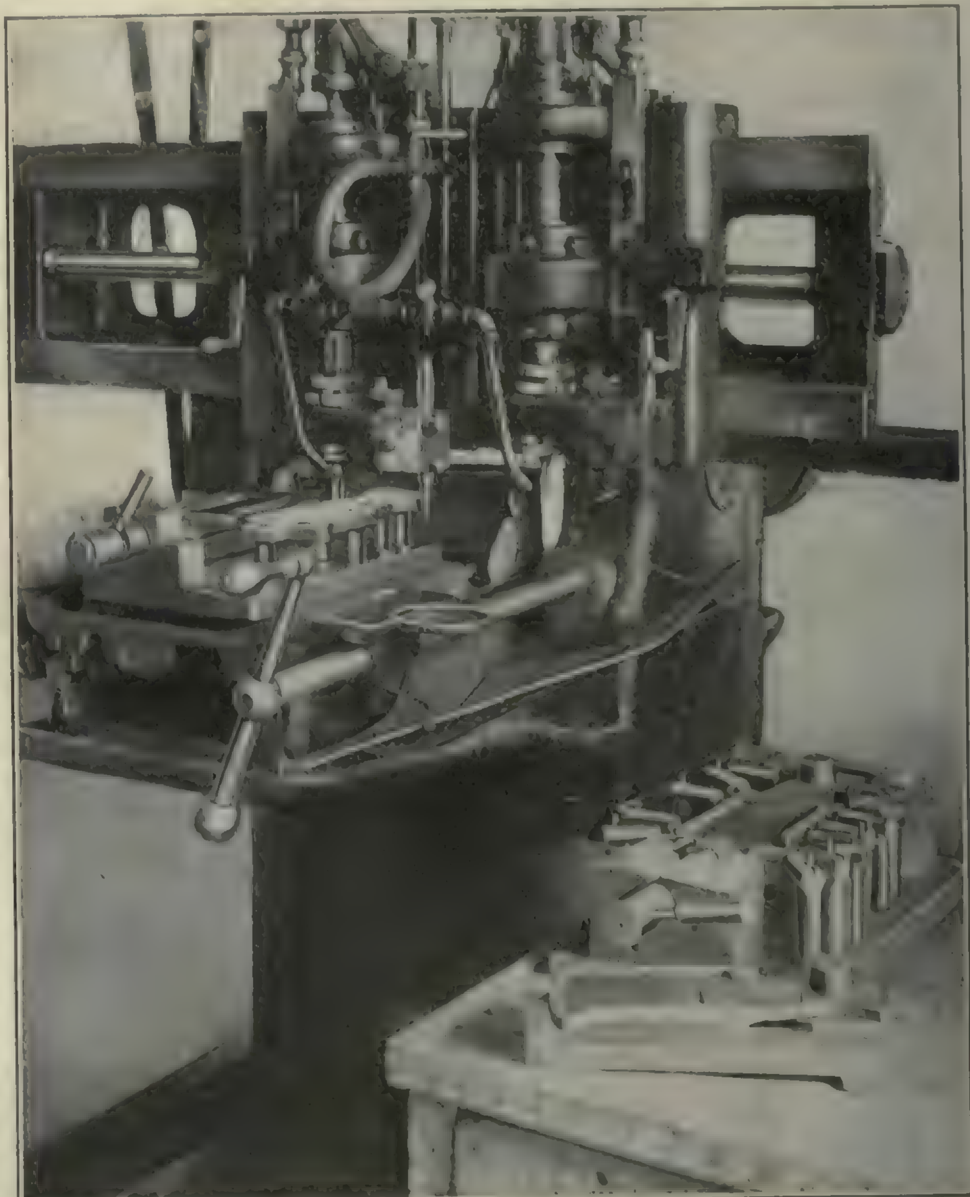


FIG. 39. PROFILING OUTSIDE SHAPE OF RECEIVER

As an illustration: surfaces that are under-cut or otherwise partially obstructed by projections of one kind or another are out of reach of the ordinary flush-pin if carried in a fixed guide; and it is oftentimes a simpler and safer practice to apply some form of swinging gaging finger or lever than to mount a flush-pin in a sliding or swiveling holder which may be improperly set at some time and lead to inaccurate results. An illustration of a gage which brings out the application

of flush-fingers in place of flush-pins is presented in Fig. 38. This device is for gaging the position and shape of profile under the left side of the receiver platform.

The dotted outline of the receiver in position in the fixture shows the points where the gage fingers contact with the work. There are three of these fingers, namely

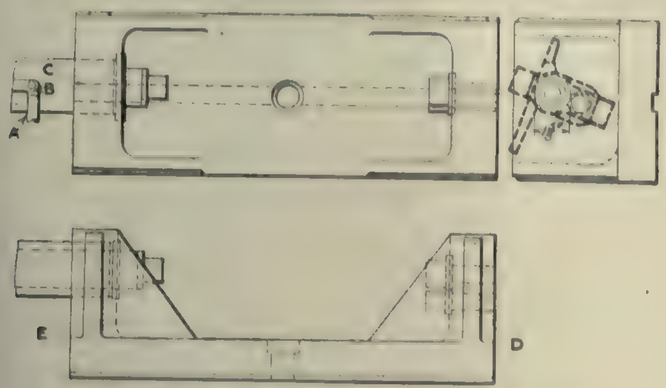


FIG. 38. MILLING-EJECTOR CLEARANCE SLOT

A, *B* and *C*, two of them, *A* and *B*, swinging in a horizontal plane, and *C* having an up and down movement about its pivot. The fingers *A* and *B* are curved at the inner or contact ends to bear against concaved contour shoulders machined in a profiling operation on the under side of the platform. When these surfaces are correctly machined and the contact ends of fingers *A* and *B* are against the work, their inner surfaces near the outer ends will be perfectly flush with the vertical inner faces of the lugs *D* and *E* over which they swing. Similarly when gage finger *C* is brought into contact with the under platform surface, its upper face at the rear end should come flush with the top face of lug *G*. The gaging surfaces of projections *D*, *E* and *G* are ground off perfectly flat and true to correspond with the square edges of the gage fingers, and in making a test with these fingers the most minute discrepancy in the matching up of the surfaces is readi-

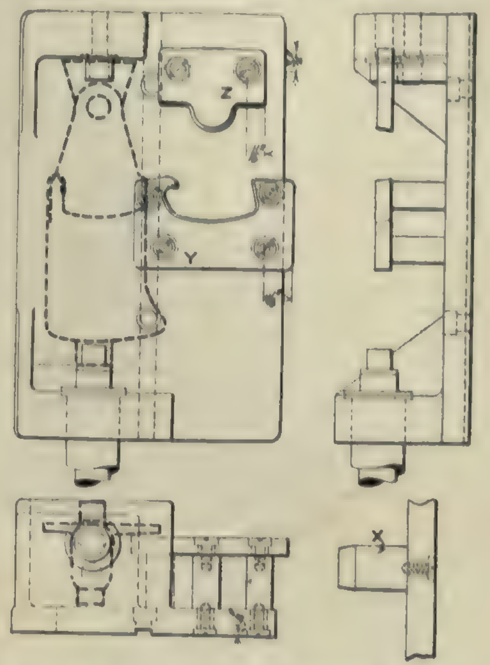


FIG. 42. PROFILING PLATFORM ENDS

ly detected by the thumb-nail or the end of one's finger when passed over the joint.

It is possible, of course, with this type of gage to derive an added advantage in the way of establishing an even more highly refined check upon a piece of work by incorporating the multiplying principle, using gage fingers with unequal length of arms, so that the extended rear end of the finger will reveal any possible error

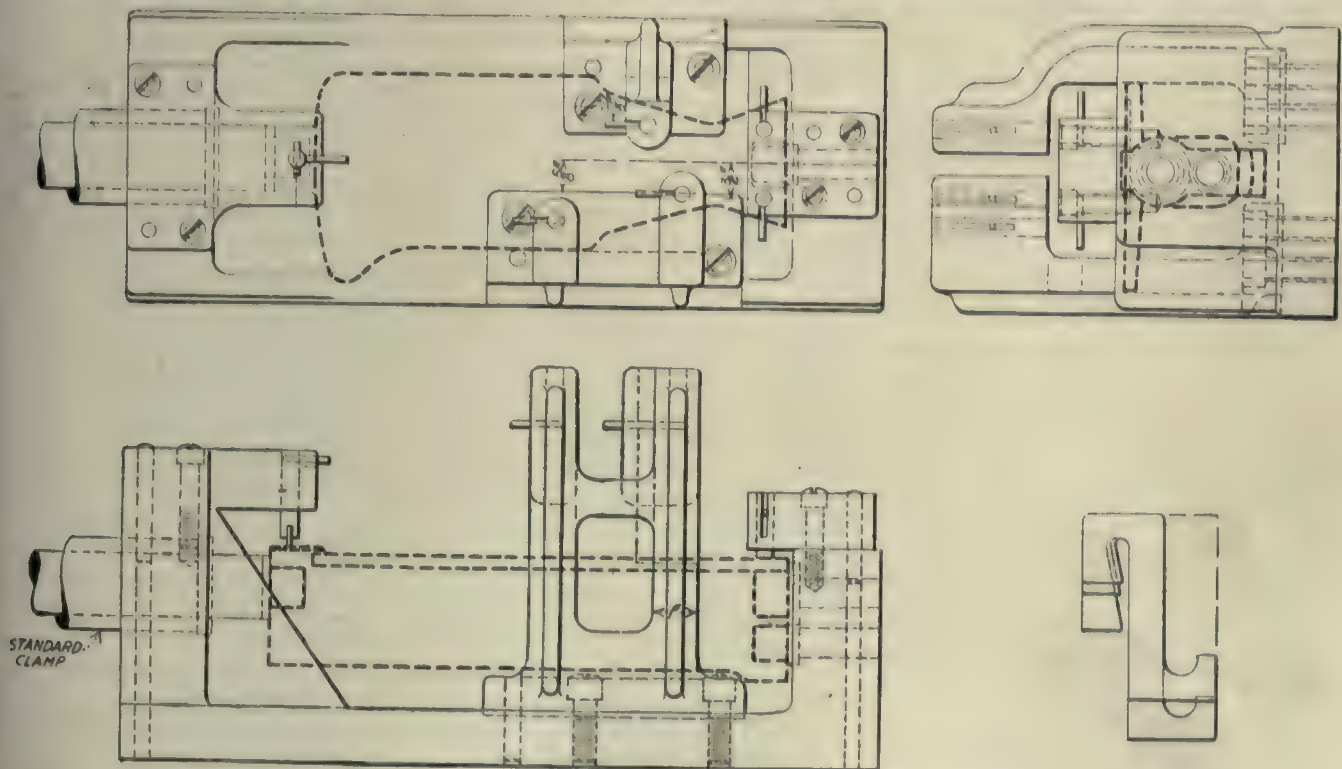


FIG. 43. GAGE FOR PROFILING OPERATIONS ON PLATFORM

multiplied by two or three or more times its actual amount. This is often a great advantage where the limits are very fine.

In the gage illustrated in Fig. 44, no such multiplying

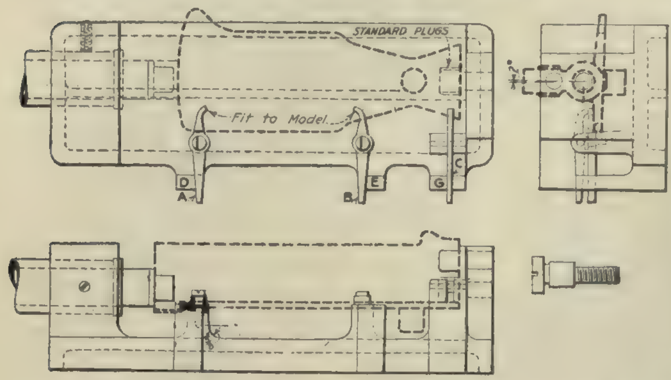


FIG. 44. GAGE WITH FLUSH-FINGERS INSTEAD OF PINS

effect is essential and the contact and rear portions of the gaging fingers utilized are of practically the same length.

The Machine-Tool Market in Switzerland

BY S. LAMBERCIER

Previous to September, 1917, the rules governing exports from the United States were about the same for neutral countries as they were for the Allies, but since that time it has been necessary to obtain a Government license to export American goods to neutral countries. This embargo has had the effect of holding up shipments of goods previously purchased by neutral countries, some of which were at ports awaiting shipment or in transit thereto.

The intention of this embargo is to prevent exported goods either from reaching Germany or being in any way used for her benefit of for the benefit of any enemies of the Allies. While the Swiss importers understand and appreciate the wisdom of this intention on the part of the United States they are loath to believe it is intended to prevent all traffic with neutral countries.

SPECIAL EXPORT LICENSES

That this assumption is true, in part at least, has been proved by the issuance of special export licenses under sufficient warranties that such exports will neither be sold to enemies of the Allies nor be used for their benefit in any manner. Under such guarantees it has lately been possible for Switzerland to import small precision tools from the United States. This partial lifting of the embargo will help to maintain business connections between the two countries and has already resulted in considerable satisfaction to the Swiss importers.

So far as machine tools are concerned the question is more difficult of solution, as the Allies seem to believe that Switzerland can produce all the machine tools needed, and therefore their exportation to that country is not a necessity. This, together with the scarcity of cargo space in transatlantic steamers, makes it probable that machine tools will not be exported from the United States to Switzerland until after the end of the war. If this should be the case it will result in building up the business of the Swedish machine-tool builders, as shipments can be made from that country directly to Switzerland, Denmark, Norway and Holland, not to mention the central empire. Recently Swiss machine-tool importers have had numerous offers from Swedish manufacturers to sell and deliver their products to them.

Although German machine-tool builders have been busily engaged in supplying tools to their own government some of them have begun an active propaganda for the exportation of their goods and have done considerable advertising in Switzerland. With this in mind it would not be suprising if the German government would grant export licenses to ship German machine tools to that country, and for two reasons: first, by repurchasing such tools from Swiss firms they could safely export their own product from there to other countries under a Swiss name, and second, this would promote German industry to the injury of Swiss trade.

AMERICAN TOOLS COSTLY

The price of American machine tools f.o.b. New York is very high, and when to this is added the excessive rate for ocean freight, insurance and transportation from the port of entry to Geneva the price becomes enormous. Nevertheless in spite of the high prices the Swiss shops do not hesitate to buy American machine tools, as they know their value and will wait from 12 to 18 months for delivery.

A number of shops in Switzerland are still doing work for enemies of the Allies, but as this work is continually growing less they have attempted to build tools after the American model. This has been found expensive, as all coal and iron must come from Germany, and the foundries charge from fr. 1.40 to 1.60 per kilo (12 to 16c. per pound) for castings.

The Entente furnish to manufacturers who are building machines for the Allies hematite iron at fr. 38 per 100 kilos ($70 per ton) and Cleveland pig at $60 per ton.

Unsawable Prison Bars

BY E. A. DIXIE

I see by the papers that "the most desperate and resourceful criminal in the United States" has succeeded in sawing his way out of prison. This sort of thing does not happen very often, but when it does a lot of us wonder why men of this stamp are not put behind case-carbonized bars. Then the "beautiful stenographer from Brooklyn" who carries 12-in. hacksaw blades under her eyelids into the cell of her Desperate Desmond will indeed be foiled. Carbonizing will cost about 1c. a pound, and it is reasonable to believe that all the prison bars in the prison could have been case-carbonized for less money than has already been spent in searching for this desperado.

Not only would the bars be made hacksaw proof by this process, but they would be harder to bend and consequently less easily removed from their seats in the masonry. There is still another side to this, that is, the humanitarian. Men in solitary confinement suffer from lack of exercise. Should a prisoner show such symptoms the guard could be empowered to slip him a hacksaw frame and a dozen saws. His avidity for escape would bring the roses of perfect health to his pallid cheeeks without hurting the bars in the least.

Foreign Trade After the War

This article is the first herewith of a series of papers by the Guaranty Trust Co. of New York on the subject of financial and economic conditions in foreign countries. It is believed that such authentic information, concisely presented, will be of much value in view of the necessity of holding and increasing our foreign trade after the war. The present article sets forth a general view of the existing conditions that will affect profoundly the future of American production and distribution.

EVERYWHERE throughout the world men and nations are preparing for peace. Their preparations are going forward not in the belief that peace will come in a month, or a year, or within any other fixed period, but rather in the conviction that no matter how far off peace may be its known problems are of such magnitude and importance as to require immediate consideration. Even those countries which at the moment are chiefly concerned with war measures are taking stock of the future and are seeking with all the prevision they can command to glean from its uncertainties some understanding of the principles that must obtain in reclaiming the wreck that this conflict has made of the activities and relationships of mankind.

The extent of that wreck is incalculable. It is only when one turns to the problems of eventual peace that some realization may be had of the destruction of the last three and one-half years. The money cost alone has been estimated at $100,000,000,000. Literally millions of men, women and children have been killed, have died, or have been rendered physically useless. Entire countries have been laid waste. In every warring country equipment for the production and distribution of goods other than war supplies has been deliberately scrapped or allowed to deteriorate beyond hope of rehabilitation. Trade routes on land and sea have been abondoned and new ones to meet temporary needs have been established. The demand for ships has taxed the resources of every country in material and labor.

Wherever the inquirer turns he sees evidences of war's ravages among the material things which are the indexes of man's advancement. There is no less of tragedy in the destruction of a host of ideas, feelings, beliefs, sentiments and personal attachments through which the moral, social and spiritual aspirations of mankind were accustomed to express themselves.

Some Benefits

On the other side, however, there are certain indisputable advantages, and in these are the seeds of restoration and future prosperity. As never before in the world's history individuals and nations have been driven to a marvelous development of their personal and economic resources. Nations which have been among the most luxury loving and carefree have turned to the business of war with an enthusiasm, a fortitude and a capacity for sacrifice that have astonished the world. To provide for the fighters and for themselves those behind the lines in every walk of life are toiling incessantly in farm and factory. The sheer necessity of preserving life and property has forced to a more efficient use of their own talents and of the resources which nature has provided. The easier habits of peace have given way before the stern demands of war. Thrift has become a necessity as well as a duty.

Neutral countries, no longer able to import the things they require, are turning to their own fields and mines for food and raw materials. They are increasing their manufactures and developing their foreign trade. Out of this is growing not only an understanding of the wants of other peoples, the extent of their resources and their methods of doing business, but also—and more important—an understanding of their own capacities. Accordingly there is observable a growing spirit of enterprise and preparation not unlike that of the renaissance which swept over Europe at the close of the Middle Ages.

What Peace Means

To come to any appreciation of what part the United States may play in world affairs at the close of this war, and by what means it is to hold its position, a clear idea must be had of what the coming of peace will immediately involve. The warring countries for a considerable period must direct their efforts largely toward taking apart, or demobilizing, the vast and intricate war machine and toward rearranging society not according to prewar standards but according to the new requirements which a long and disastrous war has made unavoidable.

It is beginning to be realized that the individual nation must organize for peace just as it did for war if it is to give effective aid to mankind in reconstructing the structure of a civilization which it took 1400 years to build up and less than three years to break down. The first step toward such an organization for peace, however, must be the clearing away of the debris of war. In this America will have the advantage of being able to turn more quickly to what may be termed development as distinguished from demobilization and rebuilding.

Problem of Readjustment

It has been estimated that 35,000,000 men are under arms or are directly connected with the military and naval services of the nations of the earth. How many more, including women, are engaged exclusively in war work it is impossible to estimate. Then come others whose talents and energies are directed toward supplying goods and services that are needed only because so many men and women have been withdrawn from production and distribution. These are merely indicators of the vast multitudes who are now doing things they did not do before the war, and who may or may not continue to do them after the war. In itself the demobilization of the fighters and their return to their own countries is a huge problem; but there are wartime industries, wartime railroads and wartime trade and shipping routes which will cease to serve any useful purpose when peace comes.

There are governmental policies, financial arrangements, legislative and military restrictions of all sorts in nearly every country, which have created new forms of industry, developed new methods of doing business, established investments and set up important obligations. To eliminate those no longer essential, to readjust relationships and make them suitable for peaceful pursuits, to clear the field for progress, is a stupendous undertaking which will demand all the wisdom of mankind.

Moreover, for Europe especially must come the period of rebuilding—a replacement as well as readjustment. Outside the matter of rebuilding, in itself tremendous, there is the equipment of farming, mining, industrial and transportation enterprises, small and large, which have been destroyed or disorganized by the war. The needs of every European country along these lines must be studied, and studied carefully, by those who would fully appreciate the opportunities for service and for gain which they offer.

Renewal of Prosperity

After this period, during which they will reorganize their forces and lay the foundation for future efforts, the nations affected by the war see a new era of prosperity. Countries that are heavily in debt will desire to reduce their obligations and eventually to turn the balance of trade in their favor. To this end they are planning an intensive cultivation of the soil, a diversification and enlargement of industry, a development of their merchant navies and a general outpouring of energies of every variety such as the world has never known before. Every resource of nature and human ingenuity will be requisitioned in the interest of this development. It is a program to touch the imagination of the dullest.

Europe's Advantages

While America will escape the burden of rebuilding; while her demobilization problem, difficult as it will be, is insignificant compared to that of the European nations, and while we shall accordingly have a very important advantage over our commercial and industrial rivals it should be remembered that the European nations will also have certain very material advantages. First of all they will have the impetus given by their colossal national debts. To pay these will be the proud ambition of every honorable nation. None of them will care to face the world with a record of repudiation. To their purpose to pay they will bring a skill in manufacture bred through many years during which competition forced them to produce cheaply and quickly. They will have colonies, rich in raw materials, which have developed during the last three years a higher degree of productive efficiency. They will have an intimate acquaintance with the conduct of foreign trade and the framework at least of an organization upon which its success depends. They will have a system of foreign banks with staffs of trained men in charge. They will undoubtedly have a degree of governmental assistance and support with which American traders have heretofore been unacquainted. These are some of the disadvantages with which America must reckon. No American will admit that they are discouraging. They are suggestive of the roads to follow—the paths that lead to our commercial empires of tomorrow.

Aside from a favorable position at the opening of this race for commercial supremacy America has certain other advantages of importance. At the foundation lies a huge gold reserve upon which can be built a structure of credit sufficient not only to finance our own enterprises but also to give aid to those of foreign countries. To guide and assist these credit extensions we have a banking system characterized by some of our rivals as ideal. This system will lend itself to the extension of American financial houses into foreign countries. Already a beginning has been made, not only by the setting up of branch banks and foreign offices—establishments which may be termed money and credit depots for the advancing trade army—but also by the organization of merchandise banks, institutions with the usefulness and working of which European nations have long been familiar.

Political Position

On the political side of the situation America is fortunate in possessing a form of government which the vast majority of her citizens believe in and intend to cherish. Considering that we have a population of more than 105,000,000 the efforts of the disloyal or the misguided to overturn the fundamental things in our national policy are not likely to make much impression. With few exceptions the nations of the world understand that America is actuated by no policy of territorial aggrandizement. Suspicions engendered by Germany in Mexico and South America are rapidly giving way before an understanding of our purposes in this war and after it. Finally this country is not, and is not likely to be, cursed with a class struggle. Despite all their propaganda the Socialists have had little success in convincing us that the future of America depends upon the domination of government and industry by one class. The prospect seems to be that for many years to come the Socialists will be extremely busy explaining why their theories failed so disastrously in Russia, the only country that ever had sufficient disregard for its own interests to try them.

Economic Strength

Economically the position of America is solid and inspiring. With an immense population, compounded of many elements, she is assured of a richness and variety of productive effort that rightly directed will give her preëminence in satisfying the mulitudinous wants of her world neighbors. An abundance of untilled farming land, inexhaustible mines, rich forests and ample water supply both for power and transportation invite this population to their conversion into wealth. Our inventive genius in the past has revolutionized the forms of industry. For the research worker in the industrial field there were never greater opportunities than now. Back of these powers of production stands the fact that we shall have at the close of the war a merchant marine and facilities for maintaining it such as America or any other nation never has known before. To bring all these factors of industrial, commercial and financial strength into complete coöperation is a task for which the American faculty for organization is excellently fitted.

This, in broad outline, is the situation. To the solution of these problems every great nation of the world,

with the exception of the United States, is already giving the thought of its most able men. Under the auspices of their governments, financiers, manufacturers, traders and workmen are being organized for the purpose of investigating and reporting on what will best serve to lift their respective enterprises out of the ruin of war. When all the resultant mass of information and opinion shall have been accumulated and organized it will be coördinated and will form the basis of policies which the governments are expected to adopt. Already it is evident that some of these policies may shatter traditions and ideals long adhered to, and will be bitterly opposed both by those who live in the past and those who dream of the future. Certain it is, however, that these problems of peace must be solved, and the nation that solves them with the largest measure of vision and practical insight will soonest get out of debt and resume a prosperous career. War is now the supreme effort of the nations. After the war all will be concentrated no less vigorously on the work of reconstruction.

The Task Before Us

In the United States there has been so far no organized undertaking on the part of the Government looking to the solution of these problems. The future political and military relations of this country to the rest of the world have been set forth by the President, but neither he nor the Congress has approached the question of financial, industrial and social reconstruction as a whole. Here and there in war measures or in the proposals of department heads may be discerned evidences of individual investigation and thinking, but thus far there has been no coöperative and avowed effort along this line as in other countries. No special body to enter upon this work has been organized here, and while it may be fairly asumed that such departments as those of the Treasury, the Interior, Agriculture, Commerce and Labor are devoting much of their time to reconstruction measures there is as yet no agency for the coördination of their findings and the suggestion of general policies unless it be Congress itself, a purely political body.

Coöperative Effort

Up to the present time the task has devolved largely upon individuals, corporations and associations who have no official standing. A great deal has been done in a desultory, detached sort of way, but no medium for interchange of opinion, except the press, or for coöperative effort, has been created. This country seems not yet to have sensed the fact that the day of individual efforts and purposes as distinguished from coöperation and public service has passed; that the war has established not only the interdependence of nations but also the interdependence of individuals and classes within the nation and that common understanding, counsel and coöperation are sure to be the watchwords of the future.

Hardening Formed High-Speed Cutters

By W. R. Bennett

It has been found that tools packed in charcoal and heated to temperatures of over 1900 deg. were completely ruined in form owing to their fused condition on the outside. This is largely because we can have no assurance that the contents in the iron tubes used is at the temperature of the furnace, which is probably indicated by means of a pyrometer stationed at a suitable place in the furnace and not in the tube itself.

The use of charcoal for this purpose is objectionable because charcoal in itself at these temperatures throws a great quantity of gas which sets up an internal combustion inside of the tube. This causes a self-contained temperature of a greater degree than that shown in the furnace proper, and the result is almost invariably a fused tool.

This, together with the fact that charcoal shrinks to a very marked degree when under high temperatures and is likely to leave the pieces exposed to oxygen, makes the results more or less uncertain. It has been stated in these columns that hardening powders did not give good results on lathe tools when cutting tough alloy steels. There is little doubt that high-speed steels properly heated to the higher temperatures give maximum results in production. The lathe tool or tool bit, however, which is so often used for testing purposes does not fully tell the story inasmuch as it is always subjected to tests that are seldom or never asked or expected from the expensive formed or intricate-shaped cutters.

I fully agree that high temperatures are advisable for high-speed tools whenever grinding to size and shape is possible. But unfortunately the grinding operation cannot always be tolerated, especially on the periphery of a circular forming cutter. This is particularly true of intricate forming tools, shavers and numerous other tools wherein distortion or pitting makes the tool useless for the purpose intended.

Steel manufacturers practically agree that high temperatures for high-speed steel are quite practical and proper. It is also true that the steel manufacturers are furnishing duplicate pieces of high-speed steel to replace tools ruined in hardening due to results in heating and caused by poor equipment, poor combustion, lack of knowledge regarding the operation of a good furnace and often by carelessness or inexperience, or both. It was to counteract these results that we compounded the powders referred to, and they were used for three years in commercial work before offering them for sale.

An Early Form of the Famous Caterpillar Tractor

By M. L. Lowrey

In reference to an article by W. D. Forbes, on page 273, anent the early form of caterpillar tractors, the writer remembers that in 1889 he was foreman of a small contract shop in San Francisco, Calif., where we were building a steam-traction engine that laid down feet under the driving wheels, two of these feet being at all times flat on the ground under each wheel. The system of levers operating these feet, however, was too complicated to be practical.

When this machine was nearly completed, our youngest apprentice boy brought to me a copy of the United States Agricultural Report of 1845, in which was published an account, with illustrations, of a track-laying tractor exactly like the one we were building. This tractor would be 25 years earlier than the one mentioned by Mr. Forbes.

Sidelights

EDITED BY E. C. PORTER

Estimates made by the Forest Service, based on incomplete reports received up to Feb. 26, place the lumber production of the United States for 1917 at 39,200,000,000 ft. This is a decrease of 2 per cent. compared with 1916.

* * *

Fifteen steel vessels aggregating 114,100 tons were completed and delivered in American shipyards in February for the Emergency Fleet Corporation. It is expected that in March the total number will be increased to 23 vessels of an aggregate tonnage of 188,275. Some of the ships included in the March schedule already have been completed.

* * *

Forest fires destroyed over 962,000 acres of national forest lands in 1917 and caused a loss of $1,358,600 to the Government in timber, forage and young growth, according to figures compiled by the National Forest Service. In addition to the actual loss in timber and forage the fires of last year entailed extra expenditures by the Government of $1,121,451.

* * *

For their respective first three months the American war-savings campaign is running ahead of the English campaign. America is pouring into the Treasury at the rate of about $2,000,000 a day—over $75,000,000 up to date. This amount of spending already put at the service of the Government by the buyers of war-savings securities has transferred from millions of patriotic, saving citizens to the national treasury command of the labor and materials to build a fleet of about one hundred 5000-ton ships.

* * *

An Administration bill was passed on Mar. 6 by the House, which declares that all strikes called to obstruct war industries are conspiracies and subjecting the offender to 30 years' imprisonment and fine. A move made by Representative Cannon of Illinois to prohibit all war industries' strikes was defeated by labor forces, who inserted a clause of their own specifically permitting what they termed bona-fide strikes "to raise wages or better working conditions." This amendment was approved.

* * *

The *Japan Advertiser* states that Japan's industry is greatly hampered by the scarcity of tools and that almost any price quoted is willingly paid by the users, even second-hand tools bringing large prices. High-speed drills are much needed by shipbuilders, and saws, especially circular ones, are wanted by lumbermen. Formerly many of these tools were imported from America and England, but the embargoes that have been placed on almost all kinds of iron and steel tools are said to be the cause of the scarcity.

* * *

The Council of National Defense has issued the following statement supplementary to its statement of Mar. 1, 1918, which dealt with the steps that the Government had taken to control the production, refining, distribution and use of crude and refined platinum for the period of the war: The council wishes to state that in issuing ordnance requisition No. 510 commandeering crude or raw platinum now in the hands of importers or refiners of this precious metal it is to be understood that this commandeering order does not apply to or interfere with the purchase by the consumer of any manufactured articles of platinum.

* * *

In comparison with the tax levied in England on incomes our own income taxes are moderate indeed. In England the tax on incomes of $1000 is 4½ per cent.; in America nothing. In England the tax on incomes of $1500 is 6¾ per cent.; in America nothing for married men or heads of families, and 2 per cent. on $500 for an unmarried man. In England the tax on an income of $2000 is 7⅞ per cent.; in America nothing for a married man or head of a family, and 2 per cent. on $1000 for unmarried men. The English income tax rate also increases more rapidly with the growth of the income than ours, a $3000 income being taxed 14 per cent., $5000 16 per cent., $10,000 20 per cent., and $15,000 25 per cent., while our corresponding taxes for married men are respectively two-thirds of 1 per cent., 1½ per cent., 3½ per cent. and 5 per cent., and only slightly more for the unmarried, due to the smaller amount exempted, the rate being the same.

* * *

Statisticians have estimated the present shipping capacity as follows: World's shipping capacity in 1914, 49,000,000 tons; world's shipping at end of 1917, 42,000,000 tons (according to Captain Persius, German naval writer). Other authorities estimate that the present tonnage is 4,400,000 less than at the beginning of the war and that the existing shortage is about 7,500,000. Add to this 3,000,000 tons as the minimum necessary to maintain 1,500,000 men in France. Total net loss of ships during war, to Jan. 1, 1918, 6,617,000 tons. Great Britain's shipping, Aug. 1, 1914, 16,841,919 tons. Great Britain's shipping loss, 1916, 2,225,000 tons. Great Britain's shipping loss, 1917, 5,000,000 tons. Great Britain's shipping loss, 1914 to 1917, 9,116,915 tons. Great Britain's construction and purchases, 1914 to 1917, 6,366,914 tons. Great Britain's construction, 1917, 1,163,474 tons (official). Great Britain's net loss, 1914 to 1917, 2,750,000 tons. United States ships in process of construction, Aug. 3, 1917, 2,800,000 tons. United States ships contracted under new program, 3,124,000 tons. United States construction, 1917, 901,223 tons. Great Britain-American construction combined, 1917, 2,064,697 tons. Submarine sinkings, 1917, 6,000,000 tons. Estimated American production, 1918, 3,000,000 tons. Estimated British production, 1918, 2,000,000 tons. United States merchant marine, Jan. 1, 1917, 12,250,000 tons.

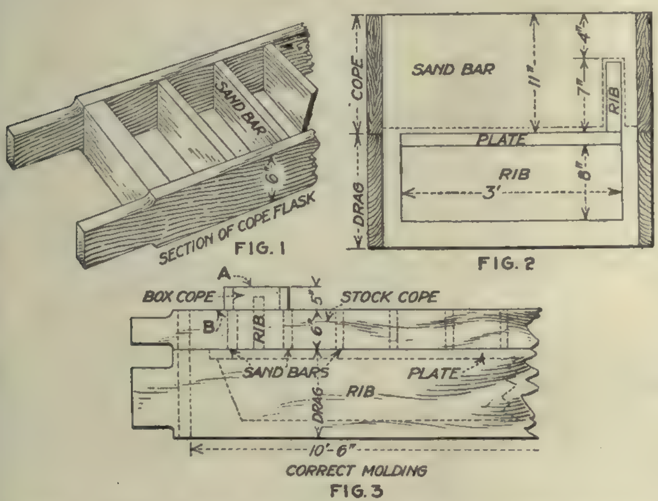
An Auxiliary Cope Flask

By M. E. Duggan

Make your pattern so that as little of it as possible will be in the "cope."

This is a rule in pattern making, but it does not answer in every case. I followed this rule in the construction of the pattern shown in Figs. 2 and 3; in doing so I made a mistake. It is hard to understand how a mistake could be made in the construction of so simple a pattern, and yet, nine out of ten patternmakers would commit a like error.

The pattern is a plate $1\frac{1}{4}$ in. thick, 3 ft. wide, 9 ft. 4 in. long. On one face at the edge is a rib running



FIGS. 1 TO 3. THE FLASK AND THE INCORRECT AND CORRECT METHODS OF MOLDING

lengthwise of the plate; on the opposite side are two ribs on the plate at right angles thereto, as shown in Figs. 2 and 3. A section of a foundry stock flask is shown in Fig. 1. The long rib I made loose on the plate to be molded in the cope; the cross-ribs I securely fastened to the plate with glue and screws to be molded in the drag. "Your method is wrong," said the boss molder. "My stock flask fitted with sandbars is 6 in. deep; two of these would be required; the sandbars would have to be cut away and rebuilt to fit around the rib, excessive sand used to handle and fill the cope, and a large and heavy cope to be lifted. This is a day's work for three molders and a loss to the foundry owner of between $7 and $8. Make the pattern with the cross-ribs loose, reverse the molding, the long rib in the drag, the cross-ribs in the cope, Fig. 3. By molding the pattern in this way, no special depth of flask is necessary, no cutting or fitting of the sandbars; less sand is used, a lighter cope to be handled, while the making of the mold and the producing of the casting is done by a man and a half" (a term used in the foundry, meaning the mold is made by one man working all day with the aid of an assistant working a half day only).

How it is possible to mold a rib that is 8 in. deep in a cope flask that is 4, 5 or 6 in. deep is not well understood by all patternmakers. It is clearly shown how this is accomplished in the side elevation in Fig. 3.

A small flask *A*, which is nothing more than a plain frame made of common lumber, temporarily fastened together for this job, is placed on the cope *B* around that part of the rib which projects through the big cope flask. In other words, it is a simple and practical way of doing a big job on a small scale.

Finishing Inside of Small Cast Handle

By E. Shaff

A problem recently brought to the writer for solution was the finishing of the inside of the loop handle shown in Fig. 1, the materials being brass and malleable iron. The strapping machine shown in the illus-

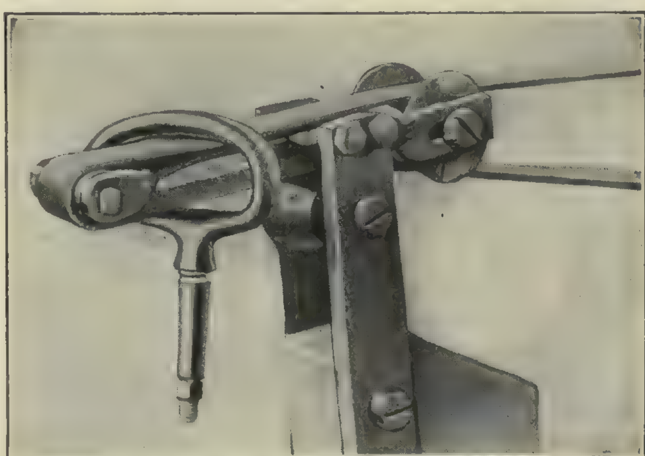


FIG. 1. THE WORK AND THE STRAPPING MACHINE

tration was made and mounted upon the end of a 2 x 6-in. plank, and could be set up and belted to any convenient pulley that would give sufficient speed. It was found necessary, however, to rough out the metal with some form of cutting tool, and after some experimenting the cutter, or rotary file, shown in the process of making in Fig. 2, was adopted.

The hob was made from 1-in. diameter tool steel,

cut with a 12-pitch double thread of the buttress form, and fluted in the usual manner.

The files were made from pieces of round cold-rolled steel ⅞ in. in diameter, with a ½-in. hole drilled through the center, the piece being formed as shown in the illustration.

A ½-in. arbor with a shoulder was clamped at an angle of about 45 deg. in the milling-machine vise, and the teeth cut by feeding the work directly to

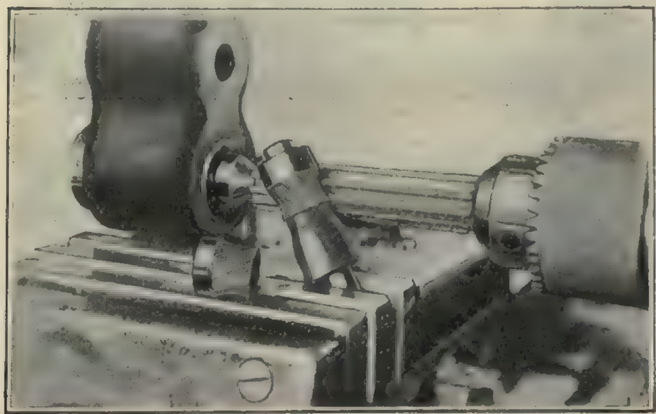


FIG. 2. CUTTING THE FILES IN THE MILLING MACHINE

the cutter, the hob causing the work to revolve from the moment of contact.

By suitable movements of the table of the milling machine the files could be made of any desired shape or length, within reason, these being made, as shown, to conform to the shape of the handle upon which they were to be used. They were pack hardened by heating about two hours with raw bone and seemed to give better results than tool steel.

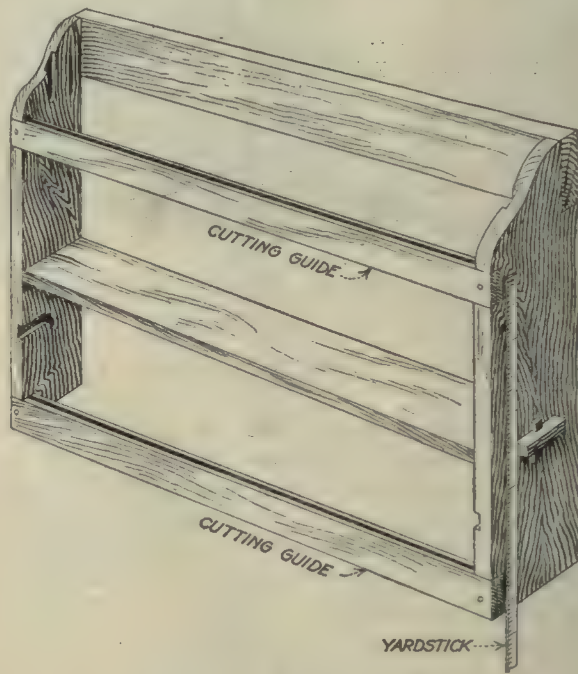
In use the files were run at speeds varying from 1000 to 4000 r.p.m., and while the higher speeds gave smoother results and faster work, the tools would not of course stand up as long, but as the process of annealing, recutting and rehardening was simple and inexpensive this did not matter.

Economical Drafting-Room Rack

By John A. Vomacka

Much detail paper and tracing cloth is wasted in every large drafting room by the draftsman who cuts off too large a piece, or by the roll becoming soiled from careless handling. This waste may be minimized by installing a rack shown in the illustration herewith; for one may assume that a man will avail himself of tools that are conveniently at hand, and will exercise judgment when cutting paper or cloth, and will not merely guess at the length in a haphazard manner.

This rack is in use in a large drafting room in New York City and has effected a considerable saving. The parts essential to the construction of this rack are two end pieces and a top piece of 1½-in. dressed stock, a shelf and two guides as shown, which may be of ½-in. material; one common yardstick and a sharp knife complete the equipment. The length of 42 in. is based upon the maximnm width of paper or cloth in common use. This dimension, however, may be changed to suit the length of the stick usually furnished with a roll of cloth or paper, or made standard by substituting a broom handle that has been cut to the correct length. The shelf is held in place by two wooden pins and performs the additional function of bracing the end pieces of the rack. The rack is fastened to the wall at any convenient place, and all that is necessary to obtain the



A DRAFTING-ROOM RACK

correct size of paper required, is to draw the paper through the guide, measure off the length desired with the yardstick and cut it along the edge of the guide with the knife. All the waste caused by handling and uneven cutting is thereby eliminated, and economy in material will unconsciously result.

Rotating Steadyrest Ring

By Edward Heller

The sketch shows a rotating steadyrest ring that is both novel and handy. The rest is intended for use on work with a flange at one end, as shown in Fig. 1, and it has the advantage of not requiring the turning of

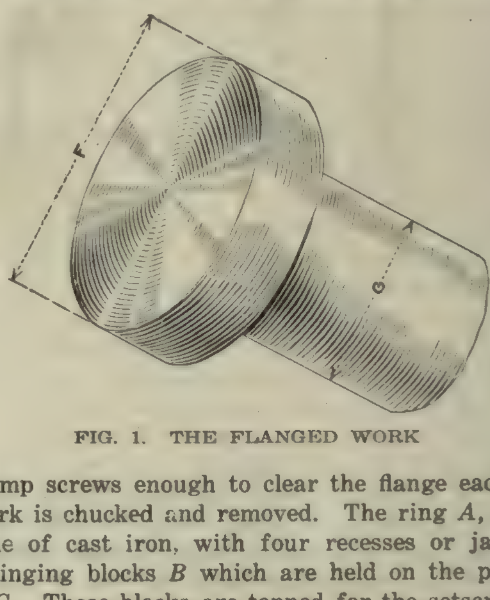


FIG. 1. THE FLANGED WORK

the clamp screws enough to clear the flange each time the work is chucked and removed. The ring *A*, Fig. 2, is made of cast iron, with four recesses or jaws for the swinging blocks *B* which are held on the pivoting studs *C*. These blocks are tapped for the setscrews *D*.

The diameter *E*, Fig. 2, is made sufficiently large to go over the work at *F*, Fig. 1, while the blocks *B*, Fig. 2, are made of a length that will clear the work at *G*, Fig. 1, when swung into position. The part *H*, Fig. 2, is finished to run smoothly in an accurately bored steadyrest.

When the ring is to be used, the blocks *B*, Fig. 2, are swung out of the way as shown at *J*. The ring is placed

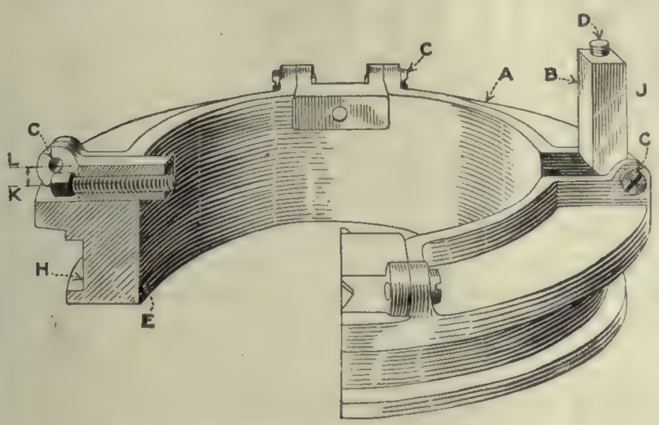


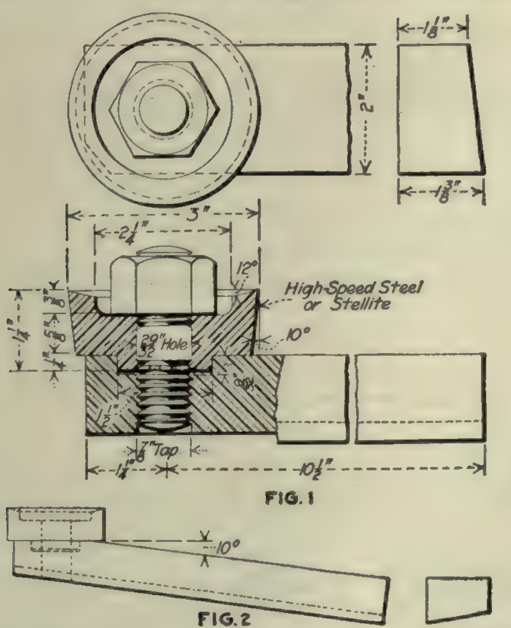
FIG. 2. THE IMPROVED STEADYREST RING

over the work and the block swung down again. The screws *D* are now tightened all around and the work is ready for truing up. Care should be taken that the center line of *D* is inside the center line of *C*, as shown at *K* and *L;* thus when the screws *D* are tightened, the blocks *B* are held in position close to the ring.

Shell-Turning Tools

By Edw. L. Robenolt

There may be seen in the accompanying sketches a tool and holder for finish-turning 8-in. shells. The tool is circular and can be made either of high-speed steel or stellite, and the holder is of machinery steel.



FIGS. 1 AND 2. TOOLS AND HOLDERS FOR 8-IN. SHELLS

The tool, Fig. 1, is made circular, so that when it becomes dull at one cutting surface it can be rotated a part of a revolution, and a new surface presented.

In the sketch, Fig. 2, is a later tool and holder which is an improvement over the one in Fig. 1, as it allows the circular tool to be made with straight sides. The radius of the cutting tool must be considered when laying out either the cam or radius arm, and the radius of the cutting tool must always be the same or it changes the profile of the shell.

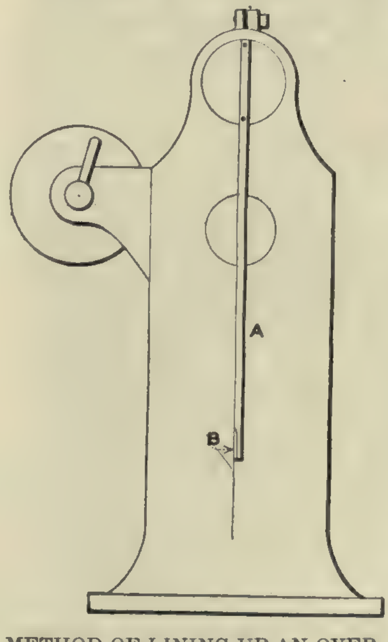
By making the sides of the cutter straight, as I have shown in Fig. 2, and only grinding on the upper surface when sharpening, this requisite is maintained.

Lining Up an Overarm Bracket Bearing

By John Miles

I recently had occasion to bore some castings 5 in. long on a milling machine, and struck an obstacle which was overcome in a manner to be herein described.

It was necessary to line up the overarm-bracket bearing dead central with main spindle of the milling machine. This could be done quite easily when the bar was not through the casting, but as the bar had to be removed to set the casting, the correct position was lost, and when the casting was in place the transverse-feed could not be moved, as the cutter would foul the casting. The difficulty was overcome in the following manner: The boring bar was ground parallel then placed between the centers of the milling machine. An indicator was clamped on the table of the machine and the table fed transversely, any variation being corrected by the shifting bracket; the overarm was then locked, the indicator being watched to see that the locking did not move the bearing center. Two holes were then drilled and tapped at the rear end of the overarm. A strip of steel *A* 1¼ x ⅛ x 3 in. was then drilled and clamped to the overarm, the side of this strip being ground to an edge for about 1 in. from the end, as at *B*. While the bar was lined up a line was scribed on the column along the edge of the strip, and I had an indicator which enabled me to line up the bar quickly and accurately. The device was used as follows: The overarm was unclamped and the bracket withdrawn enough to remove the bar. The casting was then clamped in position, the bar placed through the casting and placed between centers of the machine. All that was then necessary was to adjust the bracket until the edge of the steel strip came dead on the line on column.



METHOD OF LINING UP AN OVERARM BRACKET

Editorials

Preserving the Machinery Industry

FROM all appearances the machine industry, in common with all others, is facing changes which would have seemed revolutionary a few years ago. But we have faith that it will meet whatever changes must come with the same progressive spirit it has displayed in the past.

If we but stop and consider how revolutionary the workmen's compensation laws seemed when first proposed, and recall how quickly they were adopted, we may well be encouraged at the present prospect. It took but a short time for the attitude to change from spending time attempting to place the blame for accidents to considering the best methods of compensation. And no one would now go back to the old method.

Similarly accident prevention, sanitation of shops and group insurance have become part of the business of many shops. The reduction of labor turnover (largely by eliminating old indiscriminate methods of hiring and firing) is being carefully studied in many plants. Health insurance is finding many advocates among those who realize that absentees from any cause reduce the efficiency of the shop, and that the health of the family also has a marked bearing on the quality and quantity of work which a man turns out.

Just what changes are to come no one can say. But with the evidences of progressive thinking on the part of the leaders of the industry, we may be sure that they will receive careful consideration. Employers who show a human interest in, and are in sympathy with, their men, instead of considering them simply as "hands," will have little or no difficulty in meeting whatever new conditions may arise.

The right to an opportunity for employment and to a fair share of what their labor produces will not be denied by any right-thinking man. Neither excessively high wages nor huge profits have any place in a normal industry, for such a condition means that the few are reaping more than their share of the product. And if some are getting more than belongs to them many must be receiving less than they earn.

* * *

The changed conditions of modern industry necessitate an entirely new viewpoint in many particulars. The old shop where the owner was also a worker in the shop and a direct producer (except in rare instances) has gone by never to return. Even in a small shop of these days the owner's time is usually fully employed in handling office details, and the fellowship and understanding which come from working and sweating together are not the same factors as formerly. And when this expands into the large shop, with its directors coming to occasional meetings in limousines—the stockholders who never see the plant—the old incentive to loyalty is gone.

The problem of securing the benefits of the old-time relationship in the new kind of shop is perhaps the most vital problem which confronts us. The old shop is never coming back. And yet the old spirit of fellowship, of loyalty, of coöperation is more necessary than ever if we are to be an efficient nation. How then are we to combine the good features of the old with the new?

* * *

For years those who have thought deeply on the management problem have urged a close study of the human element. But with an abundance of labor the necessity for this was not so apparent. The demands of the war have made it more vital. The growing strength of labor all over the world is bringing the problem home, and it must be studied by all intelligent managers from the broadest viewpoints.

We must first get away from the notion that wages are the only consideration. They play a most important part, just as dividends do to the stockholder. But just as the stockholder considers safety, stability and negotiability of a stock, as well as the dividend, so the worker considers other things besides wages. He does not fancy being merely a part of the machine equipment where he is spending his life energy to help make it a success. He wants to "belong," to be a part of the shop, just as he was in the days of the two- or three-man shop. He does not want to run the shop, but he does want to be considered, and perhaps heard, when radical changes are contemplated.

We have no pet scheme or panacea. But we believe most heartily that the human element must be considered as carefully as wages; that confidence must be secured by absolutely fair treatment on a broad basis; that the human relations must not be perfunctory, but based on real human sympathy and understanding. With these as a basis the broad-minded men of the industry can go far toward working out a satisfactory solution.

The Great Need of Co-ordination and Co-operation

THE machine shops of this country are our greatest asset in winning the war, and without them the greatest armies can accomplish little; but to use them effectively there must be a thorough coördination of effort after a definite plan. The resources of the machine shops must be used to their best advantage. This cannot be done by any haphazard letting of contracts, but only by utilizing to the best possible advantage the resources we already have.

The foundation for this coördination was laid by Howard E. Coffin with the industrial inventory taken for the Council of National Defense. That it has not been utilized to its fullest extent is patent to all who have studied the question in any detail. With this inventory as a foundation, much greater production can be secured if efforts are directed in a systematic

manner from a central bureau managed by thoroughly practical men who understand the various problems of manufacturing.

It is not encouraging to see fully equipped shell plants lying idle and without contracts. Shops with equipment and help trained to make fuses are laying off men because no orders are yet ready to be placed with them. All this means a reduction of output, a disturbance in the labor conditions and a longer time before our boys can be supplied with the materials necessary to help them do their part.

Machine-tool builders are being asked to make cannon as a recognition of their ability to do good work and to get out production. In one instance two contracts of this kind have gone to a small city where each cannon shop will have to compete for labor with two shops which build the large machine tools so much needed.

One great reason for this state of affairs seems to be that each division of both army and navy is run as a separate institution and places orders with entire disregard for the needs of any other division. The Army and Navy Departments compete for machine tools and supplies of various kinds, which not only tends to raise prices but delays deliveries and prevents the coöperation which should exist.

With the Industrial Inventory Committee as a foundation, a small group of men who are well posted in regard to capacity, kind, quality and quantity of work that can be done in various shops could be of great service in directing the placing of orders in a way to avoid congestion in some localities and a lack of work in others. If for example, all inspection and gaging were classified under one head, such a committee could place orders to the best advantage of all concerned. Each shop would be asked to make only the type of gage for which it was best fitted, and could make it in sufficient quantity to insure a constant supply at a fair price. In a similar way contracts of other kinds could be placed that the work might be distributed to utilize a much greater percentage of our resources than is now being done.

Such a committee could also be of great assistance to contractors in securing the tools and fixtures necessary for the completion of their work.

Just as the great railroad terminals under direction of a federal committee are to be used for facilitating the traffic of all roads as well as the roads which built them, so such a committee could secure the more complete utilization of existing shops and all manufacturing facilities. This might well come directly under the jurisdiction of the Secretary of War, working in conjunction with the Secretary of the Navy. Such a committee's activities would lie directly in both these departments.

Some such coördination of our machine-shop capacity is necessary. Can it be secured in any other way?

Needed Readjustments

SQUARE pegs in round holes are responsible for most of our difficulties. The great need is for someone to sort the pegs that each may fit and give the best possible service.

Lack of distribution rather than shortage of coal is responsible for much untold misery and delay in all industry. Too few men in some localities and in certain lines of work has given rise to wild claims of labor shortage, while in other sections men are looking for work. Soldiers are suffering from lack of clothing while thousands of garment workers are out of employment.

The talk of labor shortage has been responsible for much of the labor difficulty. Believing that labor is scarce, men naturally refuse to take jobs at regular rates and demand war prices. Shops having cost-plus contracts, offer exceptionally high wages, steal men from other shops and cause a general feeling of unrest in many localities. A few hours away, shops of various kinds may be laying off men, while munition plants are even closing some departments.

All this tends to keep labor conditions unsettled and men discontented. They naturally seek the highest wage and shortest hours. And as long as the Government permits the stealing of men from shops engaged on work equally important with that of others, the situation will not materially improve.

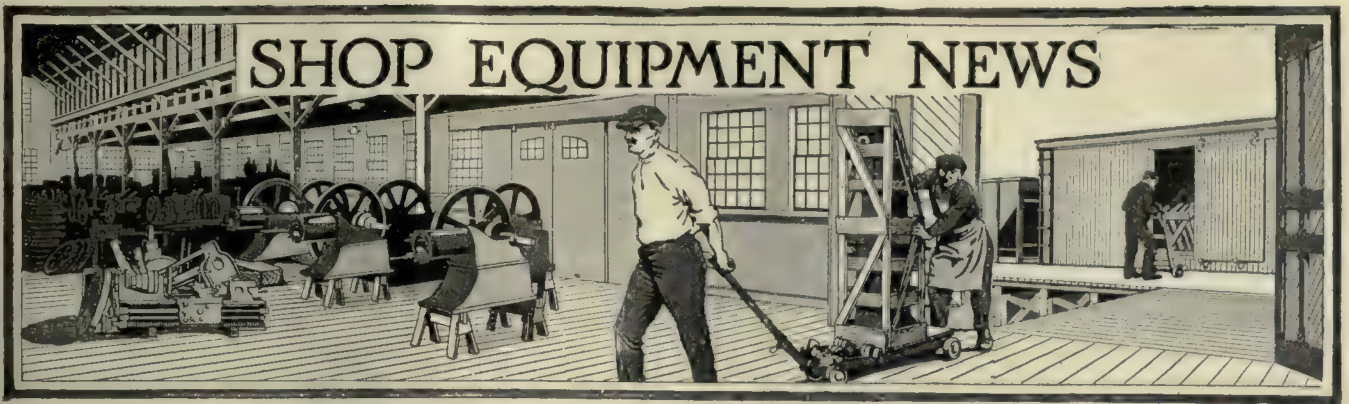
The new United States Employment Service should help to relieve this situation when it gets into good running order. It should provide clearing houses in the shape of federal employment bureaus in every center where labor is employed. This cannot be done at once, and in the meantime we should all assist to adjust the matter in every way possible. Anything we can do to maintain the working force of all our shops with a minimum labor turnover aids in the solution of the problem of production.

Speculating in Soldiers' Lives

WHEN the Government, through the Ordnance Department, requested us to let the machine-building industry of the country know its urgent need for heavy machine tools with which to make heavy guns for our boys in France, we had faith that this appeal would be heeded. This faith we are glad to say has been justified to a considerable extent. Numerous firms have come forward with offers of the machines needed, and these firms offer them at fair prices.

There have, however, been a few cases where the desire for profits overcame the patriotic desire to help the country and to assist in supplying our boys in France with the heavy guns they will soon need. A few dealers, with more desire for profit than for service, have endeavored to sell the Government some of the machines needed at from two to three times the price of a new machine. In some cases speculators in soldiers' lives have offered the same machine, which none of them owned, but which each hoped to sell at a fat profit.

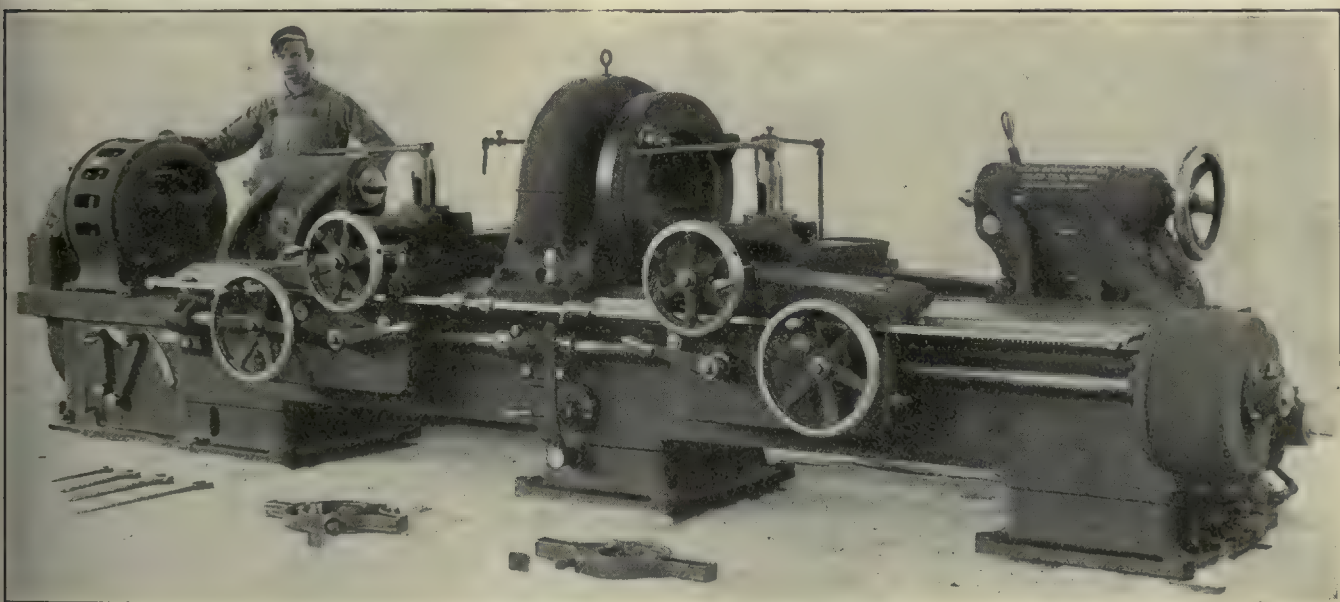
For the benefit of those whose scruples are not used often enough to be in good working order, we are pleased to announce that the Machine Tool Section of the War Industries Board has a very fair list of all the large machine tools in this country, and this list is fast becoming complete. It is already in such shape as readily to check up machine-tool speculators who try to get exorbitant prices on machines which they have never seen. It is needless to say that dealers of this kind are not likely to be classed among the essential industries when the count comes to be taken, as it may be if present practice continues. Those who are willing to speculate on soldiers' lives are not likely to stand very highly in Government circles.



This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Niles-Bement-Pond No. 3 Axle Lathe

The center-driven axle lathe illustrated is for work in machining axles and is one of the late products of the Niles-Bement-Pond Co., 111 Broadway, New York City. It is known as the No. 3 axle lathe. The bed is of box construction, the carriage sliding on a V-way in front and a flat way at the back. The V-way has a 15-deg. angle at the back and a 70-deg. angle at the front. The advantage claimed for this construction is that the V presents a thrust surface which is at right angles to the combined forces on the tools, this feature eliminating the tendency for the carriage to climb under heavy cuts. The center driving head is adjustable along the bed, and incloses the main driving gear which dips into a bath of oil. The drive is through steel gears of the herringbone type. The axle is driven by an equalizing driving plate having integral cast lugs which engage both ends of the double dog. By means of this driving plate crooked or irregular axles can be machined without setting up bending stresses. Two carriages are provided, the feeds being by means of a right- and left-hand screw positively driven by gearing. The split nuts engaging the lead screw are provided with automatic opening devices which release them when the carriages come in contact with set collars on the tappet rod at the front of the machine. Two clamps are provided for each carriage, one of these for holding the carriage while turning shoulders or facing ends, and the other is placed under the bridge to decrease the tendency of the carriage to lift during burnishing operations. Carriages are fitted with wipers. Lubrication of the tools is secured through a system including pump, jet pipes, reservoir, collecting channels, etc. Aprons are of the double-wall construction, all mechanism except the operating levers being completely inclosed. All shafts are supported at both ends. Three feeds are provided, the operating lever being placed at the center of the machine. The carriages have end traverse on the bed and the tool slides have hand cross-feed. The axle is carried on two dead centers mounted in adjustable tailstocks. These tailstocks are locked by anchor bolts, but to



NILES-BEMENT-POND NO. 3 AXLE LATHE

Swing over bed shears, $30\frac{1}{2}$ in.; swing over tool slide, 13 in.; diameter of hole in driving head, 13 in.; maximum distance between centers, 9 ft. 3 in.; length of bed, 14 ft.; width of bed at shears, $27\frac{1}{2}$ in.; depth of bed over shears, $19\frac{5}{8}$ in.; diameter of tailstock spindles, 5 in.; traverse of right spindle, 9 in.; bearing of carriages on bed, 30 in.; width of bridge, 12 in.; size of tools, $1\frac{1}{4}$ x $2\frac{1}{2}$ in.; feeds, three, $\frac{1}{16}$, $\frac{3}{32}$ and $\frac{3}{16}$ in. per revolution of driving head; floor space, from 4 ft. by 17 ft. 2 in. to 4 ft. 8 in. by 19 ft. 1 in., depending on type of drive used.

positively prevent slipping a pawl is provided, which engages a rack cast in the bed. The tailstocks have taper gibs at the back and front of the bed, which permits alignment of the spindles. The spindle of the right tailstock is adjustable by means of a handwheel.

The machine can be furnished for cone- or single-pulley drive or with constant or adjustable-speed motors. With cone-pulley drive a three-step cone is provided, the maximum diameter being 32 in., a 7-in. belt being used. A two-speed countershaft is provided, giving six speeds from 16 to 48 r.p.m.,

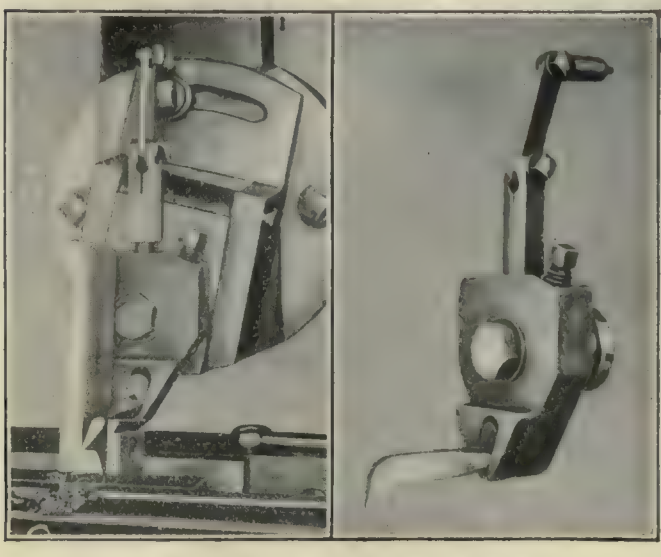
With the single-pulley drive a speed box is provided, which gives four speeds from 16 to 48 r.p.m. The speed-box gears are of steel, run in oil, and all bearings are automatically lubricated. A friction clutch and brake are provided.

With the constant-speed motor drive the motor is mounted on a speed box giving four speeds.

With the adjustable-speed motor drive a motor of the three-to-one-speed variation is mounted on a baseplate attached to the end of the bed. The motor is geared directly to the driving shaft and gives the same approximate speeds as the other types of drive. A crane for handling axles in and out of the lathe can be furnished as an extra.

Bruno Slotting Attachment for Shaping and Planing Machines

The Bruno Manufacturing Co., 61 Terrace, Buffalo, N. Y., is now marketing the slotting attachment, shown in the illustration, for shaping and planing machines. The tool is bolted to the clapper in place of the toolpost, allowing the use of a very short, stiff cutting tool, as no projecting toolpost is in the way to necessitate the use



BRUNO SLOTTING ATTACHMENT

of a long, slender tool. An adjustable friction arm is provided, which rides on the head slide, and is claimed to prevent vibration of the tool when in operation. The device can be turned in any position to make it convenient for the style or type of work that is being done. The device is made in three sizes: No. 0, taking tools with shanks from $\frac{3}{8}$ to $\frac{1}{2}$ in. in diameter; No. 1, taking tools with shanks from $\frac{1}{2}$ to $\frac{5}{8}$ in. in diameter; and No. 2, taking tools from $\frac{5}{8}$ to $\frac{3}{4}$ in. in diameter.

"Loway" Adjustable Stock Support

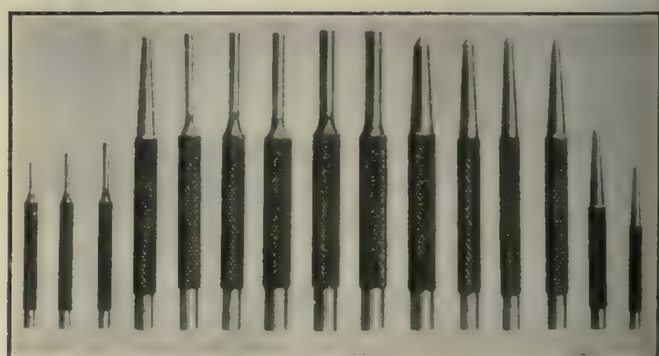
The illustration shows an adjustable stock support that has just been placed on the market by the A. F. Way Co., Inc., Hartford, Conn. The support is intended for use with hacksaws, screw machines, band and circular sawing machines, bolt cutters, thread-milling machines, pipe-threading machines, rolling mills, etc.,

"LOWAY" ADJUSTABLE STOCK SUPPORT

wherever long bar stock, pipe, tubing or other material must be supported. The device is equipped with a base of ample size so that it will not upset, and may be quickly adjusted for height by means of the column screw.

West Haven "O. K." Punches

The West Haven Manufacturing Co., New Haven, Conn., is now marketing a set of "O.K." brand punches, as illustrated, which are being put out in a convenient wood-base case having compartments for each tool. The set contains an assortment of five different sized center



NO. 15 SET OF "O. K." BRAND PUNCHES

punches, eight different sized punches for driving out pins and rivets, one solid drive punch for starting a rivet or pin that starts hard, and one prick punch intended for punching holes through thin metal. Total number of tools in the set, which is known as the com-

pany's No. 15, is 15, the largest measuring $\frac{3}{8}$ x 4 in. and the smallest $\frac{3}{16}$ x $2\frac{1}{4}$ in. The punches for driving out pins and rivets vary in size from $\frac{1}{16}$ to $\frac{1}{4}$ in. The set has been placed on the market with the intention of enabling a person to buy an assortment of punches suitable for general everyday work.

Fleming Combination-Lathe, Boring and Milling Machine

The rather unique machine shown in the illustration is the product of George W. Fleming Co., 12 Broad St., Springfield, Mass. It combines the facilities of a 16-in. engine lathe, a plain milling machine and a horizontal boring mill with the additional feature of a gap lathe. Each unit is as complete and as distinct as the same individual machines and gives the same ranges and capacity. When in use it is claimed that it can be operated as readily as any of the three separate and distinct machines. The base which carries the sliding bed is ribbed and supports the sliding member rigidly. The milling-machine table acts as a support for the sliding bed when this is closed. The lathe carriage is made with a bridge on the end toward the headstock and extends out over the face of the apron to permit of the compound rest being used up to the full swing of 25 in. for work in the gap. Four-step cone pulleys are used on the headstock, which is single back geared. The spindle is hollow and the spindle bearings are adjustable both laterally and radially. The milling-machine table, saddle and knee are scraped to fit the surfaces on which they move, and the table is elevated on the face of the column by means of helical gears and a screw. The crank for operating these is located on the face of the column convenient to the operator. The standard machine is equipped with a hand feed for the milling-machine table. The horizontal boring machine is of the platen and table type, the boring bar being $1\frac{1}{2}$ in. in diameter and provided with power feed, deriving its power from the lathe change gears. If desired, power longitudinal feed for the milling table and taper attachment may be furnished as extras.

Fig. 1 shows the machine ready for use as an ordinary lathe, with the steadyrest mounted in place, while Fig. 2 shows the machine with the lathe bed moved to the right and a boring bar in place in the spindle. The construction of the table for boring and milling work is also shown in Fig. 2.

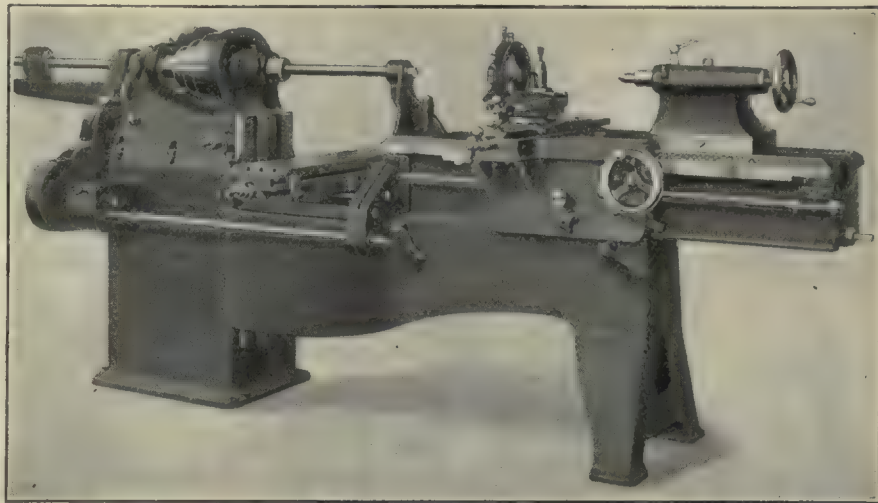


FIG. 2. THE MACHINE WITH LATHE BED OPEN, SHOWING BORING AND MILLING POSSIBILITIES

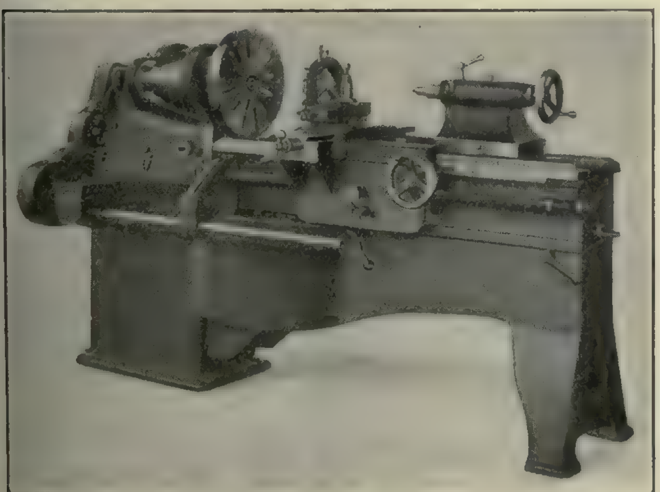
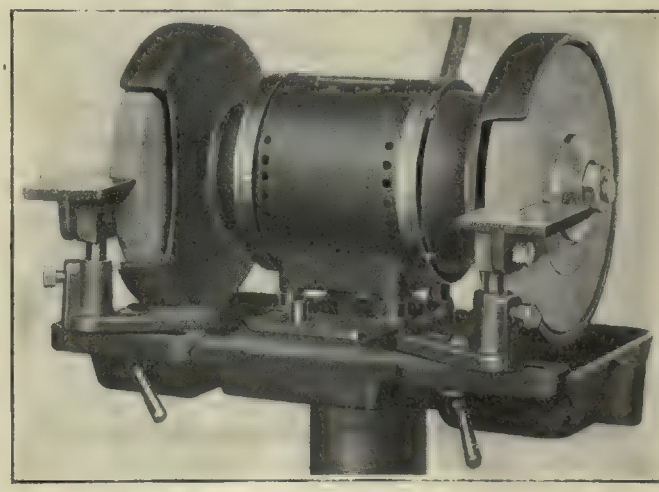


FIG. 1. THE MACHINE IN USE AS A LATHE

Length overall with bed closed, $83\frac{1}{2}$ in.; length overall with bed open, 104 in.; lathe takes between centers with bed closed, 36 in., with bed open, $57\frac{1}{2}$ in.; swing of lathe over ways, $17\frac{1}{4}$ in.; swing of lathe in gap, 32 in.; turning capacity in gap, 25 in.; swing of lathe over carriage, 9 in.; longitudinal feed of milling-machine table, 20 in.; vertical feed of milling-machine table, 15 in.; cross-feed of milling-machine table, $7\frac{1}{2}$ in.; dimensions of milling-machine table, $32\frac{3}{4}$ x 8 in.; taper in lathe spindle, Morse No. 4; taper in milling spindle, No. 12 B. & S.; diameters of cone pulley, 4, 6, 8 and 10 in.; front spindle bearing, $2\frac{1}{4}$ x $4\frac{5}{8}$ in.; rear spindle bearing, $2\frac{1}{4}$ x $3\frac{1}{4}$ in.; hole through spindle, $1\frac{1}{8}$ in.; weight, 3200 lb.

Universal Electric Grinding Stand

The illustration shows an electric grinding stand which is now being manufactured by the Universal Electric Co., 9 Oliver St., Newark, N. J. The machine



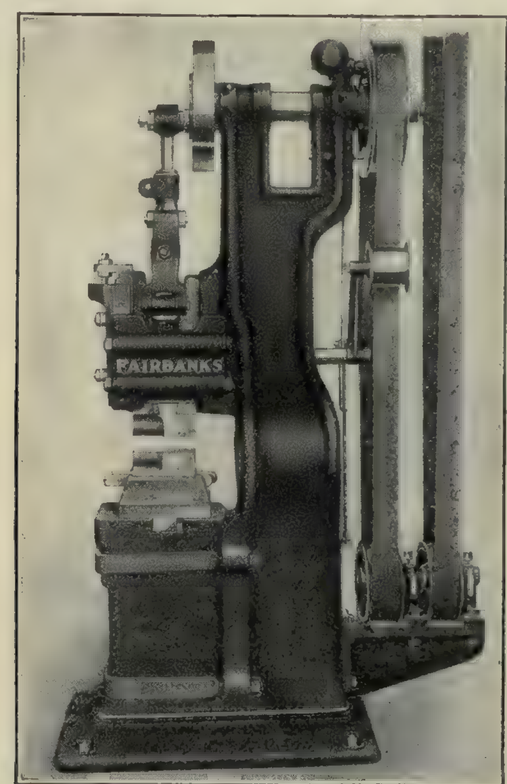
UNIVERSAL ELECTRIC GRINDING STAND

is built in both bench and floor types and is equipped with a steel shaft running in SKF ball bearings. Two 8 x 1-in. wheels are used, which are covered with ad-

justable guards held by friction produced by spring washers. This enables the operator to turn the guards completely around without the necessity of loosening screws. The tool rests are adjustable in all directions. The motor is mounted on a baseplate with depressions under each wheel for cooling water. The motor is stopped or started by means of a two-pole, push-button, knife switch which may be placed in any convenient position. The motors are wound for direct current or for two- or three-phase alternating current as desired.

"Fairbanks" Power Hammers with New Gib and Faceplate

The "Fairbanks" power hammers manufactured by the United Hammer Co., Oliver Building, Boston, Mass., are now being fitted with a new-type, adjustable, bronze

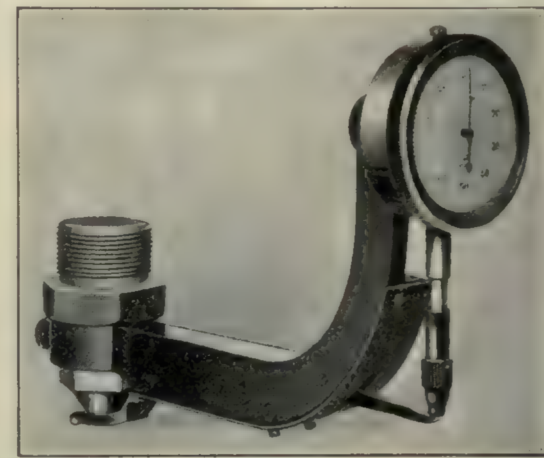


"FAIRBANKS" HAMMER SHOWING THE NEW GIB AND FACEPLATE

taper gib and faceplate, as shown in the illustration. It is claimed that this new form of gib takes up any wear in the ram guides quickly and accurately and makes possible a much finer ram adjustment than heretofore. The new gib and faceplate have been so designed that they may be readily applied to any of the "Fairbanks" hammers now in use.

Pittsburg Attachment for Measuring Depth of Brinell Impressions

The Pittsburg Instrument and Machine Co., 111 Water St., Pittsburgh, Penn., has recently placed on the market a new attachment for determining the depth of impressions made by the Brinell machine in testing materials. It is claimed that the depth of impression can be measured with considerably more accuracy than the diameter of the impression. This machine, it is claimed, permits the determination of depth readings to 0.01 mm., one complete revolution of the hand of the dial indicator representing a depth of impression of



ATTACHMENT FOR MEASURING THE DEPTH OF BRINELL IMPRESSIONS

1 mm. As indicated in the illustration this device is so arranged that it may be quickly attached to the Brinell instrument manufactured by this company.

Cowan Improved Type H Transveyor with Hydraulic Lift

The illustration shows the Type H transveyor, on which a number of improvements have recently been made by the Cowan Truck Co., Holyoke, Mass. This truck is for heavy-duty service, carrying loads up to

COWAN IMPROVED TYPE H TRANSVEYOR

5000 lb. The platform may be elevated 3 in. by means of a hydraulic ram which is operated by a few strokes of the handle. Lowering the truck is accomplished by means of a foot pedal which releases the pressure on the ram, allowing the platform to return to its lowered position without shock. The machine is built in six sizes and is mounted upon three metal wheels 10 in. in diameter.

Commendable Co-operation of Fuse Makers

THE fuse-making contractors of the country have formed the American Fuse Manufacturers' Association for the purpose of securing complete coöperation. The address of George T. Trundle, Jr., chief engineer of the American Multigraph Co., Cleveland, Ohio, which is here given, points out the aim of the association and the good which it can accomplish.

"We are called together today to authorize the taking of a step that marks an important move both to ourselves and our Government. We are to fuse together the various divisions and departments into which our work is divided, with the sole purpose of bringing out of it a firmly welded organization made up of perfectly interworking units.

What the War Has Taught

"The war has taught us all the benefits that grow out of organization. We have come to learn that coöperation means more than competition. We can no longer afford to stand aside and watch the other fellow stumble along with problems that we have encountered and mastered. It is now the duty and obligation of each of us to link arms with the next fellow, and so help him, while he on the other hand stands ready to help us.

"Especially so is this reason paramount at this particular moment. We have now a motive that we never had before. Every factory that is represented here today has some function to perform in the winning of the war. Together we represent the most powerful factor in our country's defense. We must never forget that.

"It will never do for some of us to forge ahead while others lag behind or simply mark time. I do not say that this condition exists; but because it does not is no guarantee that it never will. We are but on the threshold of this work, and no one knows what the future holds for us. But of this we can be sure: if we meet it with a solid, well-formed front; if we are completely organized and ready to act and think as one man, then we can be assured that difficulties will diminish in direct ratio to our combined power.

Reasons for Organization

"The reasons for such an organization as we are about to form are twofold. First and foremost is the necessity for one central bureau through which the Government can communicate its wishes and regulations. As things stand much time is lost in instructing us one at a time what should be done and how to do it. With a central bureau there would be no lost motion and our response as a body would be considerably more rapid and forceful.

"On the other hand such a move will mean much to ourselves. Daily problems come up for solution; often the same problems appear in different plants. If through a clearing house we could only be exchanging information we might save each other much mental anxiety and considerable time, money and effort.

"It would also be advisable to meet at least every two weeks. These meetings should be held in different cities, at the end of which should be a trip through the plants of our members there. I know that every time I go through one of your plants I get suggestions that save me no end of worry. I know that were I to have you in the Multigraph plant for an hour or so I could open your eyes, and your suggestions and advice would open mine on many things too.

"I am for this big idea. I see nothing but good as a result of it. We could have a resident secretary right here at the center of things, and with regular weekly bulletins circulated from that bureau, and with first-hand information on matters that the Government wants communicated to us, the whole industry would receive an impetus that could be obtained in no other way.

"I foresee growing out of such an organization much that will be of benefit to us when peace comes. Although founded solely for a war-time purpose it is conceivable that the benefits will be so apparent that we shall want to continue the arrangement. I can see where information on the great problem of labor can be interchanged; I can see where various engineering matters can be proved or disproved through our work; I can see where our benefits can even extend into the realm of our companies' sales work.

Problems of Sales Managers

"Those of you who are in touch with sales-department work know how seriously your sales managers are considering after-war conditions in their departments. It is not inconceivable that an association such as we propose forming today can be of great assistance to sales departments in this connection.

"I do not purpose monopolizing your time. I merely wanted to plant the seed and say to you all that the American Multigraph Co. is thoroughly and enthusiastically for this coöperation. I know that from the few suggestions I have made each of you can draw a story that is bound to throw more light on the subject.

"With this end in view I suggest that we enter into a general discussion of the subject. If you are for the idea get up and say so, and tell why. If you disfavor it, by all means let us hear your side; frankness is essential. Remember, you will hurt nobody's feelings. We are all earnestly seeking a way. The suggested program includes, besides the election of officers, the following subjects for discussion: Machining and operations; production; raw material; gages; inspection; coöperation; labor: its pay, scarcity, satisfaction, welfare and meetings."

The spirit of the members of this organization is highly commendable, and should have a beneficial effect after the war as well as at present. The success which has attended the German armies has been due to organization and coöperation not only of the military but of the manufacturing industries of the German empire. Such organization cannot be met except by complete coöperation, by abandoning many old ideas as to the benefits of competition, and by uniting all our resources into one great unit whose foremost object is the winning of the war.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., March 30, 1918—It is evident that whatever may be the ethical and financial shortcomings of the Hog Island shipyard the mechanical end is certainly making great progress. Leaving out of the question the advisability of establishing a yard at this place or of building such a huge yard at any one point the job presented to the engineers was a gigantic task and is being carried out in a most commendable manner.

Without going into details of the yard, because this is not the place for them, I may state that there are virtually ten shipyards, each consisting of five ways—fifty ways in all—and two of them already with a beginning of what will be the most radical departure in shipbuilding that this country has ever seen, for the method of building rather than the great size is the most remarkable part of the whole scheme.

The plan briefly is to build ships just as we do any other kind of structural-steel work by having all the plates cut to size and punched in the mills, shipped to the yards and assembled into real, honest-to-goodness ships. Men who never saw a ship in the water are cutting plates to size, punching the holes to dimensions from a blueprint, and, in the case of the curved plates around the bow and stern, bending these plates in huge dies just as they would for a body for an automobile.

It is too early to say how this is to work out, as no ships have been completed. But if the beginning is any indication of the finish there should be very little trouble in getting the plan into operation.

To begin with, the ships are designed for ease of manufacture, because this is strictly a manufacturing proposition, buying the parts all over the country and assembling them into a complete whole. It may be likened to the assembled-automobile proposition except for the difference in size and number of pieces. The first 50 ships are to be 400 ft. long, 50-ft. beam; the next 70 are to be 440 ft. long.

Just to indicate how this is working out—how the plates are coming from the different shops—I recently walked over the bottom, or lower skin, of the first ship, which was only partly riveted. One plate came from a mill in Canada and the next from a mill in the Middle West; yet there was no trouble whatever about their going together. The spacing was very close and the holes matched so well that not over 25 per cent. of them required reaming. It was not precision work, for this is not necessary any more than in other shipbuilding. Nor is it necessary to ream all holes, as in boiler sheets, on account of the deterioration of the metal surrounding the punched hole. The plates went together just as good structural work always goes together, and that is all that is necessary.

The question of shipbuilders is still to be solved, although a good beginning has been made. The men are now being taught right on the job, this being much better than in the schools which were used before the first ship was laid down. The preliminary teaching, which may be compared to the groundwork of aviation training, can of course be taught in the schools.

Most of the men now on the job are working for the construction contractors, and these men number many thousands. As fast as the ways are finished these men are replaced by others who can work on the ships themselves. How many of the present force can be made into shipbuilders is a problem, and opinions differ. The more that can be utilized the less turnover there will be and the less shifting from one town to another. The Industrial Relations Department has a large-sized job on its hand for the next few months.

Labor for the Shipyard

The newspapers have been full of accounts of a drive for shipyard labor and, in the language of the Liberty Loan campaigners, have in some cases announced the so-called labor loan as being oversubscribed. This is a very misleading statement, and one that requires considerable explanation if we are to understand the real facts. To begin with it is almost safe to say that none of the shipyards in the East are having any difficulty whatever in securing sufficient labor except for some of the more skilled branches of the work. From all accounts every shipyard is turning men away every day, and it is only in the case of men for special work that there has been any particular difficulty.

The great trouble with the so-called enrollment is that it means very little after it has been made. The enrollment card contained a patriotic appeal that is well calculated to secure men's signatures, and there is also a place for a man's occupation. There is, however, no means of knowing how large a percentage of these signers are already engaged in munition or other absolutely necessary work, or whether they are what they claim to be. In a number of cases that have been followed up the signers are the habitual hangers-on of the various employment agencies, who never keep a job more than three days, and in no single instance investigated were the men what they claimed to be.

One of the great difficulties with the whole shipyard situation, and this also applies to many manufacturing plants, is that the management has no adequate con-

ception of what it means to hire the right kind of men. In a great many cases the hiring of men is still looked upon as a clerical job that can be handled by a $15-a-week clerk, and the men at the top have no conception of the necessity for a high-grade employment manager. This is one of the disheartening features of the whole proposition.

Even assuming that all of the 250,000 men who are said to be enrolled were perfectly reliable it would take a long weeding-out process to select the proper men for the different localities. It is necessary to avoid taking men from places where they can be of more value than in the new work; to avoid unnecessary transportation from one point to another, and in fact to avoid disturbing business conditions and creating more harm than good.

The rational solution seems to be the proper use of the United States Employment Service, which is being established in the various centers, and, in places where this is not yet in complete operation, the utilization of the agencies already in existence. In the state of New York there are well-equipped state employment agencies in a number of cities, and these should be made use of to their fullest extent. Where this cannot be done the United States service should be speedily established, as some competent selective system is absolutely necessary to prevent extensive disturbances and delays.

Stevens Institute as Navy Steam-Engineering Training School

The Navy Department, after consultation with President Humphreys, has designated the Stevens Institute of Technology, Hoboken, N. J., as the headquarters for the new United States Naval Steam Engineering School for the training of engineer officers for the United States Naval Auxiliary Reserve.

This school is the only one devoted to training engineer officers for steam-engine service, and is a branch of the large training school now located at Pelham Bay Park, New York. There is at Pelham, in addition to the school for general training of enlisted men, an officers' material school, Naval Auxiliary Reserve. Both the school at Pelham and the engineer officer school at Stevens are under the supervision of the supervisors of the Naval Auxiliary Reserve. The education of the engineer officers at Stevens is directed by Prof. F. L. Pryor of Stevens, who has been appointed by the Navy Department, with the approval of President Humphreys, civilian director.

Division of Time

It is contemplated to make a five-month course for the training of an officer, one month to be devoted to military and ship duties training at Pelham; one month at Stevens to receive the preliminary requirements and duties of an engineer; one month in inspection and repair duties at local shipyards, machine shops and boiler shops; one month at sea in the engine room of different types of boats, and one month subsequent training and examination at Stevens. It is expected to have about one hundred men in each of these divisions, or five hundred in all.

Three of the divisions will be quartered in barracks now in the course of construction on the college grounds at the corner of Sixth and Hudson Sts., adjoining the Carnegie Laboratory of Engineering. The school divisions will attend classes in the lecture rooms of the college and will take their meals at the college mess hall at Castle Stevens.

The instructors of the school, with the exception of the civilian director, will be regularly appointed commissioned officers of the United States Naval Auxiliary Reserve and will be selected particularly for their special work.

Quotas are furnished for this school by the various naval districts throughout the country as outlined by the Navy Department, and are required to meet the following qualifications: (a) Men of ability and officer material; (b) age 21 to 30 inclusive; (c) completed high-school course and graduate of engineering course at a recognized technical school or an equivalent of the above; (d) must be regular navy, N. N. V., or N. R. F. (any class for general service; (e) physically qualified for line officer, standard of regular navy.

Enrollment

Men may be newly enrolled specifically for this course by applying to their naval district enrolling officer and then be transferred by the commandant of that district to the school in his weekly quota.

That the students will be required to perform hard work is evidenced by the routine of duty which has been posted as follows: A.M.—6, reveille; 6: 15, assembly; 7, breakfast formation; 7: 15, breakfast; 8: 15, study call; 9: 45, retreat; 10, study call; 11: 30, retreat. P.M.—12: 15, dinner formation; 12: 30, dinner 1: 15, study call; 2: 45, retreat; 3, study call; 4: 15, retreat; 4: 30, drill; 5: 30, retreat; 6, supper formation; 6: 15, supper; 7, study call; 9: 30, retreat; 10, taps.

The first course will probably start on Mar. 25 and the second course about Apr. 22. When the barracks are completed a unit of 25 men will be enrolled each week, and after the school is in full operation about one hundred engineer officers will be graduated each month. The rank of the successful students will be that of ensign. The unsuccessful students will be given appropriate ratings by the supervisor of the Naval Auxiliary Reserve and transferred to Pelham Park for general detail.

Use of Mirrors in Irregular Places

By D. E. Mapes

The use of mirrors on cranes, as described by Mr. Lailer on page 732, Vol. 47, brings to my mind a novel use of a small mirror around the milling machine.

Our milling machine is not equipped with a vertical milling attachment, so when milling a cam or other piece of work with an end mill, with the dividing head facing the column of the milling machine, it is difficult to follow the line, as the work is usually very close to the column.

By holding a small mirror at the proper angle one can look directly at the work line and follow it by means of the dividing head crank and longitudinal feed. I have found this method a great convenience but have never seen any one else use a mirror in this way in the machine shop.

Personals

Charles T. Mason has been appointed assistant general superintendent of the Joliet works of the Illinois Steel Co.

G. G Bushby of Vancouver, B. C., Canada, has been elected president of the British Columbia Manufacturers' Association.

R. T. Scott has been made Eastern manager of the Independent Pneumatic Tool Co. of Chicago, with headquarters at 170 Broadway, New York City.

H. F. Roberts, for 10 years secretary of the E. L. Essley Machinery Co., Chicago, has resigned to become associated with the Marshall, Huschart Machinery Co., Chicago.

J. S. Gillespie, formerly shop superintendent of the National Forge and Tool Co., Erie, Penn., is now president of the American Hollow Boring Co. of the same city.

Walter D. Munroe, formerly with the city sales force of the Jos. T. Ryerson & Sons Co., Chicago, Ill., has been made manager of the Pittsburgh office in the Oliver Building.

Charles E. Mullen, until recently sales manager of the Hays Manufacturing Co. of Erie, Penn., is now secretary and treasurer of the American Hollow Boring Co., Erie, Penn.

Arthur J. Simonds has resigned as superintendent of the Noble & Westbrook Manufacturing Co., Hartford, Conn., to enlist in the United States Naval Reserve as a machinist's mate, first class.

Fred C. Avery, vice president and general manager of the Long & Allstatter Co., Hamilton, Ohio, has been elected vice president and director of the Manufacturers' Association of Hamilton.

P. Leibrandt Weimer, assistant manager of the Weimer Machine Works, Lebanon, Penn., will soon leave for Washington to enter the Ordnance Department as a civilian inspector of cannon.

E. M. Kilby, vice president of the Kilby Frog and Switch Co., Birmingham, Ala., has been elected president of the National Steel Products Co., which has planned the establishing of a plant in Birmingham.

A. H. Willey, for a long time connected with Boker & Co., Inc., of New York, has joined the selling force of the Reliance Steel and Tool Co., of New York City, and will handle the Pennsylvania territory, with headquarters in Philadelphia.

F. E. Munschauer is now treasurer and **W. F. Schweigert** secretary of the Niagara Machine and Tool Works, manufacturers of machines and tools for sheet-metal work, Buffalo, N. Y. Both of them have been connected with this company for a number of years.

Obituary

Richard Ward Baker, aged 68 years, superintendent of outside construction of the Watson-Stillman Co., New York, died Mar. 24 at his home at Roselle, N. J. He spent his entire business life in the services of the Watson-Stillman Co., having entered its employ at the age of 14, finally becoming superintendent, which post he held for many years. Upon the completion of 50 years of service, in 1914, the board of directors of the Watson-Stillman Co. celebrated the event by presenting him with a substantial check and engrossed copy of the resolution setting forth the company's appreciation of him. His death was due to apoplexy.

Business Items

The Hyatt Roller Bearing Co. of Newark, N. J., has moved its industrial-bearing division to the Metropolitan Building, New York City, where all communications should be addressed.

Frank H. Seely, Jr., Co., is the successor to the Pennsylvania Supply and Equipment Co., of 421 Widner Building, Philadelphia, Penn. This change in the firm name took place Apr. 1, 1918.

The American Hollow Boring Co., Erie, Penn., was recently incorporated to conduct a manufacturing business for furnishing hollow-bored forgings. Its plant is nearing completion and it is expected to be running about Apr. 15.

Trade Catalogs

Elevating Shop Truck—Hennessy Manufacturing Co., Northampton, Mass. Circular illustrating and describing a new truck made by this company, which they call the "Sturdi-Truck."

Wells Self-Opening Die—Greenfield Tap and Die Corporation, Greenfield, Mass. Booklet. Pp. 24; 6 x 9 in.; illustrated. Describes fully the operation of the die and shows the use of same on various machines.

"Perfect Riveting"—The title of a new catalog issued by the Grant Manufacturing & Machine Co., 85 Silliman Ave., Bridgeport, Conn.; illustrates and describes the Grant noiseless rivet spinning machines, rotary vibrating riveters and pneumatic riveters. Pp. 46; 3½ x 6 in.

New Publications

Fundamentals of Cost and Profit Calculation—By Robert S. Denham. One hundred eighteen 5 x 7½-in. pages. Published by the Cost Engineer Publishing Co., Cleveland, Ohio. Price $1.00.

Unusually clear and concise is this little book, which is not too long for a busy man to read and digest. The statements are made in an understandable way and definite rules or statements are put in italics so as to stand out from the rest of the text. Altogether it is well worth reading. The chapters are: The Philosophy of Cost and Profit, Direct Expenses, Indirect Expenses, Economic Expenses, Determining Costs, Selling Prices and Profits, Making Cost and Profit Statements and the Terminology of Cost Engineering. There is also an index of terminology and a general index.

Learning to Fly in the U. S. Army—By E. N. Fales, 180 pages, 4½ x 7 in. McGraw-Hill Book Co., New York, publishers. Price, $1.50, net.

This book is of convenient size for carrying and studying, and gives a foundation for the ground work of aviation students. It begins with the history of aviation, takes up the types of military airplanes and their uses, the principles of flight, the flying of the airplane, cross-country flying, the rigging of machines and the nomenclature used in that connection, the materials used in their construction, the erection of the machines, truing up the fuselage, the handling of airplanes in the field and at the air bases, both previous to flying and after returning to the field, and ends with a chapter on the inspection of the airplane.

There are numerous illustrations, many of these being diagrammatic to show the action of airplanes in flight, the action of the various controlling surfaces and other information of great importance to the student. It is very conveniently arranged and is attractively printed.

Applied Motion Study—By Frank B. and Lillian M. Gilbreth. Two hundred and twenty pages, 5 x 8 in. Published by Sturgis & Walton Co., New York. Price, $1.40, net.

This book aims to present an outline of the fields in which motion study has been and can be applied, the way in which it is applied and the effect of the application after it is made. It shows the way by which waste can be eliminated in actual practice, shows past saving and future possibilities. It is published at this time as a definte suggestion for repairing or offsetting the wealth that is being destroyed by the war. It shows the studies the authors have made in various lines, the time-saving which they feel may be accomplished, and definite suggestions as to eliminating monotony in repetition work.

The plan endeavors to arouse the worker's interest and to secure his coöperation. It supplies incentive and stimulates investigation. The judicious use of the suggestion box is relied upon to induce improvement and invention, and it points the way so to stimulate the worker as to lead to his advancement toward an executive position.

The book includes the study of crippled workers, victims of both war and of industry, and is particularly timely on that account. Factory managers, production superintendents and others will do well to become familiar with the ideas here advanced.

Forthcoming Meetings

The American Gear Manufacturers' Association will hold its second annual convention at White Sulphur Springs, W. Va., Apr. 18, 19 and 20, with headquarters at the Green Brier Hotel. The secretary is F. D. Hamlin of the Earle Gear and Machine Co., 4701 Stenton Ave., Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers. Spring meeting at Worcester, Mass., June 4, 5, 6 and 7, with headquarters at the Hotel Bancroft.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

The sixth annual meeting of the Chamber of Commerce of the United States of America will be held in Chicago, Apr. 10, 11 and 12, 1918. Elliot H. Goodwin, Riggs Building, Washington, D. C., is general secretary.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

The National Gas Engine Association will hold its eleventh annual meeting at the Hotel Sherman, Chicago, Ill., June 3 and 4. The headquarters of the association are at Lakemont, N. Y.

The spring convention of the National Machine Tool Builders' Association for 1918 will be held Thursday and Friday, May 16 and 17, at the Marlborough-Blenheim Hotel, Atlantic City, N. J. Charles L. Taylor of Hartford, Conn., is secretary.

The National Metal Trades Association announces the following program of its forthcoming convention, which will be held at the Hotel Astor, New York City: Monday, Apr. 22, 10 a.m., executive committee meeting; 7 p.m., secretaries' dinner. Tuesday, Apr. 23, 10 a.m. to 5 p.m., council meeting; 10 a.m., meeting of local secretaries; 6:45 p.m., alumni dinner. Wednesday, Apr. 24, 9:30 a.m. and 2 p.m., convention; 12:30 p.m., buffet luncheon; 7 p.m., banquet. Thursday, Apr. 25, 9:30 a.m., and 2 p.m., convention and meeting of the incoming administrative council. Homer D. Sayre, People's Gas Building, Chicago, Ill., is the secretary.

A joint convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held at Cleveland, Ohio, May 15-17. Among the important subjects to come up for action will be Government control of fuel, transportation and shipping of materials and price fixing. The coöperation of labor in war activities will also be discussed at length.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

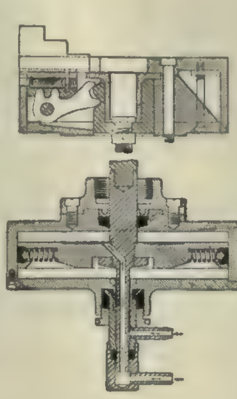
Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, [illegible]etary, 1786 Monadnock Block, Chic[illegible]

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Chuck, Air-Operated

American Pneumatic Chuck Co., 9 South Clinton St., Chicago, Ill.

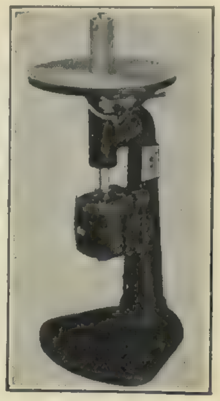


"American Machinist," Mar. 14, 1918

An air-operated chuck made in either the two- or three-jaw type in 6½-, 8-, 10-, 12- and 15-in. sizes. It is arranged to be operated either by the double-acting air cylinder shown or by means of a hand device on the back plate in case the air system should fail. The air cylinder is attached to the rear end of the spindle and is connected to the chuck by means of a draw rod passing through the spindle. It is claimed the cam construction and the 3-to-1 increase in power secured by means of the sector lever greatly increase the gripping power secured

Sander, Motor-Driven

Carter & Buchholz Co., Inc., 1234 South State St., Syracuse, N. Y.



"American Machinist," Mar. 21, 1918

This oscillating-spindle sander is for use in pattern shops and woodworking plants. Is equipped throughout with New Departure ball bearings and is driven by a ½-hp., inclosed, ball-bearing motor. The table is 20 in. in diameter and tilts 45 deg. downward and 15 deg. upward. Two spindles are furnished, measuring 2 x 9 in. and 3 x 9 in. respectively. The motor is for either alternating or direct current, as specified

Drilling Head, Multiple-Spindle Adjustable-Center

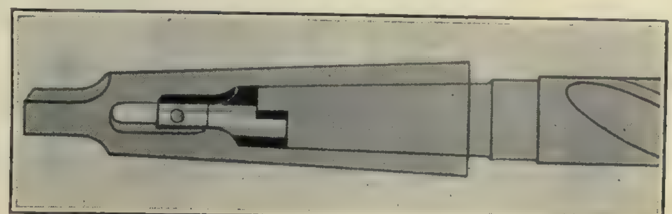
Heinkel Machine Tool Co., Sandusky, Ohio

"American Machinist," Mar. 21, 1918

A four-spindle drilling head of the gearless type on which the center distances are adjustable. The spindles may be adjusted to any center distance within their range while the machine is running. When once adjusted and locked in position the spindles are rigid and cannot move. Another feature claimed is the elimination of overhang on one side of the drilling-machine spindle, as the method of adjustment allows for movement in a complete circle, thereby making it possible to keep the drills equally balanced across the center line of the spindle. It is claimed that the crank method of driving allows quieter operation, closer center distances, lighter and smaller heads and less loss of power. Made in two standard sizes with minimum center distances of 1⅜ and 2 in. respectively

Tang, Repair "Economy"

The Mailometer Co., Kresge Building, Detroit, Mich.



"American Machinist," Mar. 21, 1918

When a tang breaks the end is sawed off to fit the driving shoulder of the repair tang, a special gage being provided for the sawing so that there shall be no material variation in the lengths of the reclaimed shanks. After being so fitted the tool may be held in any socket and driven through the repair tang

Grinding Machine, Plain

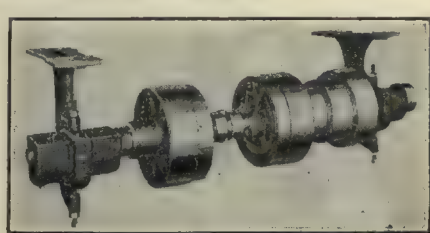
Ott Grinder Co., Indianapolis, Ind.

"American Machinist," Mar. 28, 1918

Normal swing, 5 in.; distance between centers, 18 in.; swivel table graduated to grind tapers up to 3 in. per foot; diameter of head- and footstock spindles, 1¼ in.; centers, No. 6 Jarno taper; front spindle bearing, 1⅝ x 3¾ in.; rear spindle bearing, 1¼ x 3⅜ in.; width of wheel belt, 2¼ in.; grinding-wheel speeds, 2000 and 3000 r.p.m.; minimum reduction of automatic cross-feed, 0.00025 in.; maximum reduction of automatic cross-feed, 0.005 in.; number of work speeds, four, 85 to 425 r.p.m.; table feeds, 20 to 65 in. per minute; horsepower required, 5; floor space, 31 x 68 in.; weight, 1700 lb.

Countershaft, Friction-Clutch

Foster Machine Co., Elkhart, Ind.



"American Machinist," Mar. 28, 1918

This friction countershaft is made in six sizes in double-friction style and six sixes in triple-friction style. Hyatt roller bearings are used on all loose pulleys. The friction is of the expanding-ring type, the operating wedge being controlled by a fork, shipper rod and lever in the customary manner. Three-step cone pulleys and universal suspension are used

Tool Holders, Short Bit

Right and Left Tool Holder Co., Jasper and East Willard Sts., Philadelphia, Penn.

"American Machinist," Mar. 28, 1918

This holder is intended for using up short bits of high-speed steel. The illustration shows one tool assembled and one disassembled. The short tool bit is held between the body of the toolholder and the small cap which is clamped down by means of the square-head screw. The screw has a long thread which decreases the danger of stripping. Made of high-carbon steel and can be furnished in straight, right-hand offset or left-hand offset, as desired. They are furnished in eight body sizes from 5/16 x ⅜ x 4½ in. to 1¼ x 2¼ x 13 in. and accommodate high-speed bits measuring from 3/16 x 3/16 in. up to ⅜ x ⅜ in.

Grinding Machine, Surface

Bridgeport Die and Machine Co., Bridgeport, Conn.

"American Machinist," Mar. 28, 1918

A surface-grinding machine which will handle work up to 5 x 8 x 14 in. Is intended either for toolroom or manufacturing needs. The movements of the table are automatic in either direction. Chrome nickel steel, hardened, ground and lapped, is used for the spindle, which runs in phosphor-bronze bearings provided with adjustment for wear. The power longitudinal feed is 14 in.; the power cross-feed is 5 in.; and the vertical adjustment is 8¼ in. The wheels used are 7 in. in diameter with a ½-in. face and ⅝-in. hole. The table is 24 in. long and 6⅞ in. wide and has a working surface 14 x 5 in. provided with three 7/16-in. T-slots. The net weight of the complete machine is 575 lb.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Mar. 28, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	$27.00
No. 2 Southern Foundry, Chicago	37.00	33.00	35.50
*Bessemer, Pittsburgh	37.25	37.25	36.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia	33.75	33.75	34.75
*No. 2, Valley	33.95	33.95	36.00
No. 2, Southern Cincinnati	35.90	35.90	29.90
Basic, Eastern Pennsylvania	33.75	30.75	30.50

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Mar. 28, 1918	One Month Ago	One Year Ago	Mar. 28, 1918	One Year Ago	Mar. 28, 1918	One Year Ago
Structural shapes	$4.195	$4.20	$4.10	$4-4.04	$4.10	$4.20	$3.75
Soft steel bars	4.095	4.10	4.00	4-4.04	4.00	4.10	4.00
Soft steel bar shapes	4.095	4.10	4.00	4.14	4.00	4.10	3.75
Plates, ¼ to 1 in. thick	4.445	4.45	5.15	4.39	5.00	4.45	4.75

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Mar. 28, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York	4.70	3.75
Warehouse, Cleveland	3.98½	3.95
Warehouse, Chicago	4.10	3.75

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Mar. 28, 1918	One Month Ago	One Year Ago	Mar. 28, 1918	One Year Ago	Mar. 28, 1918	One Year Ago
*No. 28 black	5.00	6.445	6.445	6.00	6.385	5.50	6.45	5.40
*No. 26 black	4.90	6.345	6.345	5.90	6.285	5.40	6.35	5.30
*Nos. 22 and 24 black	4.85	6.295	6.295	5.85	6.235	5.35	6.30	5.25
Nos. 18 and 26 black	4.80	6.245	6.245	5.80	6.185	5.30	6.25	5.20
No. 16 blue annealed	4.45	5.645	5.645	5.45	5.585	5.20	5.65	5.45
No. 14 blue annealed	4.35	5.545	5.545	5.35	5.485	5.10	5.55	5.35
No. 10 blue annealed	4.25	5.445	5.445	5.30	5.385	5.05	5.45	5.30
*No. 28 galvanized	6.25	7.695	7.695	5.25	7.635	5.00	7.70	5.20
*No. 26 galvanized	5.95	7.395	7.395	8.00	7.335	7.25	7.40	7.50
No. 24 galvanized	5.80	7.245	7.245	7.70	7.185	6.95	7.25	7.20

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Mar. 28, 1918	One Year Ago
New York	List plus 10%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Mar. 28, 1918	One Year Ago
New York	$15.00	$9.50
Cleveland	15.00	7.50
Chicago	15.00	6.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

5/32, 11/64, 3/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 3/32 and No. 10	
⅛	
No. 12	
1/16, No. 14 and 1/16	
No. 18	
No. 20	

¹Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	32.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Mar. 28, 1918	Cleveland Mar. 28, 1918	Chicago Mar. 28, 1918
Tire	4.10	4.00	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel	7.50	8.00	8.25
Spring steel (crucible analysis)	11.00	11.25	11.25
Coppered bessemer rods	7.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel	9.00	8.25	8.25
Floor plates	6.19½	6.00	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			

LAP WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Mar. 28, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	37.00
Tin, in 5-ton lots	85.00	85.00	54.50
Lead	7.25	7.25	10.75
Spelter	7.50	8.00	11.00

*Government price.

ST. LOUIS

	Mar. 28, 1918	One Month Ago	One Year Ago
Lead	7.10	7.10	10.50
Spelter	7.25	7.75	10.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Mar. 28, 1918	One Month Ago	One Year Ago	Mar. 28, 1918	One Year Ago	Mar. 28, 1918	One Year Ago
Copper sheets, base	31.50-33.00	32.00	44.00	32.50	46.00	35.00	43.00
Copper wire (carload lots	32.00	32.00	39.50	28.50	44.00	34.00	39.00
Brass pipe base	36.50	36.50	47.50	38.00	52.00	40.00	47.50
Brass sheets	30.75	30.75	45.50	32.00	45.00	35.00	43.50
Solder ½ and ½ (case lots)	62.00	62.00	45.50	48.50	33.50	48.00	33.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Mar. 28, 1918	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	35.00	42.50

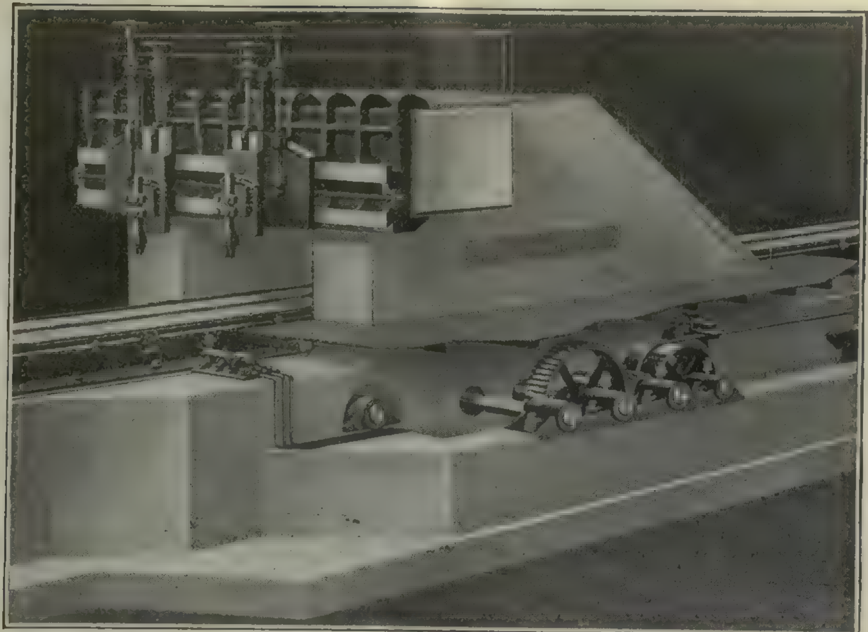
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Mar. 28, 1918	One Year Ago	Mar. 28, 1918	One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	20.00	23.00	20.50	23.25
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Mar. 28, 1918	One Year Ago
New York	13.50	31.00
Chicago	16.00	32.00
Cleveland	16.25	34.00



Making Concrete Metal-Planing Machines

BY ETHAN VIALL

The machines described in this article are a radical departure from anything hitherto attempted in the machine-tool line, but the possibilities suggested by their construction are numerous in this as well as in other fields.

THE IDEA of building machine tools in which the bulk of the material used is reinforced concrete is novel in itself, but aside from this, the time taken to construct the huge machines described in this article is startling, and is especially welcome just at this time when speed is so essential in everything that has to do with winning the war. The machines were built by the Amalgamated Machinery Corp., Chicago, Ill., primarily for the purpose of planing the beds of large gun-boring machines made for the Government. They were designed and built under the supervision of Lucien I. Yeomans, who last year received the medal of the Franklin Institute for his novel method of lathe construction, which was almost as novel a proposition as the present one.

The original construction plan for these machines comprises a battery of four huge planing machines, each with a bed 184 ft. long, 17 ft. at its widest place, and 18 ft. from bottom of the bed to the top of the housing. There are approximately 212,000 lb. of iron and steel castings used in each machine, and about 13,500 cu.ft. of concrete reinforced with 34,000 lb. of steel bars.

The shop layout for the four machines is shown in Fig. 1. A view of one of the machines is given in Fig. 2, and details in Figs. 3 and 4.

The bed was designed like a huge concrete girder intended to support a load, which accounts for the high percentage of steel reinforcement. This was done to avoid any possibility of the bed settling at any point and destroying the alignment of the ways.

The power for running each planer is furnished by two 40-hp., three-phase, sixty-cycle motors running at 1800 r.p.m. One motor drives the table forward at a speed of approximately 20 ft. a minute while the other motor gives a rapid return of approximately 40 ft. a minute.

The method of feeding the cutting tools might be termed "human feed," and is perhaps as unusual as the planers themselves, no automatic means of feeding being supplied, but each cutter head is controlled independently in both horizontal and vertical directions by a man stationed on top of the housings. Four 24-in. handwheels are conveniently located for the operator at this place, and the shaft carrying each handwheel also carries an index finger which, in conjunction with a graduated dial, forms the means of gaging the rate of feed.

Work on the machines was begun Dec. 24, 1917, and in spite of the unusually severe winter, heavy storms, the Garfield closing order and other difficulties the first machine was ready to run the last week of February, 1918, and the other three were well along toward completion.

The picture shown in Fig. 5 was taken Dec. 31, 1917, and shows a steam shovel excavating a trench for one

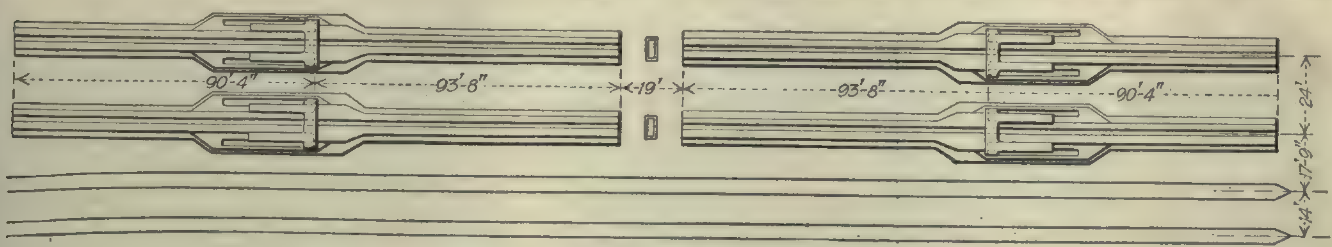


FIG. 1. SHOP LAYOUT FOR FOUR 90-FT. PLANING MACHINES

FIG. 2 REINFORCED-CONCRETE PLANING MACHINE WITH 90-FT. BED MANUFACTURED

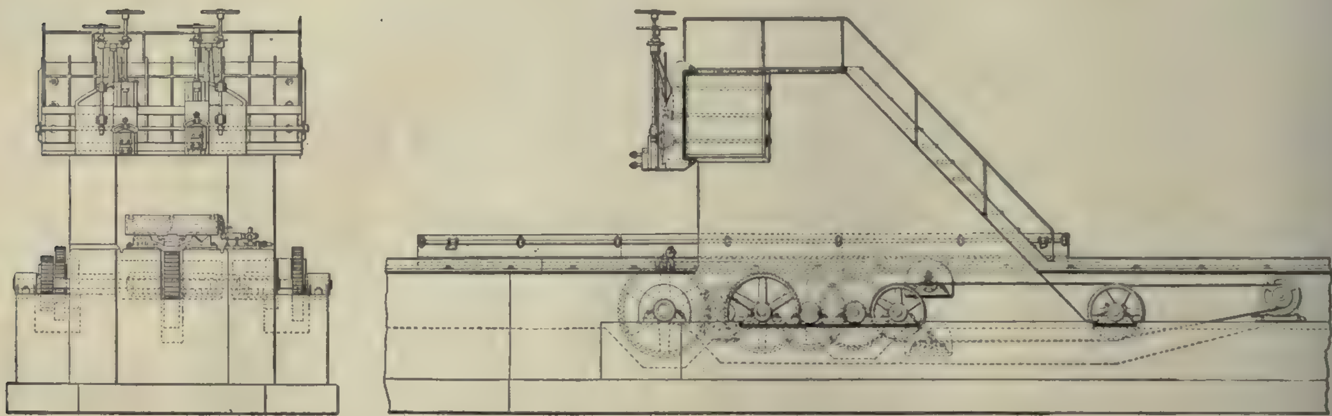


FIG. 3. SIDE AND END ELEVATION OF PLANING MACHINE

FIG. 5. EXCAVATING FOR THE BEDS

BY THE AMALGAMATED MACHINERY CORP. FOR WORK ON GUN-BORING MACHINES

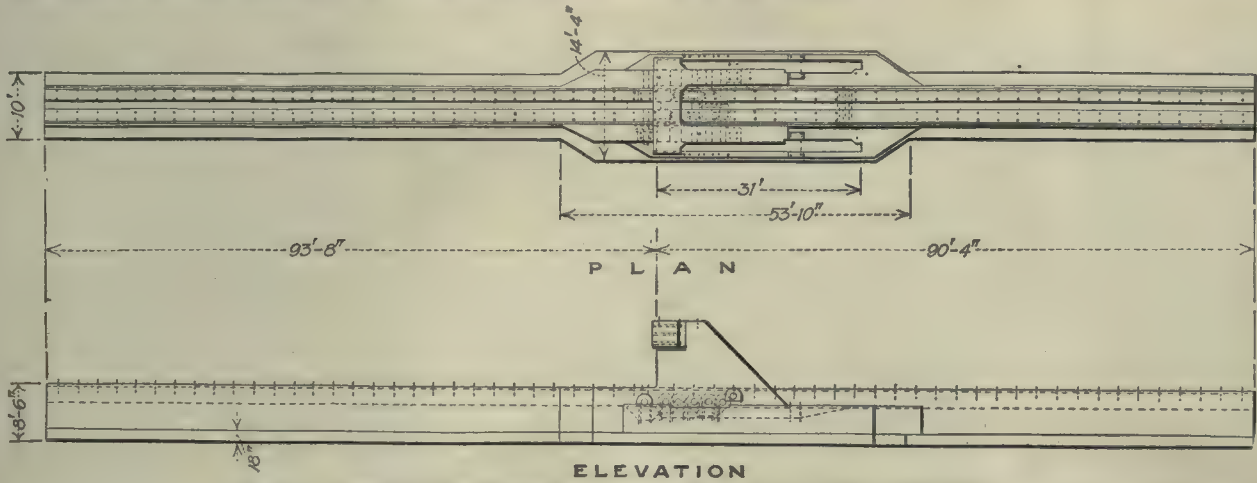


FIG. 4 DETAILS OF REINFORCED-CONCRETE PLANING MACHINE

FIG. 6 VIEW OF PARTLY FINISHED FORMS UNDER CIRCUS TENT

FIGS. 7 TO 9. SOME VIEWS TAKEN DURING THE CONSTRUCTION OF THE PLANING MACHINES

Fig. 7—Bed forms and steel reinforcements. Fig. 8—A finished concrete bed and a canvas cover. Fig. 9—Ways in place and being approximately leveled

of the beds. Forms for the concrete were rapidly put in place and a huge circus tent was erected over the entire project. A few days later a terrific wind and snow storm tore down the tent and damaged it so that it was impossible to re-erect it. Tunnel-like structures of canvas were then erected over each machine site. Steam pipes leading from a heater were run into these canvas covers and the temperature kept high enough for the poured concrete to set without danger of freezing.

A view taken Jan. 12, 1918, is reproduced in Fig. 6. This shows the partly finished wooden forms erected for the bed and housing and also indicates how the snow weighed down the canvas of the tent and drifted onto the work.

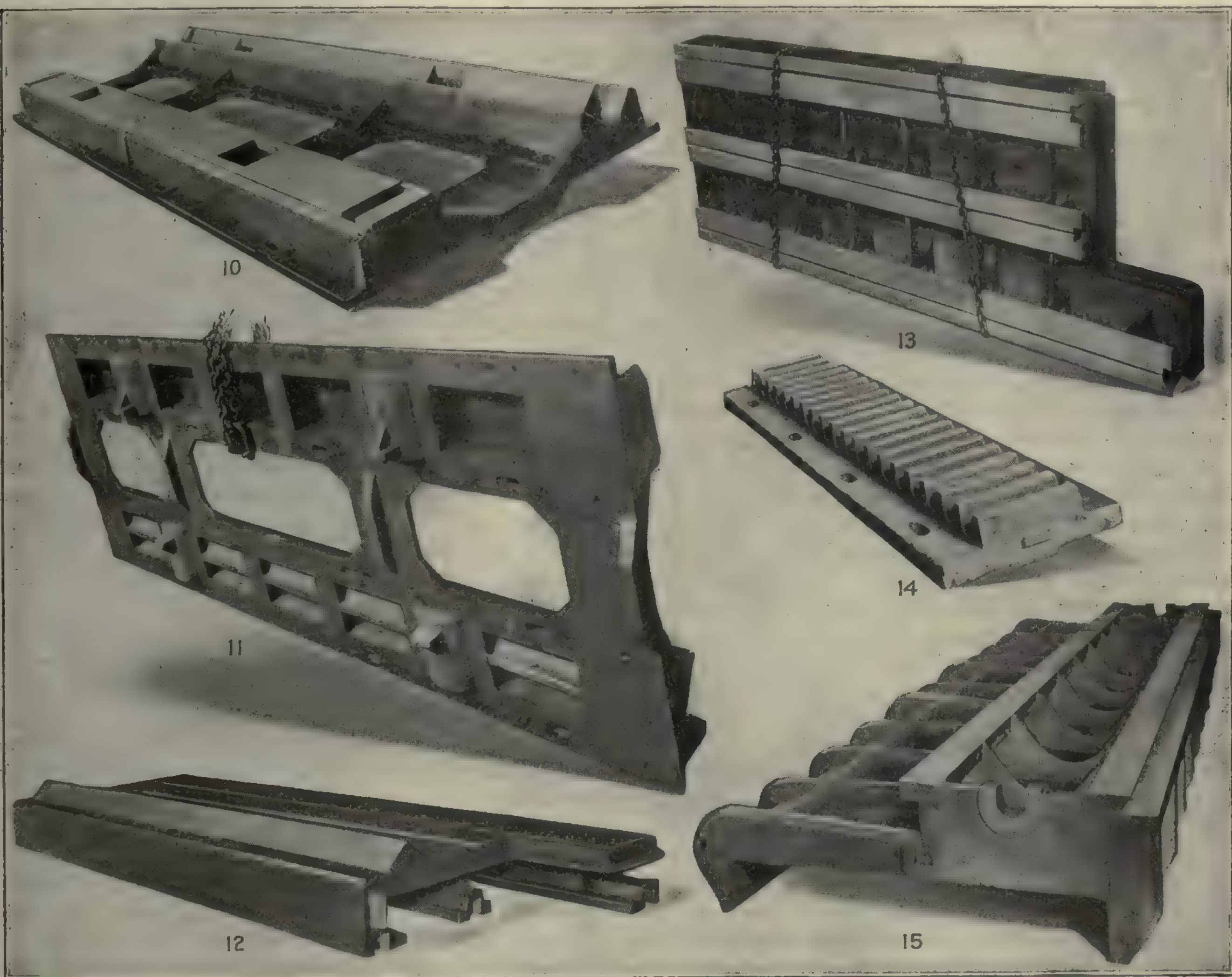
Another view, taken Jan. 23, is shown in Fig. 7. This was taken looking from the housing down along the bed forms, and gives a good idea of the steel reinforcing used in the concrete bed work.

Fig. 8 is a picture taken Feb. 12. Here the concrete part of the bed is shown finished and ready to receive the metal ways. The studs with which the ways are bolted to the concrete are plainly shown. At the right in this picture is shown one of the canvas structures placed over one of the machine sites.

On Feb. 19, the iron ways were in place on one of the machines, as shown in Fig. 9. This illustrates the sections being approximately leveled up, after which they were accurately leveled by means of engineering instruments of extreme precision.

The bed ways are made with one flat- and one V-guide, and in skeleton form, as shown in top and bottom views, Figs. 10 and 11. The ways are made in sections 12 ft. long, 4 ft. 10 in. wide and 13 in. through at the thickest point. The V is cut 50 deg. slope angle and is 10 in. wide at the top of the flare. The flat guide is 10 in. wide on top.

The table is also made in sections about 12 ft. in length, shown in bottom and top views in Figs. 12 and 13 respectively. After the table sections have been fastened together concrete is poured into the box-like sections, making the table one long, solid monolith of concrete and iron.



FIGS. 10 TO 15. SOME OF THE METAL SECTIONS USED.

Bolted to the bottom of the table are the steel rack sections, one of which is shown in Fig. 14. These sections are 5 ft. long, 18 in. wide and with 20 teeth 3 in. pitch. These mesh with a bull gear of 53.48-in. pitch diameter, 3-in. pitch, 56 teeth and 10-in. face.

All the sections of the table, bed and bottoms of racks were machined on a Gray planer previous to being put in position, master templets being bolted to the table of the planing machine as guides for the workman in each case.

The cross-rail is a huge cast-iron casting 14 ft. long,

5 ft. 2 in. wide and 19½ in. at its thickest point. One of the cross-rail castings is shown in Fig. 15.

Clearance holes through the bed and base of housing for the gear shafts were made by placing spiral metal pipe in the forms and pouring the concrete around them.

While the machines described were all built alike for a special purpose they may be made in various sizes if necessary, and the short time needed to complete them should make them an attractive proposition for certain special-planing jobs.

Kind of Work for a Trade School

By Entropy

It is very easy for all of us to look at large problems from our own individual point of view, which is invariably a narrow one, but it should be our policy to broaden our scope and endeavor to see problems from a large standpoint.

W. D. Forbes, in his article on page 1052, Vol. 47, attempts to narrow the field of the trade school to that of providing operatives for machine shops. There is no doubt that at the present time he could secure larger subscriptions to a fund for training this kind of quasi-mechanic than he could for a broad training. We are at war and it is the duty of everyone to seriously consider the problems that face us immediately and that must be promptly solved. On the other hand we should not forget that some day the war will be over, and when that day comes we will regret every bit of narrow training that could have been avoided.

One of these things which can be avoided is the taking of young children 14 to 16 years of age and training them to be mere operatives if they have it in them to become all-around, capable mechanics. The case is very different from that of the young man of draft age or over, or different from that of the young women who must be trained for immediate work at something useful. These people should be given the most intensive training at one single thing and not a smattering of the whole trade, which will make them think that they are capable of doing any job in a machine shop after the war. There should even be some restriction to such people going from shop to shop and learning one operation after another, for that will result exactly as was the case in the past, namely, training a lot of people to do what they have done before, but without a conception of underlying principles. Such training as this requires no trade school and is not trade training in its true sense.

What Should Be Taught

What should be taught in a trade school depends on the needs of the community in which it is located. Trade-school pupils do not as a rule come from a distance; twenty miles is about the limit. The needs of the community may include a great many things besides the machinist's trade. There may be communities where silversmithing is of much greater importance, or where printing or shoemaking is most needed. It may be that the requirements of the community are not pressing and that only a long look into the future will show what is needed.

It has been the habit of most of us when discussing the trade-school problem in the columns of the *American Machinist* to limit ourselves to the machinists' trade and its branches, entirely forgetting that this is only a single item and that an evenly balanced trade school should study its problem irrespective of the trade of the men who may be conducting the schools.

So far as the question of teaching toolmaking is concerned it should be enough to say that in every class of 25 boys there will be some who ought never to try to be machinists because they are better adapted to other occupations; but it is almost equally certain that there will be those who stand out as fit to become toolmakers or gagemakers or jig and fixture men. These should be given opportunity to get the fundamentals of the kind of work for which they are fitted. To deliberately set out to train toolmakers from the rough is likely to result in a lot of failures.

For war emergency there is no question in the writer's mind but that the shops should be glad to send their brightest young mechanics to some school where they can have intensive training in the kind of toolmaking that they will be called on to do, even if it may be for only a few weeks.

Applied Mathematics

In spite of Mr. Forbes' denial I believe that Mr. McArdle is right in considering the machinists' trade as applied mathematics. After all, the big job of a machinist is to make some piece of metal to size and shape that someone else has demanded. He may then have to fasten the parts together with screws that have been made to the size and shape which some committee on standardization has determined upon. This is arithmetic and geometry applied to metal.

A great many machinists do not know enough about mathematics to injure them even in Mr. Forbes' mind, but they do for the most part know how to use books like the "American Machinist Handbook," which almost wholly treats of applied mathematics. I recall one shop superintendent who always derided any attempt to teach trigonometry to apprentices, but who was delighted to find a young man, not an apprentice, who had discovered how to measure a dovetail slide with the aid of two standard cylindrical plugs. He got it from a handbook, and he learned to apply "trig" to the case without knowing what it was that he was using.

An operative can get along very well without mathematics. He is not allowed to add two measurements together; that is the draftsman's job, and properly so. He is not allowed to scale a drawing, nor is he allowed to chose his own method of doing any job. His thinking has all been done for him, and mostly by men who have been over the same path before him. There are few men today in responsible positions who have not learned what they know by digging it out themselves.

It is apparent that mathematical and mechanical ability go hand in hand. In one of our largest industrial cities there are evening trade schools where men are sent by their employers. Records have been kept of hundreds of these men and it has been found that only those who were able to use both common and decimal fractions could be taught to be competent machine-tool operators. This may not be conclusive, but it is certainly suggestive.

Machine-Tool Exports After the War

BY LUDWIG W. SCHMIDT

Machine tools exported from this country to Europe during the last few years have been for the most part adapted to the manufacture of munitions. The demand for machines of this class will cease when the war is over, and the attention of exporters will be directed to machines for other purposes. This article contains some excellent suggestions as to how American machine-tool builders can best secure and maintain a market for their product in European countries.

THE writer has had a letter from a man closely connected with machinery conditions in Europe. This letter and other information that has come to him contain many suggestions for the future development and handling of machine-tool exports to European and other foreign markets which deserve close attention of American machine builders.

There is repeated at first the frequently heard statement that most of the machine tools now received by European importers from the United States will be useless after the war. The high specialization of these machines, which is their present advantage over other tools of a similar construction, will prove to be their undoing after the war. It is therefore expected that France and England will be swamped with a multitude of types of machine tools without any value for further industrial employment. Many engineers in Europe are now studying the question how under certain conditions these machines might be reconstructed and made to serve more general purposes. Technical journals have also given this question attention, and the deduction seems to be the holding out of some hope that by dismantling the machines certain of their parts may be used in building other machines. As European manufacturers have invested rather heavily in these machines the outlook is not a pleasant one, and there is some apprehension for the future, especially as to those machines that have been ordered in the United States and that may remain undelivered when the war stops.

At the beginning of the war European manufacturers ordered American machine tools rather recklessly, knowing that the success of the defense of their respective countries was more or less dependent upon the possession of machinery specially adapted to the production of munitions. With the end of the war—if not in actual sight at least becoming more probable—the question arose whether they should curtail their orders and run the risk of being not fully equipped in case the war should continue, or whether they should order as before and face the possible loss of having to retain machines ordered but not wanted. Most of the manufacturers seem to have done the patriotic thing and not curtailed their orders, but it is clear that the actual loss to many of them will be great if they should be held uncompromisingly to their contracts with American makers. The question is one which deserves the attention of the American machine-tool builder as well.

The war has been a big advertisement for the American machine-tool builder in Europe. Before the war the possession of an American machine tool was with many manufacturers more or less a luxury. The American automatic machine tool was expensive, and did not represent for the average manufacturer the value to justify the fairly large outlay for its purchase. Now everything has changed. The machine shops of England, France, Spain and Norway are filled with American machine tools of all descriptions. There is hardly a manufacturer of importance who does not make use of American tools, and certainly none who is not intimately acquainted with their qualities. This will reflect very much to the credit of future American business in Europe.

But in the meantime the general industrial conditions of Europe have undergone changes. While in former years in most of the European countries labor was fairly plentiful and cheaper than in the United States it has now become scarce, and wages are rising. The return of the armies may somewhat relieve the situation, but the general impression is that the industry will have to take special steps to raise industrial production. The value of labor-saving machine tools has been demonstrated during the war, and labor-saving methods have become today as essential to Europe as they are to the United States. It is generally realized by European engineers that American designers have been more successful in devising labor-saving machinery than have been the European. One of the principal reasons given for this is that American engineers have been encouraged by the coöperation of the workmen.

OPPORTUNITY OF AMERICA

The indications are that European manufacturers will buy more American machine tools after the war than they bought before. Doubtless this will be a great opportunity for the American machine-tool maker. It is now suggested by men interested in machine-tool importing in Europe that good use might be made of this opportunity. My correspondent argues that there are many American machine-tool makers who now have extensive orders on hand for machine tools especially designed for munition and similar war work. The aggregate value of these orders must amount to millions of dollars. If the European manufacturers who have given these orders should be compelled to accept them an economic loss would occur to both parties if peace should come suddenly. There would be the danger that a man who might become a good and permanent customer after the war would be made antagonistic if forced to pay for machines he did not require. It would be better in such a case if the whole order were cancelled and replaced by one of similar quantity of machine tools needed for the particular line the manufacturer desires to make after the war. Further, much would be gained if American machine-tool makers would now agree to accept orders generally under the condition that they might be replaced by similar orders for different types if peace should come within a given period.

The advantages gained by such a policy would lie

entirely with the American machine-tool builder. There is no doubt that many European manufacturers are holding back their orders because they want to save capital for after-war equipment. Under the condition mentioned they would give larger orders now, and by doing so insure American makers of their continued trade after the war. Such a policy would be greatly appreciated by the allied manufacturers, who feel, not without cause, that they have added a good deal to the industrial prosperity enjoyed by the United States.

The return of peace may give American machine-tool manufacturers a chance to settle down to a more definite policy in handling their European business. Before the war much of the export trade to Europe was not handled by the American manufacturer himself, but by European agents with buying houses in the United States. This system has had many advantages and also disadvantages, and it must be a matter of individual policy whether American firms will continue this arrangement after the war. Whatever they do, however, they should take a more active part in furthering their foreign interests. However friendly buyers in Europe may be to the American machine tool there is bound to be competition. As coöperation between American makers in the European field does not seem feasible it follows that each manufacturer will have to look out for himself. He cannot rest after handing his interests over to an agent, but he will have to give this agent very material support.

Necessary Advertising

Advertising will pay as well after the war as it has paid before and will be more necessary. In this respect one point deserves special mentioning; that is, the influence gained by the American engineering press in Europe since the outbreak of the war. The American press has covered most effectively the difficult field of war engineering, with the result that American engineering journals today are read more widely in Europe than at any other time. No doubt this increasing influence of the press has also greatly benefitted the individual machinery manufacturer.

Support to agents can be given very effectively by more frequent visits to the European sales field by the constructing engineers of American factories, who in this way would gain a better understanding of the requirements of the markets. This will be especially important after the war, as great changes are expected in this respect. The fact that many partly disabled men will have to be employed in European machine shops will have a decided influence on machine construction for at least the next ten years, and the situation can best be understood by local inspection. Frequent visits of the chief engineers will also have a good influence in other directions.

Before the war the writer frequently saw American machine tools standing idly in shops. An inquiry showed that as a rule something had gone wrong with the machine shortly after installation and that it had not been used since then, as the workmen did not care to bother about it. In this way much harm has been done to the American machine-tool business in Europe. The actual cause of the troubles in most cases was that (1) the machine had suffered in transportation; (2) it had not been installed properly; (3) it had not been handled in the right way. Some part had got jammed or broken and the engineers of the plant either were unable to tackle the job or were too lazy. The result was that in one particular case a machine costing $4000 was left unused, and the work was done by hand as before. By chance we had an engineer on our staff who knew that kind of machine and repaired the trouble in one afternoon. Nevertheless, before the war that firm had not bought another American tool. If an engineer representing the American maker had been in the field he probably could have saved this customer for his firm. Of more importance, however, would have been locating the original mistake which led to the trouble. Was the packing faulty? Were the instructions given for installing and operating the machine incomplete, misleading or incomprehensible to somebody not used to that type? A knowledge of these facts certainly would have been of interest to the maker of the machine.

An Illustration

The following hypothesis may serve as an illustration: Suppose a manufacturer buys a certain complicated tool. It arrives at its destination with an important part broken, or an important part later gets out of condition. Both are incidents that may happen. The recipient or user has three remedies. He either attempts to make a new part himself, providing he has the equipment, or he can send the part to a European manufacturer, or he can ask for a new part from America. In the first instance he runs the risk of not making an exact copy; in the second he has probably to pay for the single part, and in the third there will be wasted at least three or four weeks. The result is that many manufacturers will prefer the European-made tool to the American, because worn or broken parts can be replaced more easily and cheaply by the latter. The matter is well worth the consideration of the American manufacturer, as every year much trade is lost on account of this condition. The remedy is simple, and it is astonishing that no steps have been taken before to prevent such occurrences.

Breakages cannot be avoided completely. Every factory has a record of repair work done, and it is practically easy to find out how many new parts are required for a given number of machines sold. Also every engineer knows quite well what parts of his machine are most liable to break or wear. In most cases the number of these parts is not very large. For argument's sake, say there are six parts subject to breakage and the rate of renewal is 3 per cent. What would prevent this particular manufacturer from establishing somewhere in Europe an agency where a sufficient supply of spare parts is kept and from where repairs can be drawn at a moment's notice? Several firms might combine for the purpose of such an agency. A suitable location could be found for it in a city within easy reach of the principal markets. There are a great number of shop foremen in America who are excellently qualified to take charge of such an agency and whose services would save to their principal many customers who are now being lost. Every customer should be notified of the existence of the repair center so that he can get into communication with it when necessity arose.

The selection of a policy in dealing with the Euro-

pean markets after the war should also take into consideration the question of competitive supply. During the war many machines and machine tools have been shipped to Europe, which under normal circumstances could not have been sold. Before the war it was generally realized in European machinery circles that there would come a time when the heavier American tool would not be competitive in Europe unless it possessed exceptional advantages over the European counterpart. If this was the case before the war it will be still more so when peace shall return. Freight rates, which have been rising constantly, will add to the present high prices of heavy machines; therefore the question arises whether American makers should lose time trying to sell machines that after a while will be driven from the market by the better situated European product or whether they should not concentrate their efforts on such machines that by their whole character promise a permanent success.

Paying Extreme Prices

Of this class of machine tools there are a great number, and experience has shown that the market is ready to take them up. American manufacturers should of course understand that after the war European buyers will not be able to pay the prices that were charged during the war. It is well understood in Europe that at present American manufacturers work under great difficulties; that he has to pay extreme prices, and that high wages are paid to labor; besides the machine tools ordered in this country for Europe are needed and consequently not much bargaining is done. After the war prices will go down and the situation will be less pressing; therefore there will be more stability in prices. This ought to be given special consideration by all manufacturers in the United States permanently engaged in supplying the foreign trade. Every machine tool added to equipment represents a certain capital investment, and the monetary value of this investment must be figured on the basis of the advantage expected from the tool either by increased production or the saving of labor. This value, however, becomes real or fictitious according to the general price and wage situation in each country. A machine tool, the price of which appears low under American conditions, may be uneconomical under European conditions. American manufacturers of machine tools will do well to keep this in mind.

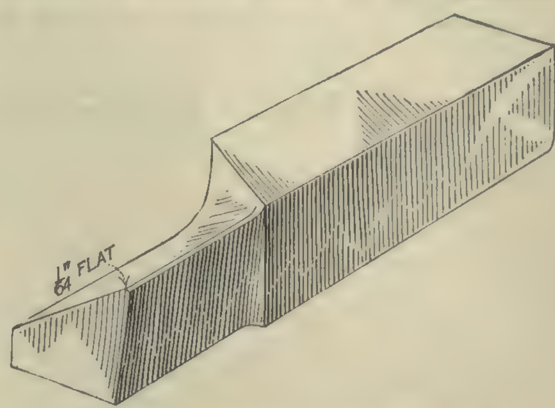
Grinding Shrapnel Punch-Tool Bits

By J. W. Thayer

The writer has recently been engaged in making punches for 75-mm. French shrapnel shells, and ran across a little kink which he believes will interest many readers of the *American Machinist*.

These punches are used in making the first perforation in the billet. The perforation is made while the metal is hot, and requires a very hard, tough material for the punch. That used was a chrome-vanadium steel, much of it unannealed. Reduction of stock from 4½ in. to 3½ in. was made in many cases, and as the lathe used was only 14-in. swing, and not very heavy at that, the question of reducing a piece of hard material from approximately 4 in. to 3 in. and of 23-in. length was a difficult one. This is the way it was done, with ½ in. depth of cut, and a feed of from 0.012 to 0.016 inch.

The tool used was a ⅜-in. square tool bit in an Armstrong toolholder; plenty of top clearance was



THE WAY THE BIT WAS GROUND

provided, and after grinding to an edge, the tool was slightly flattened on the point. Tools ground as per sketch herewith are 50 per cent. more efficient than if left with sharp edges. Five minutes' use will demonstrate this to any one interested.

Jack Is Now a Toolmaker

By E. A. Dixie

I am a trusting sort of soul, as a general thing, but, honestly, I could not bring myself to believe that those "Letters from Jack to Bill" were genuine. However, now I know that I was wrong, because Jack has, or had, a job in our toolroom.

In spite of the statewide anti-treating law I have for the past eight or nine months been running the heat-treating department of the So-and-So Manufacturing Co. The firm makes a variety of agricultural implements and has a well-equipped heat-treating plant to take care of the work from the other departments, among which is a toolroom with about twenty men.

Of late the foreman toolmaker has had a lot of trouble to get men, and that I suppose accounts for the fact that Jack has, or had, a job there.

The other morning about 10 o'clock Jack came staggering in with a big die block on his shoulder. I did not know that he was Jack then, nor for that matter do I now know that Jack is his name, but after you read the rest of this I think that you will agree that he *must* be Jack.

Without putting the die block down he came over to the desk where I was and said:

"Be you O'Neill?"

"No," said I, "my name's Dixie."

"Be there *a* O'Neill here?"

"Not that I know. What's the idea? Do you want to drop that die block on him?"

"No, I be one of the toolmakers, and this block is too hard to plane so the foreman said, 'Take it down to the heat-treating department to O'Neill,' and that's why I'm looking for him. I'll bet he can't plane it any better than I can."

"I don't believe he can; but you just put it down in front of that furnace and I'll see that it gets O'Neilled."

THE INSPECTOR'S PART

By Berton Braley.

AMID the battle's reek and noise,
"Somewhere in France," across the sea,
There is a bunch of Yankee boys
Whose life or death depends on me;
I do not know who they may be—
They do not know my face or name,
But to my skill and loyalty
Their fate's entrusted, just the same.

A RIFLE or machine-gun part
Wrong by a thousandth of an inch,
May make a company lose heart
Because it failed them in a pinch;
I must not slack my task nor flinch
From drudgery and dull detail,
Lest in some crucial battle-clinch
The arms we send our boys should fail.

SO WHEN I chafe at jobs that irk
Or fret at wearisome routine,
I must remember what my work
And care and watchfulness may mean;
And how our fighters must lean
On men like me for tools of war
That, when conflict waxes keen,
Will do the work they're needed for!

Ball Bearings for Electric Motors

By A. H. MacCAFFRAY
Ball Bearing Co., Hartford, Conn.

During the past twelve years ball bearings have been employed successfully in electric motors in America and in Europe, the application extending to general-purpose motors as well as those for special purposes.

MANY articles have appeared from time to time in the technical press stating the pro and con of the application of ball bearings from the motor manufacturer's viewpoint as well as that of the motor user and the ball-bearing manufacturer.

The object of this article is to present the latest experience in connection with ball bearings in electrical machinery.

Through ball bearings distinct improvements are obtained, which may be clasified under three general headings—Electrical, Mechanical and Upkeep.

Electrical

Ball bearings, of high-grade wearing and shock-resisting steel, being accurate to within very close limits, substitute rolling for rubbing friction, and therefore eliminate wear and permit motor manufacturers to employ air gaps with clearness so slight, especially in induction motors, that power factors are considerably improved. They keep the shaft, and consequently the rotor, in the center of the magnetic field.

Ball bearings are sealed to prevent the escape of lubricant, and this keeps the commutator clean. On d.c. machines commutators as well as coils are thus protected against a conducting "slop" of oil and dust, and perfect commutation is maintained. Their precision and durability also insure better commutation.

Freedom from brush sparking in flour mills, coal mines, textile mills, woodworking plants or wherever there is combustible dust reduces the danger of ignition and explosions and thus lowers the hazard from fire and accident.

Mechanical

Compactness is required under conditions usually found in general industrial applications for both a.c. and d.c. motors. To obtain this, motor manufacturers develop, or try to develop, the greatest possible horsepower from given frame sizes. The reduced size per horsepower capacity gives greater output for acquired motor space.

Babbitt bearings are usually designed with an over-all length of two and one-half or three times the diameter of the shaft which they are called upon to support. Contrasted with this the length of the ball bearing proper on the shaft usually is not over one-third of the shaft diameter. Through ball bearings the over-all length of motors can be reduced from 10 to 30 per cent.

To be sure, on motors in which the shaft is subject only to torque bearing friction is a small percentage of the motor loss. This condition obtains for the most part in direct-coupled units, such as pumps, motor-generator sets, etc. These bearings carry little, if anything, above the weight of the rotor, and the pressure between the shaft and the bearing is slight and friction is at a minimum.

Wherever such motors are running at high speeds even slightly unbalanced forces will produce considerable bearing loads that tend to increase friction and wear. Where the shaft is subjected to bending strains, bearing friction becomes an important consideration. This is the case of belt- or gear-driven motors. The bearings are subject to severe binding, pounding or shock, especially at the drive end. Ball bearings in these instances show a very decided saving over plain bearings, especially if the self-aligning type, which compensates for shaft deflection or misalignment, is used. Power saving in ball bearings is entirely due to the fact that their friction is practically constant over a wide range of loads and because rolling is substituted for the rubbing action of plain bearings.

As ball bearings consume no more energy at start then they do at speed, acceleration is rapid and the starting torque improved several hundred per cent. Belt slippage is eliminated and it becomes possible to use smaller belts and pulleys. These savings are mechanical only and are in addition to other economies that will be shown in the succeeding paragraphs.

Upkeep

To gain a proper conception as to how ball bearings affect the cost of motor upkeep, an investigation was conducted and a series of questions submitted to a number of users of ball-bearing motors. To the question of how much the total motor-repair bill was reduced by the use of ball bearings one company replied 60 per cent.; another 50 per cent., while a third stated, "We are sure of a large saving." To a question as to how much have motor failures due to grounds on brush holders, cable and inside parts of motors been reduced on account of ball-bearing armatures one company said 80 per cent. and another 75 per cent.

Ball bearings offer the motor user the solution of his lubrication problem. Ball bearings contained in bearing brackets, with lubrication chambers which are sealed on both sides by end caps, successfully prevent the intrusion of foreign matter and at the same time preclude the escape of the lubricant; and another advantage is that they eliminate the frequent inspection of plain bearings as the user need not concern himself about sticking of oil rings.

Motors equipped with ball bearings are free from the dirty condition caused by the collection of dust around the bearing heads by dripping oils. Safety against such conditions is worth the cost of the motor, especially in plants where dripping oil adds to the fire risk or is ruinous to the stock in process of manufacture.

To illustrate how a ball-bearing motor will run more satisfactorily under conditions of neglect than a plain-bearing motor, observe how two motors operating side by side, one on ball bearings, the other on plain bearings, will act. The plain-bearing motor, as soon as the oil has become exhausted, will heat up and the bear-

ings will run to destruction, with the likelihood of the armature being stripped when bearing wear is sufficient to let the rotor rub on the pole pieces.

On the other hand, the ball-bearing motor, because of the lubricant being held in the sealed chambers, and its lubricating properties not being exhausted as quickly as in plain bearings, will run for an indefinite period without showing any signs of heating or bearing wear. A motor of this kind requires oiling only three or four times a year to insure perfect bearing operation.

An analysis of the foregoing statement clearly shows the following benefits obtained from ball-bearing motors: (1) Increased efficiency; (2) mechanical durability; (3) decreased maintenance cost, and (4) freedom from lubrication troubles.

Gear Drive

Where gear drive is employed, ball bearings are of particular advantage in order that the proper distances between pinion and gear centers may be maintained so that the gears may run smoothly and quietly. Chattering gears may be caused by wear in the bearings supporting the gears. After long service with this type of drive, ball bearings do not show any noticeable wear, consequently the gears mesh quietly and properly, wear very little and give more satisfactory service.

Modern machine-shop practice calls for individual drive, and motors are usually placed on the machines where they will take up the least amount of room while being within easy reach of the operator. The saving in motor length has been pointed out previously.

In motors for grinding rooms, buffing rooms, or where abrasive dust or grit is present, ball-bearing motors, because of the sealed bearing heads, keep foreign matter out of the bearing, and prevent frequent bearing renewal.

Their use in the wood-working industry is general because they have eliminated inspections formerly required whenever the plain-bearings motors were started. The operator on a ball-bearing motor need not be concerned about the oil ring sticking in the bearing or frozen bearings, or about belts coming off because of extreme starting resistance in the motor bearings due to tight belts. A prominent concern in the wood-working field writes: "The motors and dynamos which are equipped with ball bearings have given us complete satisfaction, and our power saving has been enormous. We are saving a very large amount of money on our coal alone."

One of the difficulties on plain-bearing vertical motors is the starting. When the motor is stopped the oil film separating the bearing surface is destroyed. The starting effort is then very great until the film is reëstablished. Ball bearings, because they roll (not rub), do not depend upon the immediate circulation of the lubricant and thus this undesirable condition is avoided.

A large motor manufacturer reports having used ball bearings in his vertical units for a number of years without a single complaint.

The increased dependability of ball-bearing equipment in vertical motors has resulted in their recommendation by many of the most prominent electrical engineers in this country and abroad. Vertical motors are frequently required to operate in wet and dirty places, such as sumps, sub-basements, pumping stations, etc., where the protection of sealed ball-bearing housing is most desirable. By the use of ball bearings uninterrupted service is attained, and, after all, service in equipment and economic operation is what is always desired.

Ruggedness and foolproof qualities of motors and bearings are prime requisites; but while the modern ball bearing is a highly refined product, with a manufacturing accuracy of a few ten thousandths of an inch, yet because they may be had of the self-aligning type it is not necessary for motor makers to work to such close limits, and the usual manufacturer's tolerances now generally employed in the manufacture of interchangeable parts are quite sufficient. Thus it will be apparent that while motor makers require interchangeable parts in their standard work it is not necessary to have specially trained crews or inspectors to look after ball bearings any more than other parts.

Alignment Chart for Dempster Smith's Formulas for Cutting Speed

By A. Lewis Jenkins

Associate Professor of Mechanical Engineering, University of Cincinnati.

According to Dempster Smith (Trans. Am. Soc. M. E., Vol. 32, page 780) the results of tests published in the "Art of Cutting Metals" is closely represented by the formulas

$$V = \frac{6.5}{\sqrt{fd}} \quad \text{for steel,}$$

$$V = \frac{11}{\sqrt[3]{fd}} \quad \text{for cast iron}$$

V = Cutting speed in feet per min.;
f = Feed per revolution;
d = Depth of cut;
fd = Area of cut

the constants, 6.5 and 11, depend upon the character of the metal cut, the shape and life of the tool. For the varying conditions of operation these formulas may be written

$$V = \frac{c}{\sqrt{fd}} \quad \text{for steel;}$$

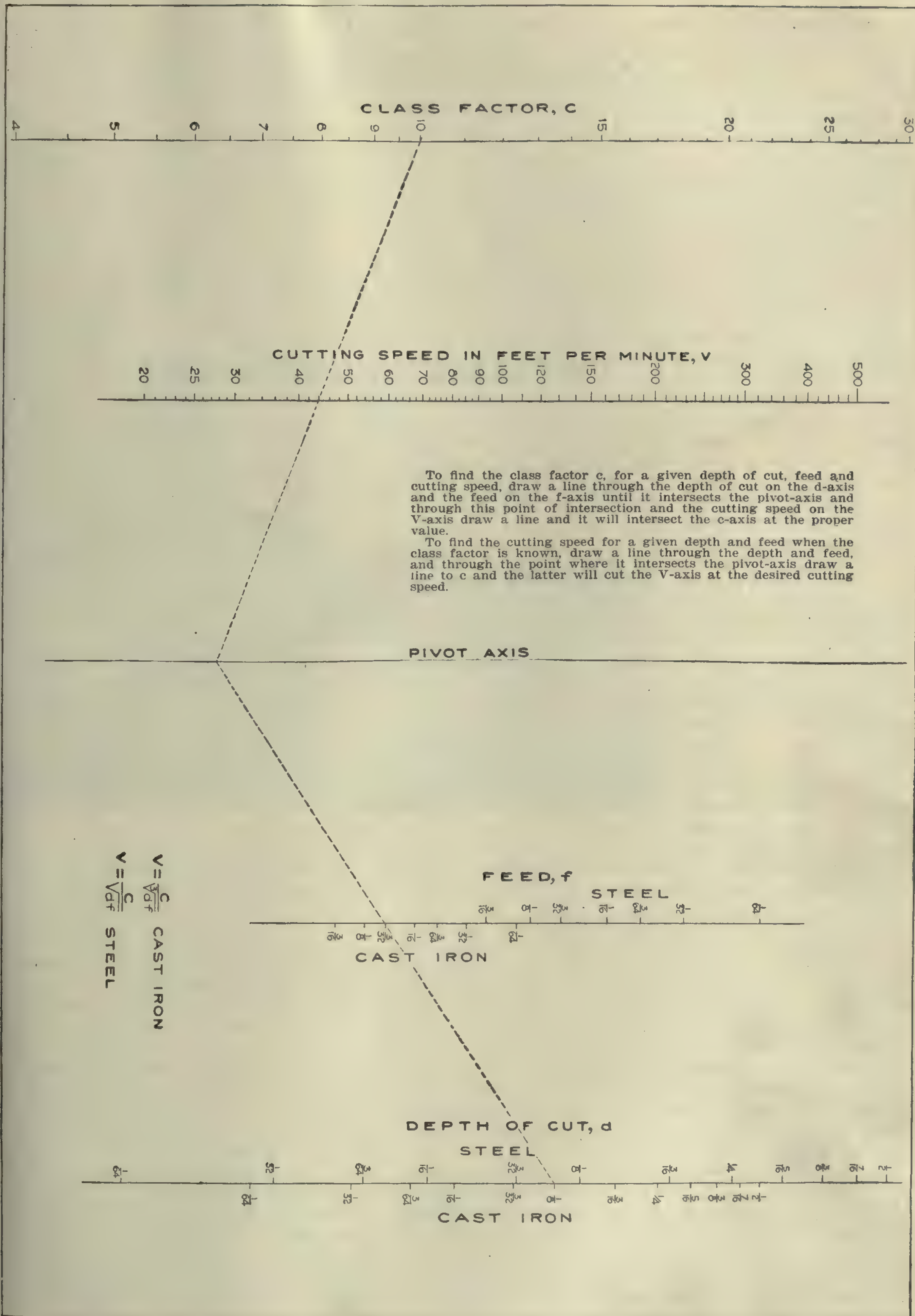
and

$$V = \frac{c}{\sqrt[3]{fd}} \quad \text{for cast iron}$$

where c is a class factor and may be determined experimentally for any class of work and tool.

The class factor for a given material and tool may be found by experimentally determining the cutting speed for a given feed and depth of cut and then substituting these values in the above equations and solving for c or by using the chart to find c. This value of c is supposed to be correct for any feed and depth of cut taken with the same tool and under like conditions. Special graduations on the c-axis may be used to denote the various classes of work.

Example: For a class factor equal to 10, what is the proper cutting speed for a depth of cut equal to $\frac{1}{8}$ in. and feed of $\frac{3}{32}$ in. when cutting cast iron. Draw a line through $\frac{1}{8}$ in. on the d-axis and $\frac{3}{32}$ on the f-axis, and through the pivot where this line cuts the pivot axis draw a line through 10 on the c-axis and it will cut the V-axis at 44, which is the desired cutting speed in feet per minute.



To find the class factor c, for a given depth of cut, feed and cutting speed, draw a line through the depth of cut on the d-axis and the feed on the f-axis until it intersects the pivot-axis and through this point of intersection and the cutting speed on the V-axis draw a line and it will intersect the c-axis at the proper value.

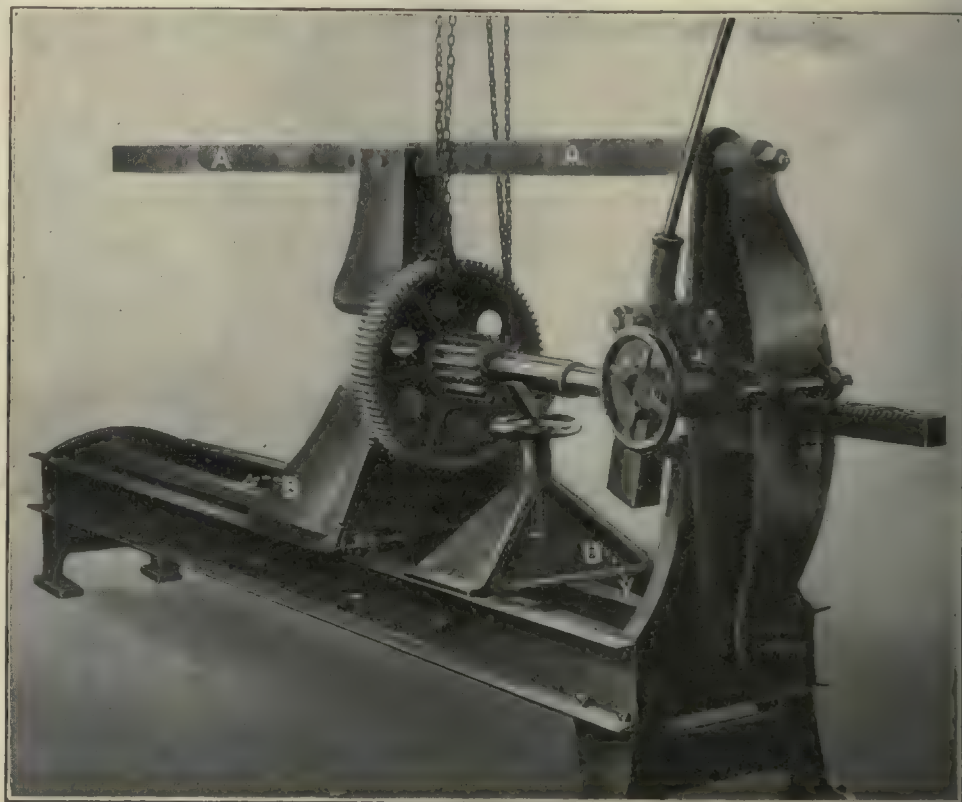
To find the cutting speed for a given depth and feed when the class factor is known, draw a line through the depth and feed, and through the point where it intersects the pivot-axis draw a line to c and the latter will cut the V-axis at the desired cutting speed.

A Heavy-Duty Horizontal Press

By R. H. Wadsworth

Having need in our shop for a horizontal press of the mandrel type of about 20,000 lb. capacity and being unable to find anything on the market to answer our requirements we were constrained to build one to suit ourselves

After studying the catalogs of manufacturers of mandrel presses we decided upon one that would answer our purpose and entered our order for the head only. From detail dimensions furnished we were enabled to make up a drawing in advance so that when the head was delivered we were ready to assemble the press. The illustration shows the completed press with work in position. The maximum length between anvil and ram is 7 ft.; largest diameter of pulley or gear that can be handled is 3 ft. The hand lever is 4 ft. long, and there are two gear ratios providing one speed for light loads and another for heavier work. A pull of 100 lb. on the hand lever with the latter gear ratio gives a resultant pressure of 20,000 lb. at the ram.



A HEAVY-DUTY MANDREL PRESS

The main frame is composed of a pair of 8-in. channel beams securely bolted to the head and the anvil is arranged to slide upon them, though not gibbed to them. Guide pieces are provided to keep the anvil in alignment, and the traverse is accomplished by means of a rack and pinion. The end of the pinion shaft is squared for a detachable rachet wrench, which is shown in place in the illustration.

Two bars *A* and *B*, of rectagular section, take the thrust of the ram, the upper bar *A* passing through a slot in the end of the anvil, its weight being supported by a roller at the bottom of the slot. This arrangement permits the free movement of the anvil upon the frame without tendency to tip up and bind. When the anvil is located at the right point to accommodate the job in hand, 1¼ in.-diameter pins are passed through holes in the anvil and corresponding holes in the bars both top and bottom so that the strain comes directly upon the bars and is not transmitted to or through the frame of the press.

A fork rest, vertically adjustable, is mounted upon the frame in such manner that it can be easily moved to whatever point it may be required to support the work.

Two faceplates with U-shaped openings are provided for supporting the work under pressure, these plates being mounted upon studs projecting from the face of the anvil.

Signal Corps Wants Electrical Men

The Signal Corps, U. S. A., has announced that it can use the services of a large number of men having electrical training. They are needed especially in connection with the radio communication systems in use in the military service. All classes of electrical men—wiremen, expert electricians, storage-battery men, telegraph and wireless operators and men with electrical engineering training and experience—are wanted. The opportunity offered is exceptional because of the great interest and importance of this branch of the service, which has been most aptly characterized as the nerve system of the army. Men engaged in the radio division of the communication work in particular have an increasingly important part in the great intelligence system upon which army operations are almost totally dependent. The work may be divided into three general classes, depending on the character and amount of experience had by the individual; namely, radio operators, radio mechanics and field radio experts.

Application blanks for service in the radio work of the Signal Corps may be secured by addressing the office of the Chief Signal Officer, Land Division, Training Section, Washington, D. C. Men of draft age may make application, and if qualified will be inducted into the army, at their request, for service in this branch of the Signal Corps. After enlistment or induction all personnel will be sent to one of several radio schools for six weeks to three months of intensive training in one of the three general branches of the radio work for which their previous experience qualifies them. Some of the personnel completing these courses will be commissioned, and the opportunity for advancement for all graduates will depend on the individual ability.

Industrial, Mill or Job Gearing—To What Extent Can It Be Standardized?

By FRANK BURGESS
Boston Gear Works, Norfolk Downs, Mass.

This paper was read before the American Gear Manufacturers' Association May 14, 1917, but has not up to this time been published in the technical papers. In view, however, of the fact that gear standardization is to be the theme of the forthcoming annual meeting to be held at White Sulphur Springs, W. Va., Apr. 18-20, it seems especially timely.

A LARGE number of books as well as contributions to mechanical magazines have been written on the various subjects of gearing, going into lengthy details with which the members of this association are familiar. There does not, however, appear to be any organized movement by the members to date as to how orders shall be placed and accepted so as to reduce to a minimum any dissatisfaction occurring in such transactions. Whereas in general the manufacturer is usually posted on the details of standard dimensions it is not customary with the average person, in placing orders, to specify the limits of error on the various measurements given. Years ago I received an important order for automobile gears, wherein was printed in small type the expression, "suitable for the purpose intended." The result in this instance was a costly lawsuit, which might have been avoided had the order been received with more explicit information. Even granted that an actual lawsuit may not be incurred, it is desirable that manufacturers receive clear specifications in order to give satisfaction to their customers.

Standardization

The Society of Automotive Engineers for years has been working to standardize various parts of the automobile, the manufacture of which has reached such a high state of perfection that it behooves all other manufacturers to give the same attention to standardization as is given by this eminent society. For instance, take the subject of heat treatment of steels used in gearwheels, shafts or other parts of the automobile; certainly we should have similar standardization in our association. I have adopted the S. A. E. standard for heat treatment in the manufacture of gears, and use it today for the usual gears manufactured particularly for automobile purposes. The standardization of steels for various purposes specified by a committee would also be of great service to the American Gear Manufacturers' Association and be well worth the time put into a meeting to have it thoroughly threshed out.

I would suggest that all manufacturers of gears, before accepting orders or giving estimates, have a list of specifications that should be mentioned in an inquiry as well as in an order, and the following subjects might be entertained: First, the material to be used.

Steel—There seems to be no unity of ideas among manufacturers, outside of the automobile industry, or customers as to what line of steels to adopt for ordinary gear-using purposes. Standardization of this sort would tend to create a better standardization of materials as now furnished by steel manufacturers by having them checked up by methods that could be adopted by this association. In these abnormal times there will be a greater necessity of holding the manufacturers of steels to greater care in the analysis and final inspection of steels before shipment, so as to eliminate the costly chemical and physical tests now made by gear manufacturers.

Bronze—The subject of bronze, which is used a great deal for worm-gear purposes, also should be standardized with respect to analyzing the component parts most suitable for worm-gear purposes. The Government and the automobile trade have formulated their own specifications, and similar specifications should be adopted where greater durability and nonfriction qualities are to be obtained, particularly where helical-shaped teeth and a sliding motion is desired rather than a rolling motion, as in the spur-gear type.

Cast Iron—In regard to the material called cast iron, with a tensile strength averaging 15,000 to 17,000 lb., there has been a tendency for the last ten years to specify a material possessing 27,000 to 30,000 lb. tensile strength, usually called semi-steel, or gun iron; also a material of higher grade and greater tensile strength averaging from 50,000 to 60,000 lb., commonly known as steel castings.

Fiber, etc.—For the softer and noiseless materials, fiber, rawhide, cloth and the Bakelite Micarta-D, and how and for what purpose such materials shall be used, taking into consideration the question of durability, tables giving the exact conditions under which gears of this type could be used would be valuable to the manufacturer of gears, as well as to customers.

Hammer Test Method for Determining the Strength of Gear Teeth

Some years ago I manufactured a hammer-test machine, an article on which was published in the *American Machinist* of Jan. 12, 1912, for determining the comparative strength of gear teeth subjected to great shocks and strains, particularly for automobile gears. Such a machine could be used for standardizing the subject of breakage rather than mere tensile-strength machines, which are not so convenient to use, besides being more costly in operation as well as in first cost. Furthermore, a real test of the exact condition of the gear teeth should be made after they have been hardened, and if failure occurs before the standard limit has been reached it can be determined whether the right steel has been used, as well as the proper method of heat treatment.

Therefore, in placing orders specifications should make known how high and how many times a 10-lb. hammer raised a certain distance, say 30 to 48 in., can

strike a tooth up to the time of its breakage. Regarding a part of this article on the hammer-test machine, printed in "American Vanadium Facts" of April, 1912, printed in Pittsburgh, it states: "The manufacturer who wishes to know the quality of his output must make use of numerous tests, both for raw material and finished products." A table giving the results of various tests made with this machine can be seen in this article, which shows the number of blows that certain materials resisted before breaking. The standard-test gears used were 6-pitch, 15-teeth, 1-in. face, 14½-deg. involute.

Style

The shape or style of gear, including the exact dimensions of web or spoke, as well as hub, is an important subject, which cannot be reduced to a standard, but depends a great deal on the designer and the particular purpose for which such gears are to be used. There are, however, certain general dimensions which can be kept by referring to the standard catalogs of stock gears, which are usually correct for the size shaft on which the gear is intended to be used. A suggestion on this would be that dimensions of hole and face for certain sizes of standard gears now used shall be printed and, if accepted by the association, be used as far as possible in placing orders for gears, manufacturers and designers to use this as a standard before placing orders, and as far as possible to adopt the standard stock gears manufactured by various concerns, if these standards agree with same.

Kind of Gear To Be Used—Spur, Bevel, Etc.

Specifications should be given of the mating gear, as a manufacturer can more satisfactorily fill a customer's requirements if he possesses full information of this gear and all the conditions under which it is to be used.

Pitch—Diametral, Circular or Chord

This usually comes under the head of diametral pitch, as the one most commonly used; but in the duplication of old gears it is necessary sometimes to give specifications of the circular or chord pitch. Anyone not familiar with the economy and construction of a gear-wheel should be encouraged to use the diametral pitch and to adopt it almost entirely over the older type of circular, or chord, pitch, which is now becoming obsolete. Chord pitch, however, has its advantages over diametral, particularly for worm wheels where there are a small number of teeth (less than 30, and particularly less than 20), in avoiding the undercut or a weakened form of tooth, and is highly recommended where possible to be used.

Pitch Diameter

Orders for gears stating diameter is understood to be the pitch diameter, and for the sake of definiteness should be so specified; also the pitch diameter of the mating gear should be given, in order that the gears can be properly tested before completion. In all cases we have established a rule to cut with the limitation of error on small centers rather than on larger centers, as will be seen from the table on "Standard Limits" here presented. For instance, a gear cut for a pitch diameter of 6 in. would be tested on a center-testing machine with the centers set at exactly 6 in. minus 0.006 in. for all gears cut 6 diametral pitch. Other pitches commonly used are shown in the same table.

Number of Teeth of Worm Gears

Where it is immaterial to obtain an exact ratio it is always best for gears meshing with multiple-thread worms to have an odd ratio of reduction, as this will give a better generating movement than could otherwise be obtained, as related in a pamphlet which I published on the subject of worm gears, worms and spirals.

Face

The face is a matter of design and depends greatly upon the material used. For instance, a steel gear could be used to advantage with the face half, or less than half, that of a cast-iron gear or where a weaker material is used. It is just as well, however, for gears to be standard and as near as possible to the stock gears now made, providing that they are considered proper for the diameter and the size of the shaft used.

Diameter of Hole

This is also a matter of judgment and cannot be determined by a set rule for all purposes; but for the ordinary machines in use I would refer again to the usual stock gears in the market.

Hub, If Any, and Projection

Where spur gears are used hubs are not always necessary, particularly where wide-face gears are adopted. On the narrow-face gears a hub is usually necessary to give stability to the movement and lessen the wobble that may occur. For helical or worm gears, particularly helicals where the end thrust is considerable, it is usually necessary to have hub projection in order to take care of the end thrust by the use of setscrews or pins which can be easily passed through the hub in addition to the use of keys.

Center Distance, If Fixed

It is important in accepting orders to know if the center distance is fixed, so that there may be no misunderstanding as to the exact pitch diameter the gears are to be cut. As mentioned under the head of pitch diameter, it is necessary, however, to establish a slight error in regard to the center distance, and the same table which I have mentioned under pitch diameter can be adopted as they are practically the same.

Form of Tooth, If Not Involute

On account of the various methods of cutting gears, some of the epicycloidal form, some of the short and long addenda, or stub tooth, and some of the extreme angle of 30 deg., as on special worm gearing, it is not well to accept an order unless the specifications of the tooth form are clearly given.

Keyways or Setscrews, If Any

The standard that we have adopted for the straight keyway, which is generally used for the smaller gears, is specified on page 87 of our 1917 gear catalog. This we have found usually satisfactory. I would suggest, however, that for sliding purposes where the gear slides on the shaft or the shaft slides on the gear that a larger key be used for various reasons, and which in

my own case I have found to be much better than the ordinary key that is used where the gear is fastened securely to the shaft. I also advocate that these keys be used in multiples, not less than two. The taper keys, if adopted, should be used as in the list published in the "American Machinist Gear Book," by Logue, page 131. This gives ⅛-in. taper to the foot.

Quality, Accuracy and Finish Required

Quality and accuracy are necessary for most gears. Finish, however, is a matter of preference, but not necessary where used, as in automobiles, out of sight, and run in a bath of oil. Therefore if the required accuracy is obtained, that is all that is necessary. The grinding process is usually the best. Where a high-grade finish is required, it should be specified, and which side of the gear is in sight.

Purpose and Speed, Unless Ordinary

The exact purpose to which gears are to be put should be specified, as well as the speed, in order that the tests and inspection may be more intelligently made. If such information is not given the manufacturer is not responsible, provided he follows the exact specifications in other respects.

Worm and Ratchet, or Helical, if Right or Left Hand

Worm and helical gears are as apt to be left-hand as right-hand. If this specification is omitted and a hob is made up say, for instance, for right-hand, and then it is found that left-hand is required, it would be very expensive, especially in the case of worm gears, to make up another hob for left-hand.

Pressure Angle of Teeth, Unless 14½ Deg. Standard

On bevel gears with 15 teeth or less, where heavy duty is performed, 20 deg. angle is desirable, and in some instances on worm gearing and spurs. By the use of this special pressure angle a smaller gear can be used which will transmit safely heavy loads, as the 14½-deg. pressure angle is not desirable in many cases where the power is great and the driving member is small.

Drawing, Sketch or Blueprint

One of the above is always desirable on receipt of inquires or orders. This will eliminate a great many errors that might otherwise creep in in the giving and receiving of orders. A drawing will very often bring out little details that are otherwise not expressed where an order is merely written, and even on small orders the time put on an ordinary rough sketch should be encouraged.

Maker's Identification and Limits of Error

The method of stamping gears with data such as the gear ratio, pitch, style, symbol and pressure angle and maker's name is becoming more and more good practice and is valuable. Where two concerns manufacture the same style of gears it is necessary that they, at least, have their name stamped on the gear, as well as some symbol for the date, so that in case of replacement or defects the matter may be taken up with the proper person.

As mentioned in the beginning of this paper, the limit of error to be allowed is a most important matter for discussion by this organization, and I have prepared a blueprint giving the standard limits, unless otherwise specified by the customer, that have been

TABLE OF STANDARD LIMITS, UNLESS OTHERWISE SPECIFIED, USED AT THE BOSTON GEAR WORKS

Holes in all cases +0.000 can be —0.0005 in. up to 2 in., and —0.0010 in. from 2 to 6 in.

Width of face may be ±0.002 in. up to ½ in., ±0.005 in. from ½ to 2 in., and ± 0.010 in. over 2 in.

Length through hole may be —0.000 in. in all cases and +0.0025 in. up to ½ in., +0.005 in. from ½ to 2 in., and +0.010 over 2 in.

Hub diameter may be —0.000 in. in all cases and may be +0.005 in. up to ½ in., +0.015 in. from ½ to 2 in., and +0.025 over 2 in.

Backing distance on bevels from tip of tooth to end of hub may be +0.000 in all cases and may be —0.002 in. up to 16 pitch, —0.004 in. from 16 to 10 pitch, and —0.005 in. from 9 to 3 pitch.

Outside diameter may be +0.000 in. in all cases and —0.005 in. up to 10 pitch, —0.007 in. from 9 to 6 pitch, and —0.015 in. from 5 to 3 pitch.

Eccentricity of the outside diameter may be 0.002 in. up to 16 pitch, 0.003 in. from 16 to 10 pitch, 0.005 in. from 9 to 6 pitch, and 0.010 in. from 5 to 3 pitch.

Eccentricity of pitch diameter may be 0.001 in. up to 4 in., 0.002 in. from 4 to 8 in., and 0.003 in. from 8 to 24 in. Helicals, spirals and bevels to be held close to 0.001 in.

Run out at the rim may be 0.001 in. up to 3 in., 0.002 in. from 3 to 6 in., 0.003 in. from 6 to 9 in., 0.005 in. from 9 to 12 in., and 0.010 in. from 12 to 24 in. Helicals and spirals to be held close to 0.001 in.

Center distance may never exceed standard, but may be below standard by the following amounts: 64 pitch, —0.002 in.; 32 pitch, —0.003 in.; 24 pitch, —0.004 in.; 16 pitch, —0.004 in.; 12 pitch, —0.005 in.; 10 pitch, —0.005 in.; 8 pitch, —0.006 in.; 6 pitch, —0.006 in.; 5 pitch, —0.007 in.; 4 pitch, —0.008 in.; 3 pitch, —0.010 in.; 2 pitch, —0.012 in.

established in our shop for our inspectors' use, and a copy of this will be sent to any member of the association for his information. I would be glad to receive correspondence in reference to this matter and will endeavor to reply as far as possible, so that later on we can take a vote on some set of tables of this kind after it has been thoroughly investigated by the members.

Unwarranted Accuracy in the Machining of Various Parts

In my shop it was found necessary to establish these limits, which have proved very successful for a number of years, and practically few changes have been made on this list. The average gear order is liable to be placed by a draftsman who is not fully competent to give limits, and if limits are given they often call for unwarranted accuracy, thereby increasing greatly the cost of production and causing delay in the manufacture. For instance, we have sometimes received orders from responsible concerns asking for the fourth or fifth figure decimal in regard to outside diameter and face of gears, which to those versed in the business is known to be impractical and unnecessary. With the confusion existing on this matter—absolutely no standardization of terms such as back lash, hub projection, lead and pitch, pressure angle, size of hole, keyways, etc.—some table giving these limits of error, where not necessary to be otherwise, would be a great boon to gear manufacturers. Bear in mind that it will be absolutely impossible to get out a set of tables that will cover all cases, but from experience in my own shop probably 90 per cent. of all orders will be covered by the table I have submitted.

Regarding the standard limits on the limit tables submitted, I would particularly refer to the matter of backing distance of bevel gears, which is an important matter to have standardized, as this distance is theoretically figured from the pitch diameter to the end of the hub, but in measuring it is taken from the

tip of the gear to the end of the hub. The limits as expressed on the sheet have been quite satisfactory in our own manufacture.

In conclusion I would say that I would be very glad to obtain any sheet from other members that may be used by them and found to be satisfactory, and if each member is willing to submit a sheet similar to the one which I offer this would be invaluable to the association. In this way a comparison could be made of the various limits allowed by the different members, on regular work, and after comparison has been made, where the majority agree to certain limits, a standard could then be established for the association, and anyone coming within these limits would have the approval of the association as to the manufactured product. These standard limits could then be printed and circulated by the different members of the association to the trade, and a similar standard of measurement established as is now adopted by the S. A. E. in regard to the standardization of material and heat treatments.

Harry Replies to His Uncle

(Contributed.—With apologies to the real author of this series.)

Dear Uncle—I am in receipt of your letter of recent date, copy of which appeared on page 226 of the *American Machinist*, and I was very much interested in the new psychological employment wrinkle which you outlined therein, particularly as we, in common with other and more prominent industries, have experienced considerable difficulty in securing efficient help.

We did not happen to have a one-legged man available for the head of the employment department (all of our elevators being properly equipped with safety devices), but we were able to secure the services of a young female person of more or less charming and business-like appearance, who laid verbal claim to a thorough understanding of the vagaries of human nature, backed by a wide experience in the assorting and classification of all kinds of jobseekers, and assigning to them positions to which their peculiarities best adapted them. She gracefully acknowledged her twenty-three summers—she did not mention any winters, which in view of recent weather conditions I thought somewhat strange—and modestly admitted that she was the best litle help-getter in seven counties.

After adjusting the position of her escritoire to her satisfaction, putting up suitable decorative units of lavender and cerise ribbons, arranging sundry bric-à-brac to secure just the proper effect and requisitioning the purchasing department for a Mojave rug, she settled down to her business of filling our shop with toolmakers, etc. (especially the latter), of irreproachable manners and incomparable appearance.

Believe me, they were some toolmakers! They wore just the right weight of horn-rimmed spectacles, parted their hair three degrees west of the meridian, and their taste in neckwear was something phenomenal. Many of them were able to get along for a whole week without getting more than one spot on their immaculate *creepy de chinee* aprons. I did not notice that any of them smoked "Pulchritudes;" most of 'em seemed to prefer the commoner brands—Meccas, Camels, etc., but they knew more about sine bars, Johanssen gages, dial indicators and buttons than the men who invented them; in fact not a few of them seemed to have all their own buttons, while others—but why go into details? Things were going along very smoothly indeed until one sad day the Lady Directress of the Employment Chiffonier—pardon me; the Employment Bureau—up and married the best-looking toolmaker in the whole bunch.

This would not have been a serious matter in itself, but when the fellow stayed out a whole week to celebrate the event by getting canned, I was obliged to can him. He wasn't much of a toolmaker anyway.

In the reign of chaos immediately following the resultant breakdown of our necessary article of industrial furniture, the office boy stepped into the breach and assumed charge of the hiring, while the fireman, a husky and peculiarly appropriate individual for the job, attended to the firing. However, as the aforesaid office boy (whose hair was a delicate shade of brick) flatly refused to hire on anybody whom he could not lick, his policy soon assumed the prospect of a grave menace to the standing of our little concern in the athletic field, and I was obliged again to interfere with things.

We now have a full-fledged and certificated Psychological Engineer attending to this essential feature of our business, and we have a complete assortment of mauve, ecru, and roses-of-ashes blank forms to carry out the details. The dark black forms with margins of the same shade have not yet been delivered, owing to an unfortunate controversy with the stationer as to the point where the body color should leave off and the border begin, but no doubt this will be satisfactorily arranged.

I see no reason why things should not go along swimmingly now that we are well started, but despite the rosy outlook, there are moments when I feel an unaccountable discouragement, and it seems as if nothing would do but that I get into my overalls, go out in the shop and fire somebody. I thank you for your kind suggestions, and will keep you posted as to results.

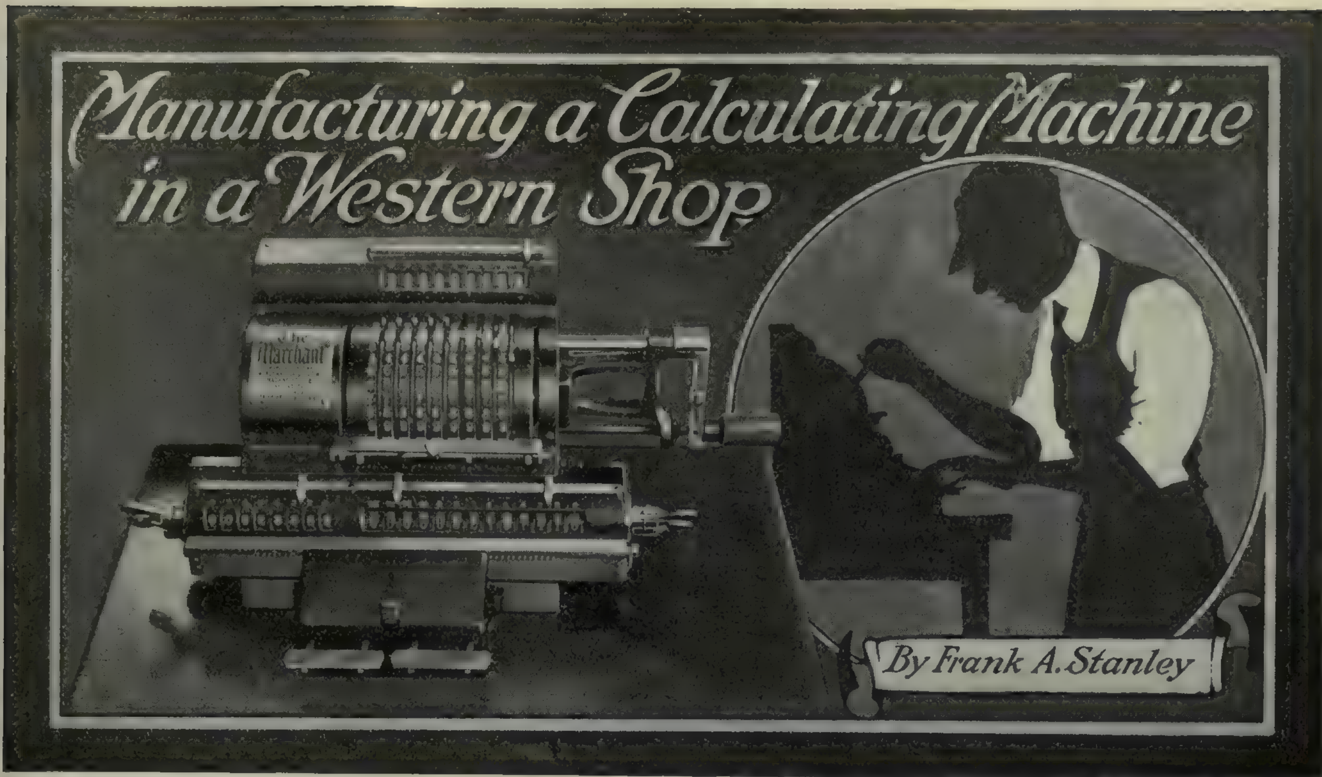
Your graceless nephew,

HARRY.

P.S. Can you tell me where I can get the right shade of white ink, in barrel lots, for filling out the black forms? H.

Ott Plain Grinding Machine—Erratum

On page 553 in the description of the Ott plain grinding machine an incorrect address was given. The correct address of the Ott Grinder Co. is Indianapolis.



II.—Work on Setting Dials

These dials have some accurate slotting and notching operations which are performed after the blanks are turned by means of a special indexing fixture which is here described in detail, after a general account of some of the preceding practice on other parts of the work.

THE setting dials for the calculating machine made at the Marchant Calculating Machine Co.'s plant in Oakland, Calif., are illustrated full size in the illustration, Fig. 16. The dials are carried side by side on a spindle to form a drum, and in assembled condition they are mounted between the side brackets at the rear of the base of the machine.

There are 12 of these dials to each drum or set; all are of cast brass, and of uniform diameter, thickness, bore, etc., but all vary from one another in respect to the locations of certain groups of slots which control the action of the different dials and their movements in relation to other apparatus in the machine.

Upon examining the illustration, Fig. 16, it will be noticed that nine dials in the drum, counting from right to left, are each provided with operating pins placed in radial slots in the left face of the dial. There are nine of these pins in each dial and they are adjusted outwardly into operative position by a sheet-metal cam which is set at the desired point by means of a lever-shaped projection clearly represented at the bottom of the drum. The cam is mounted upon a large hub machined on the face of the dial, and in operation is set to throw out one, two, three or more pins, up to nine, according to the computation to be performed on the machine. If the cam is moved in the reverse direction, the operating pins are withdrawn, and their ends then stand flush with the dial periphery and in inoperative position.

The location of the slots in the dials vary from one dial to another, as pointed out above, the entire series in the set of dials taking the form of a number of helixes across the face of the drum when the dials are assembled in place upon their spindle. This feature is quite noticeable when the illustration of the drum is examined carefully.

There are many interesting features involved in the production of these dials, particularly as the work reaches the point where the cutting of the slots is accomplished. This operation is performed in a milling-machine fixture, in which are incorporated some novel details of design.

The dimensions of the dials and the locations of the various slots are given in Figs. 17 and 18, where two disks, Nos. 3 and 4 in the drum series, are represented. While they are alike in general dimensions, their slots, as noted, are differently placed as to angular position, and for this reason the two dials are illustrated as indicative of the varying slot positions throughout the series. A brief consideration of the angular advance which the group of slots in one dial bears to the corresponding group in the adjacent dial will give an idea of the helical arrangement of the slot groups throughout the entire series of dials which constitute the assembled drum.

In laying out these slots in the different dials to secure their correct angular relationship, and in constructing the special fixture for the milling of these slots in all of the dials, some important problems came up for solution; and on the toolroom end of the work the milling-machine dividing head proved indispensable, as it so often does in cases where accurate spacing between holes and slots is required on special jigs and fixtures.

The slot-milling fixture with its indexing features will

be taken up in detail at a later point in this article, and some attention will also be given to the process of making certain of its members in the tool department.

Returning for the moment to the dials themselves they have, as indicated by Figs. 17 and 18, a common diameter of 2.325 in. They are provided with hubs or shoulders at each side, the one for the operating cam referred to being on the left side and having a diameter of 1.574 in., which leaves an allowance of 0.001 in. under the diameter of the hole in the sheet-metal cam member which fits over the hub. The outer rim of the dial extending beyond the two shouldered portions is 0.10 in. thick, and the thickness of the body of the dial is 0.275 in. The bore is finish reamed to 0.4062 in. in diameter.

Machine Work

The dials of cast brass, after boring and reaming to the size of a work-holding arbor, are turned and faced in a lathe as illustrated by Fig. 19, which shows the method of holding the brass disk on a short plug arbor provided with a taper shank fitting the hole in the head spindle. The body of the arbor is closely fitted to the reamed hole in the brass disk, and is split for a short distance to enable a slight degree of expansion to be effected by a taper draw-in plug fitted into the center of the arbor.

The facing and turning of the piece is accomplished with simple tools which in the finishing cuts are controlled by carriage stops and checked for accuracy of work by micrometer measurements over the particular dimensions.

A reaming operation follows to assure the bore of the dial being exactly to size after the piece has been rough-turned on the lathe arbor. It is accomplished in the jig shown on the drilling machine in Fig. 20. Here only a minute amount of metal (merely a scraping cut) is removed with the tool, the latter being controlled as to steadiness of running by the guide bushing, while the work is free to float under the tool without the necessity of clamping in the jig.

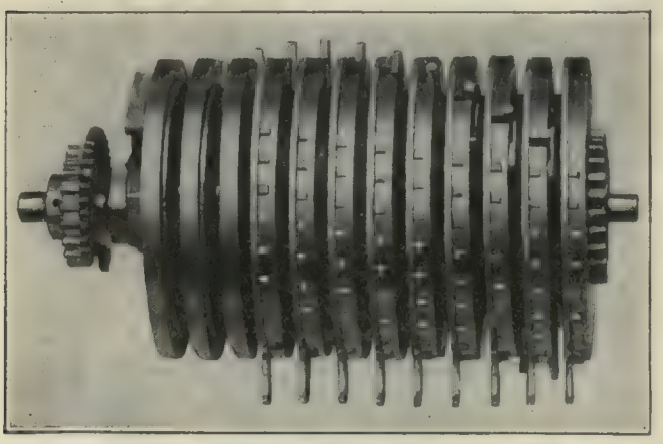
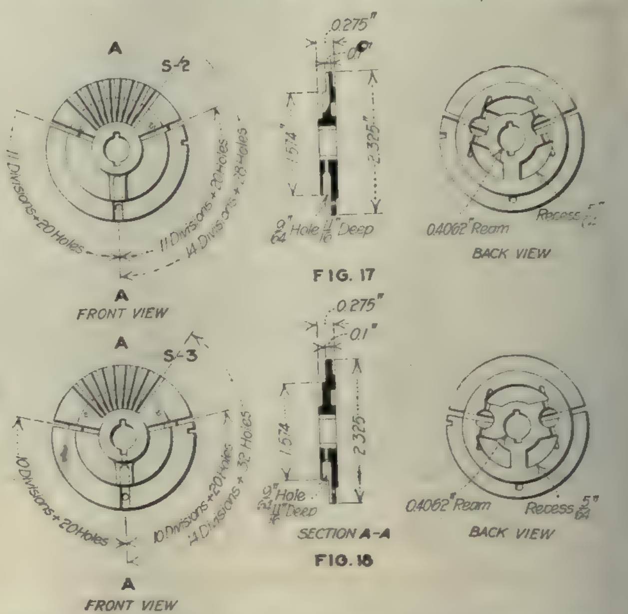


FIG. 16. THE SETTING DIALS SHOWN ASSEMBLED IN THEIR DRUM

After the finishing of the blank dial to size and thickness it is ready for slotting on the index-milling fixture, Fig. 21, which is used on the table of a hand milling machine. This fixture is so constructed as to accomplish with one index plate the slotting operations on all the different dials in the drum of the calculating machine; for though the slot groups are all differently positioned in relation to their individual dials throughout the set, they are all of the same spacing, so that with the adjustment to be later described, the one index plate not only locates the slot groups, but also the through slots milled across the edges of the dials.

The index plate of this fixture is over four times the diameter of the dials to be slotted. Therefore any possible error that might exist in the index plate itself would be reduced to negligibilty as a consequence of the reduced ratio. The work is secured in place on the fixture by a quick-acting clamping device, and when the dial has been slotted it is removed by an ejecting arrangement analogous to the device commonly used in press tools for ejecting blanks from the die.



FIGS. 17 AND 18. TWO ADJACENT DIALS WITH DIFFERENT POSITION OF SLOTS

As the dials come from this slotting fixture they are placed on holding pegs or rods secured in blocks, as in Fig. 22, where they remain until required at the assembling bench. Each rod carries a stack of 20 or more dials, so that one rod is thus the holder for No. 1 dials, the next rod for No. 2 dials and so on. Thus in making up the drum, the assemblers take one dial for each drum from each stack on the board, and thus they avoid confusion.

Handling Finished Material

The closets in Fig. 22 are the storage cabinets for such parts while awaiting transfer to the assembling benches. The system of boards, with their vertical pegs, serves all the purposes of tote boxes or trays and enables the finished dials to be handled without danger of becoming marred or injured from their edges striking one another or against other parts.

This system of handling parts of this character is developed for general use about the plant and forms of itself a good indication of the careful and painstaking methods or the organization in putting work through the factory.

The working drawing, Fig. 23, may now be examined, as this shows the important features of the fixture.

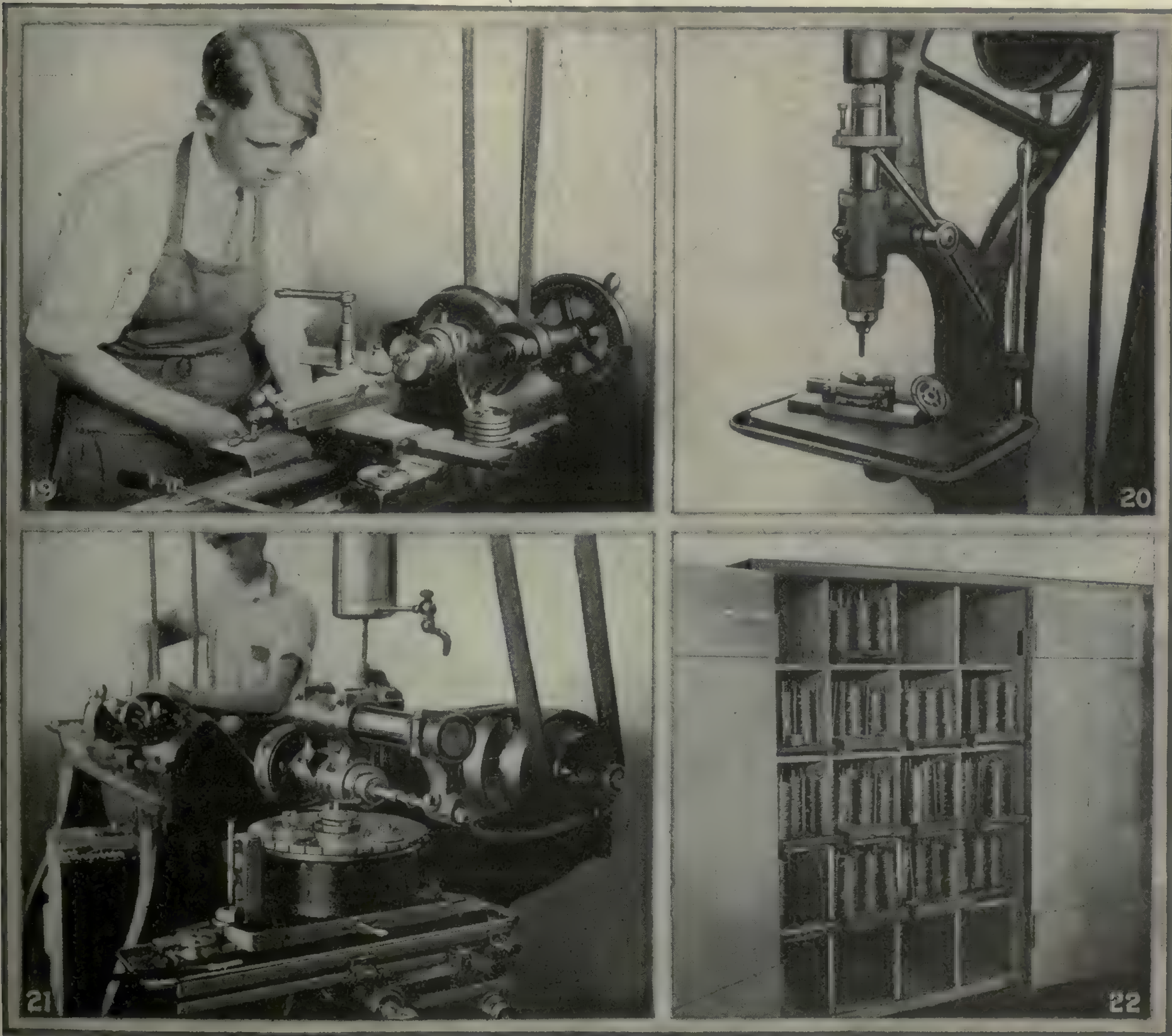
The base *A* is of cast iron and is bored out at the center to receive the vertical spindle *B* which has a

45-deg. bearing under its upper shoulder, and which is fitted at its lower end with a bearing ring *C* beveled to the same angle and adjusted properly to its seat by means of the split nut *D* which is clamped to the threaded portion of the spindle by a fillister-head screw at *E*. The upper end of the spindle is turned down to a 7.750-in. diameter to receive the two circular plates *F* and *G*, the lower plate *F* being fastened to the shoulder on the spindle by four 10x32 fillister-head screws and one $\frac{1}{4}$-in. dowel pin. The upper plate *G*, or index plate proper, is adjustably mounted on plate *F*, the knurled head plug at *H* in one of the locating holes Nos. 1 to 9 giving the index plate the desired position in respect to the lower plate. Four collar-head screws through slots at *I* secure the index plate to the lower plate when adjustment has been made. This arrangement provides for the desired amount of adjustment of the index plate around the axis of the spindle, consequently for the requisite degree of angular adjustment in respect to the work itself, which is mounted upon the carrier *J* which in turn is secured directly to the spindle.

This carrier, or it might better be called a faceplate, is made with a hub on its under side, which fits snugly into a seat bored in the upper end of the spindle. The flange on *J* allows three small countersunk machine-head screws to be utilized for holding it in place on the spindle; also a small dowel is used to locate it definitely, irrespective of the screws.

The carrier *J* has at the top a central hub or pilot which is ground to 0.4055-in. in diameter to receive the work or dials to be slotted. The dials are all jig drilled on the center line at a point near the periphery to receive the small locating pin *K*. Another small hole, which will be seen in this view of the work and which is jig drilled in a preliminary operation, is a $\frac{9}{16}$-in. hole put in radially from the edge to receive a spring plunger or detent which acts as a stop to control the cam ring with which the dial is fitted when the series of dials are assembled into the drum unit for the calculating machine.

When the dial to be slotted is placed over the hub on carrier *J* it is secured by the slip washer *L* and the screw *M* which is operated by the snap handle *N*.



FIGS. 19 TO 22. VARIOUS OPERATIONS ON DIALS

Fig. 19—Machining dial blanks in the lathe. Fig. 20—Reaming operation in the drilling machine. Fig. 21—The indexing fixture. Fig. 22—Storage of dials before assembling

The latter is $1\frac{1}{2}$ in. in length and 0.400 in. in diameter so that it may allow the work to be slipped down over it and into place on the fixture, when in the vertical position on the milling machine, after which the handle can be brought down to a horizontal position and given a slight turn to tighten the screw and bind the washer and dial in position. To release the work the handle is merely turned back to free the washer, the washer removed and the handle raised to upright position. The knock-out bar *O* is then operated by a lever projecting from the front of the fixture, pushing up the three ejector pins *P* and lifting the work from its seat on the spindle.

The three pins are shouldered at the bottom and fit into holes drilled in the face of a round plate which is mounted on the reduced end of the knock-out bar *O* and which is a sliding fit in the chamber bored in the spindle. Above this plate is placed a compression spring which forces the knock-out bar downward as soon as the operating handle in front is released.

The snap handle *N* is held perpendicular while the work is being removed by means of a small spring-actuated detent which is inclosed in the body of the clamp screw *M*, the pointed upper end of this detent entering a corresponding seat in the lower end of the handle, keeping the latter upright while the work is changed.

The index plate *G* is $10\frac{1}{2}$ in. outside diameter by $\frac{3}{8}$ in. thick. It has three groups of index notches cut into the edge, these notches having an included angle of 20 deg. The locking device is in the form of a thumb latch *Q* which is normally held in engagement with one of the notches by means of a flat spring, as indicated on the drawing. The block *R* directly opposite the index latch is a fixed guide for setting the slotting cutter for the work directly on the center line. The milling cutter used is 0.079 in. thick by $\frac{15}{16}$ in. in diameter.

The group of nine notches at *S* in the index plate are for locating the nine radial slots as shown at *S*-2, Fig. 17, and *S*-3, Fig. 18, these slots being required in the faces of nine of the dials in the drum unit. The slots are uniformly spaced in respect to each other in all dials, but the position of each group in relation to the center line *AA* (Fig. 17) varies with each dial in the set. There is an angular advance by a definite amount from the first slot in the first dial of the set to the corresponding slot in the next dial, and so on throughout the set. But, as has been pointed out, the spacing between slots is alike in all dials so that the one set of index-plate notches at *S*, Fig. 23, serves for all dials, the necessary adjustment to secure the offset relation of one group of slots to the next group being effected by the plug *H* and the nine holes by which the index plate is located in relation to the lower plate *F*.

If we examine the detail drawings, Figs. 17 and 18, we find that the dials have the slots spaced just $\frac{1}{37}$ of the circumference apart, which would include an angle of 9 deg. 43 min. 47.02 sec. If these dials were to be slotted directly on the dividing head of a milling machine the desired spacing could be obtained by using the 37 circle on the index plate of the dividing head

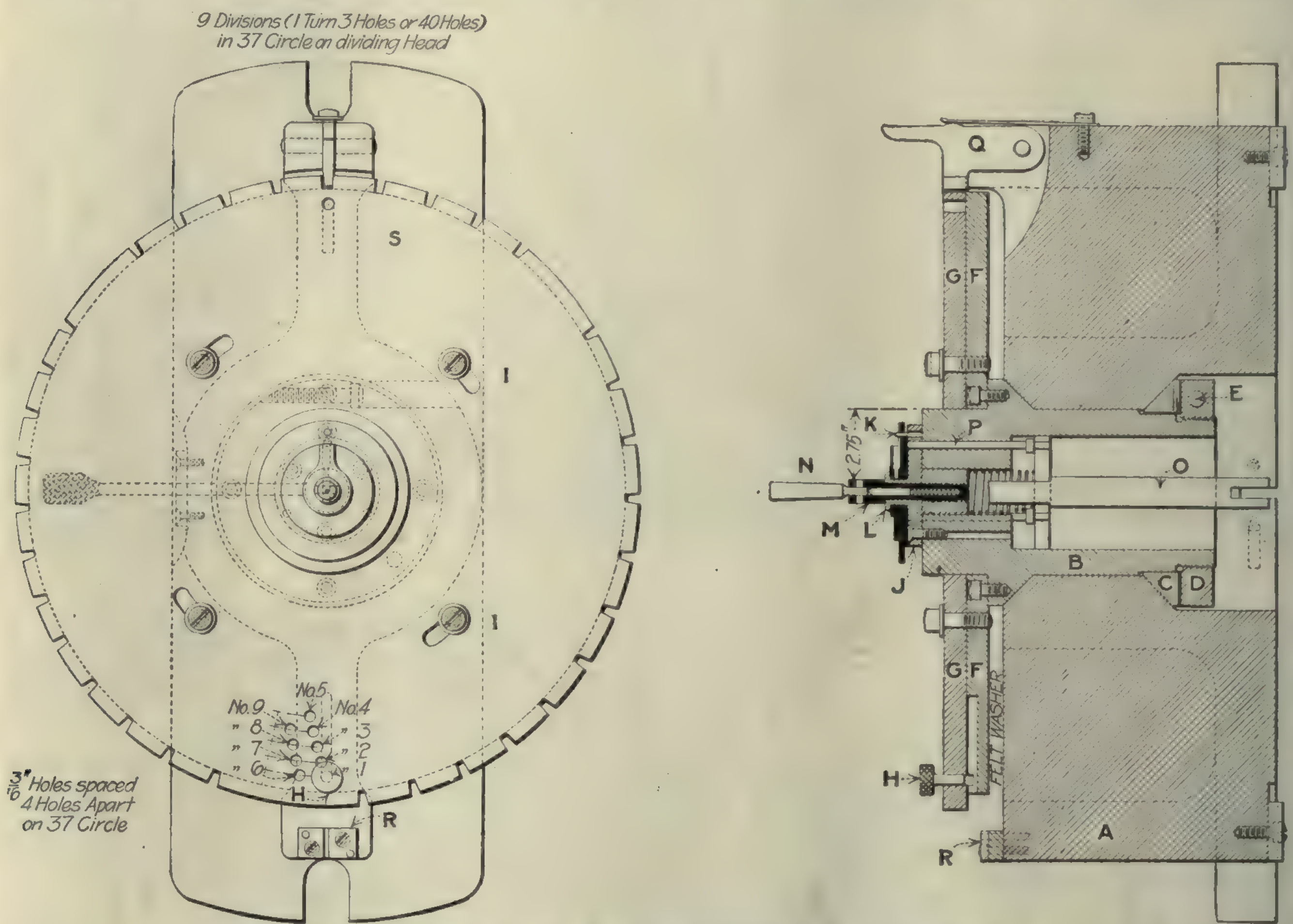


FIG. 23. CONSTRUCTION OF MILLING FIXTURE FOR SLOTTING DIALS

and making one turn plus three holes, or 40 holes for each advance of the index crank. This is in fact the index movement used in cutting the nine notches *S* in the index plate for the fixture in Fig. 23.

Comparing now the two dials in Figs. 17 and 18, it will be seen that the angular distance of the first slot *S*-2, Fig. 17, from the center line *AA* is equivalent to "14 divisions plus 28 holes," while the corresponding

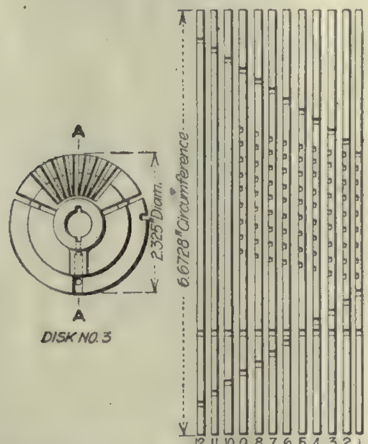


FIG. 24. DEVELOPMENT OF DIAL SURFACES SHOWING HELICAL LINES OF SLOTS AND NOTCHES

slot *S*-3 in the next dial, Fig. 18, is located "14 divisions plus 32 holes" from the center line, or an advance equal to four holes on the 37 circle of the index plate of the milling-machine dividing head. Referring again to Fig. 23, we shall find that the series of offset holes for plug *H* in the index plate *G* are spaced in accordance with these figures, giving an angular advance of 58 min. 23 sec., or slightly under 1 deg., for each succeeding hole.

Locating Holes for Adjusting Plug

This plug which establishes the required relationship between the index plate *G* and the spindle plate *F* is beveled off on opposite sides and enters a 20-deg. slot provided in the top face of plate *F*. The slot is made along the center line of the plate for a distance of about $1\frac{3}{4}$ in. and answers for all positions of the setting plug *H*.

As there are nine locating holes for the adjusting plug, there will be eight steps from the first hole, No. 1, to the last one, No. 9; and upon multiplying 58 min. 23 sec. by 8 we find the total angle included between the first and the last holes to be 7 deg. 47 min. 4 seconds.

The holes are $\frac{3}{16}$ in. in diameter and are placed at five different radii from the center of the plate, the radial distances varying by $\frac{1}{4}$ in. The work was done in the milling machine with the plate mounted upon the dividing head, a drill and a boring tool being used in a small chuck in the machine spindle. No. 1 hole was located on the vertical center line of the work with a spotting drill, and a hole drilled through, a trifle under finish size, the hole being finished with a boring tool to the size of a standard plug. The machine table was then lowered $\frac{1}{4}$ in. and the work indexed to position for No. 2 hole by moving the crankpin of the dividing head four holes in the 37 circle. This gave the setting for the second hole. Similar procedure was followed for the holes Nos. 3, 4 and 5, and then the machine table was raised an inch to bring the work up again to the right height for the outer hole No. 6 and the plate indexed as before for the angular position of this hole. The three remaining holes were put through in similar manner, completing the work on this portion of the index plate.

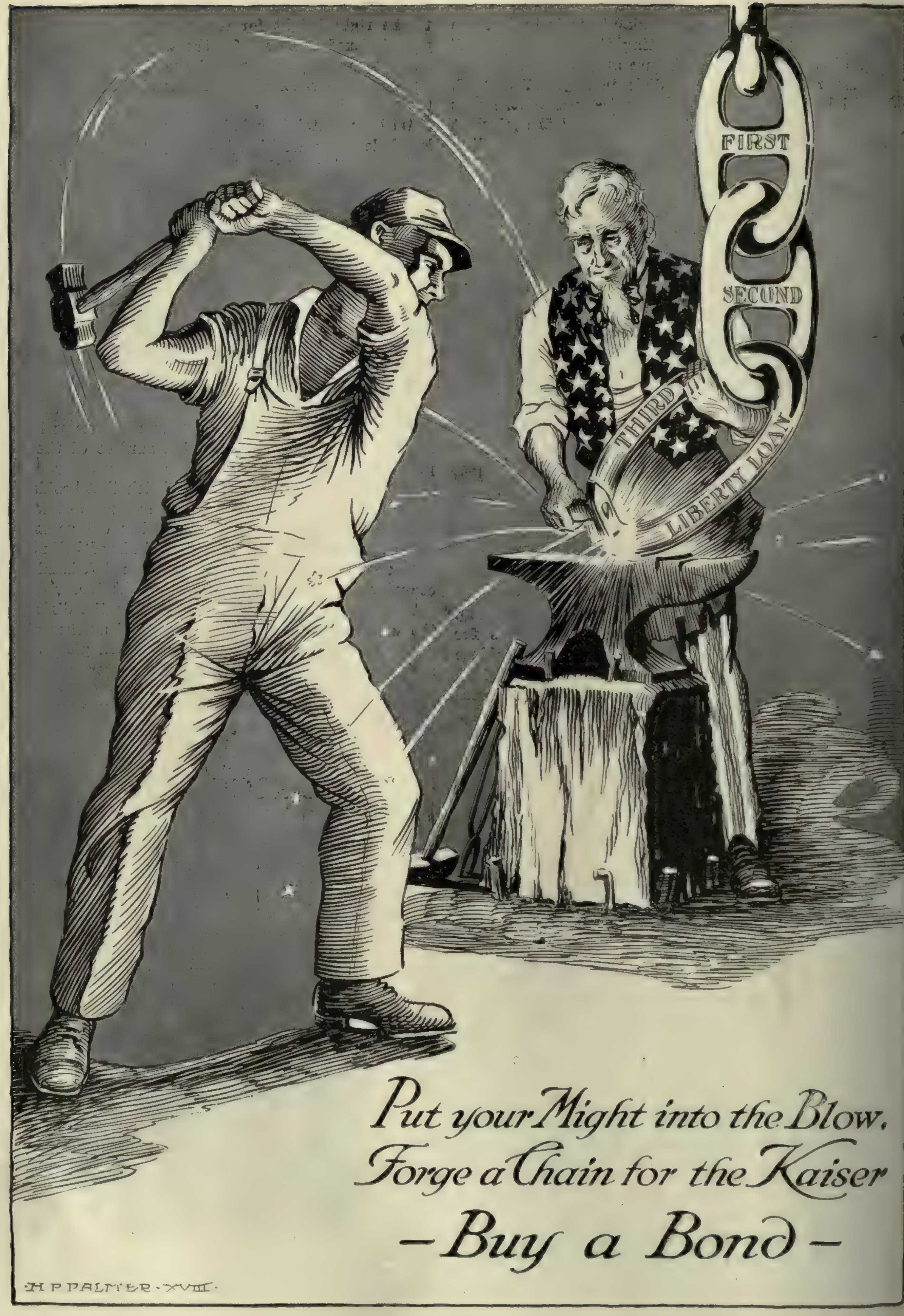
With the total included angle between the first and last holes as a working basis, as described above, the actual position of the slots in relation to the circumference of the dials can be readily determined in decimal fractions.

The diameter of the dial being 2.325 in., the circumference will be 7.304 in., which divided by 360 gives 0.02029 in. as the circumferential distance corresponding to 1 deg. of arc. This multiplied by 7 deg. 47 min. 4 sec. gives the total distance from the position of the first slot of the first dial to the corresponding slot of the ninth dial as 0.1579, stated as before in decimal fractions laid down upon the periphery.

Fig. 24 is a development of the peripheries of a set of 12 dials calculated upon this basis, showing the relative positions of the successive slot groups located is parallel helical lines along the surface of the completed drum.

It will be gathered from this sketch that besides the groups of nine radial slots in each of nine dial faces, there are two single rows of notches cut across the dial edges, one row following a right-hand helix above the center line and the other taking a left-hand helix course across the lower half of the sketch.

These two lines of cuts are made in the dials with the work indexed by the two series of notches at the right and left sides of the fixture index plate as described in *G*, Fig. 23.


FIRST
SECOND
THIRD
LIBERTY LOAN
Put your Might into the Blow.
Forge a Chain for the Kaiser
-Buy a Bond-
H P PALMER · XVIII ·

Principle of the Generation and Application of Heat in Steel Treating

By A. F. MacFARLAND

This paper discusses the general principles underlying the selection and use of various types of heat-treating furnaces.

THE following article is an extract from a paper read before the Chicago Section of the Steel Treating Society, Jan. 14, 1918, by the metallurgist of the U. S. Ball Bearing Manufacturing Co.:

The primary considerations in the heat treatment of steel are the generation of heat and its subsequent application to the parts undergoing treatment. Dealing with this large subject in a short paper of this nature has been, I must confess, somewhat of a problem. There are so many important points to be considered that it has been deemed expedient to deal only with the fundamental principles involved, as exemplified by some of the methods in use at the present time.

Ideal heat-treating conditions would be realized if we were able to transmit simultaneously to each molecule of steel a given amount of heat in a given time. This, however, in practice is not attainable for reasons that appear obvious upon a consideration of the inherent properties of steel, particularly its specific conductivity. As an illustration of this ideal situation, assuming that we have a solid sphere of steel suspended by some means in a hollow spherical muffle which is heated uniformly, the ideal is approached, obviously, as the size of the steel sphere decreases. In an effort to approach as nearly as possible to the ideal in heat treating, fuel and furnace engineers have brought out a vast number of burners and furnaces of various types and designs, many of which are on the market at the present time.

Industrial Heating

In industrial heating there is no general solution as to what to use as a heating element and what sort of furnace to use it in. No single type of furnace, fuel or system is applicable to all problems. Quality of product and cost of manufacture are the bases on which the selection of the method of heat treatment should be determined. Obviously, it would not be feasible from a practical standpoint to treat eighteen-pound, high-explosive shells in small electric furnaces, nor would it be advisable to treat small steel balls in a gas furnace with a 6 x 4-in hearth. Each class of work calls for its own special arrangement for heat treating, hence we have such great variety in furnace design and such varied methods of heat generation.

The accompanying table shows fuels commonly used for heat treating, with their relative heating value and cost. Electricity has been classed here as a fuel, inasmuch as this paper deals with it primarily as a means of heat generation. The figures for fuel oil, city gas and electricity are based on recent prices; however, it is not desired that any of these computations be taken authoritatively; in these days of fluctuating prices the computation of today are entirely upset by the quotations of tomorrow. Note buying power of 1c. in B.t.u.

A great many mistakes have been made in selecting a fuel from a chart of this nature. It is true that these figures represent accurately the calorific value of fuels determined by careful experiment in the laboratory. However, the actual calorific power obtained in practice depends entirely upon the method of burning the fuel. For example, the old-style oil burner of the forge shop will not give the calorific value from one gallon of oil that the recently perfected vaporizing system for burning oil will give. The general manager of one of the most progressive drop-forge plants in this country told me that he had cut his oil bill in half by replacing the old-style burners with his improved vaporizing system.

TABLE OF RELATIVE HEATING VALUE AND COST OF FUELS

	Price Basis	B.t.u. Basis	No. B.t.u. for 1c.
Electricity	$0.01 per K.w.	3,412	3,412
City gas	.75 per 1,000 cu.ft.	600	8,000
Natural gas	.50 per 1,000 cu.ft.	950	19,000
Producer gas	.10 per 1,000 cu.ft.	145	14,500
Crude oil	.075 per gal.	146,000	19,466
Kerosene oil	.140 per gal.	132,000	9,429
Bituminous coal	9.50 per ton	14,000	20,473

The means used for the generation of heat also bears an important relation to the quality of product. A fuel which carries a considerable percentage of sulphur has a deleterious effect on steel when the products of combustion come in contact with the metal. Oxidizing gases in the furnace cause excessive scaling and sometimes troublesome decarbonization of steel furnaces. The ease with which furnace atmospheres are able to be maintained depends largely upon the flexibility of the medium of heat generation. By flexibility is meant the ease with which the fuel lends itself to producing either oxidizing or reducing atmospheres in the furnace. Gas and oil are more easily controlled in this respect than coal or coke, depending somewhat on the facilities of burning them, while electricity is an ideal heating medium for producing neutral atmospheres. I hardened a number of small parts a short time ago in an electric furnace. To my surprise, after quenching the parts from 1500 deg. F., not one of them showed the least particle of scale or oxidation. We investigated the matter immediately and found that a new piece of insulating brick placed in the furnace was responsible for the phenomenon, as it contained a substance which produced a strongly reducing atmosphere in the furnace. This phenomenon should prove of interest to some manufacturers who are treating parts where even the thinnest scale is undesirable. The cheapest fuel on a strictly B.t.u. or calorific basis is not often the cheapest fuel for heat-treating steel when all the factors which have a distinct influence on the subject are taken into consideration. There is always a right fuel for the particular heat-treating operation at hand, and each problem should be thoroughly studied and understood if the best solution is to be had. I might mention that in heat generation and application the human element plays a very important part. The manufacturer who invests in expensive furnaces and fuel equipment

makes a grave mistake is he fails at the same time to invest in a suitable amount of brains to operate this equipment for him efficiently. Foolproof heat-treating equipment is still a thing of the future, although considerable progress along the lines of automatic temperature control has been made, resulting in various appliances which tend to minimize the difficulties encountered, especially on very large installations where uniformity is as important as the enormous production.

Furnace builders, up to the past few years, with a few possible exceptions, seem to have been in a dormant state. While pyrometry, metallography and other related branches of heat-treating were making rapid progress, the furnace men were apparently mentally asleep, and it is only until comparatively recent years that they have been awakened to the crying need of better furnaces. With this awakening has come the electric furnace, new systems for burning oil, gas and coal, and the basing of recent furnace design by the enterprising furnace companies on sound scientific principles.

Additional Equipment

The following story may be enlightening to those of you who are in the market for additional equipment. Not long years ago one of my friends called me in to look at a new furnace he had purchased which was not giving the results anticipated. After I had listened to the unkind remarks he made about all furnaces in general and this furnace in particular, we went out to talk to the foreman of the heat-treating room and to look the furnace over. The furnace was all right for some operations but not designed for the work for which it was purchased. My friend told me it was guaranteed. I asked him if he had it in writing and he proudly produced the contract with the air of a business man who never lets any one "hang" anything on him. The contract read that the furnace was guaranteed to heat uniformly. I told him the real test of a furnace from the standpoint of a uniformly heated product is not the temperature variation when the heating chamber is empty, but the temperature variation around the material to be heated when the chamber is loaded to full capacity. It is not extremely difficult to build a furnace whose heating chamber has a fairly uniform temperature empty, but what is desired is a furnace which will heat the stock in it evenly and uniformly. As a result of our discussion, this particular furnace was restricted to the uses for which it was suited, and an additional furnace was put in to take care of the special requirements referred to above.

Furnaces Used

Electric furnaces used in commercial heat treating may be roughly classed under two heads:

1. Wire-wound furnaces, where the resistance material consists of wire usually composed of an alloy of nickel and chromium, and useful for temperatures up to about 1800 deg. F. These furnaces range in size from small laboratory furnaces to muffle furnaces with chamber dimensions of 24 x 24 x 48 in.

2. Carbon resistance furnaces where the resistance material is carbon. Small furnaces of this type may be used for relatively high temperatures and are suitable for treating high-speed steel and even for melting a quantity of brass. Larger furnaces have been built for steel treating, although I am not in a position to say whether they are highly successful or not.

The construction of the wire-wound furnaces is very simple and the heating elements are easily manufactured if one is able to obtain the necessary materials for their construction. There are two general types of wire-wound electric furnaces which are used to a quite large extent for relatively small work. One type may be called the cylindrical, or "pot," type, illustrated by Fig. 1, and the other the ordinary hearth muffle type, as shown in Fig. 2. In the ordinary hearth muffle furnace the work usually rests on the hearth, while in the cylindrical furnaces the work is usually suspended

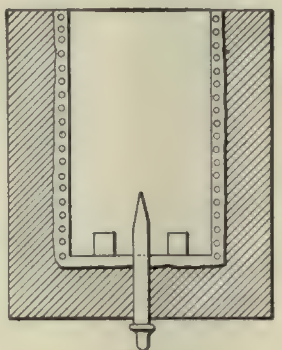


FIG. 1

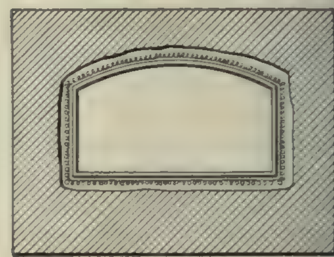


FIG. 2

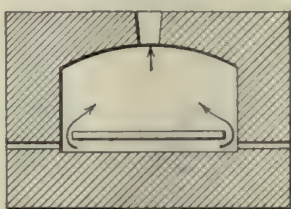


FIG. 3

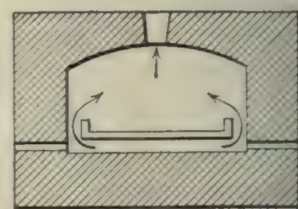


FIG. 4

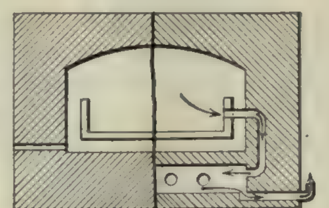


FIG. 5

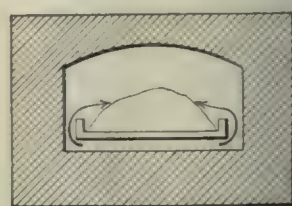


FIG. 6

FIGS. 1 TO 6. VARIOUS FURNACE CONSTRUCTIONS

Fig. 1—Cylindrical type of electric furnace. Fig. 2—Ordinary muffler type of furnace. Fig. 3—Furnace with flat hearth. Fig. 4—Sides of hearth built up. Fig. 5—Vents near hearth level. Fig. 6—Bolts heaped on the hearth.

on jigs or by wires. When the product being treated requires the utmost care as to rate of heating and uniformity of temperature the cylindrical type of furnace in my opinion is the ideal furnace to use. The advantage this furnace exhibits over the ordinary hearth muffle furnace lies in the method of placing the work in the furnace. The work in the hearth muffle furnace resting on the hearth receives heat from three walls of the muffle by radiation and by conduction through the surrounding air and by direct conduction from the hearth, while in the cylindrical type of furnace the heat is transmitted from all sides of the piece by radiation and by conduction through the atmosphere of the furnace. Another advantage is the facility for handling material in the cylindrical furnaces on jigs. In naming these advantages I have based my deductions on prev-

alent practice, so do not misconstrue these statements as being meant to cover special cases where the hearth muffle type of furnace may have an advantage over other types. There are also special types of wire-wound electric furnaces designed for special jobs.

Gas and oil furnaces are, perhaps, the most widely used for commercial treatment. A discussion of the multitudinous designs in detail would obviously entail a great amount of time, so I will confine my remarks to short discussions of a few of the designs in common usage and will endeavor to outline briefly some of their advantages and disadvantages.

First, let us consider a simple underfired furnace which is being used at the present time for a large number of heat-treating operations.

Combustion

The combustion takes place below the hearth, and the hot gases, products of the combustion, pass around the sides of the hearth into the heating chamber. Obviously, the edges of the hearth, as shown in Fig. 3, will heat first, and stock placed in the furnace, if placed near the edge of the hearth, will heat locally in the place which is nearest the edge. This can be overcome to some extent by building up the sides of the hearth as in Fig. 4. This arrangement automatically stops any overloading at the sides of the furnace and tends to prevent cutting action of the gases near the hearth line of the furnace. There is no need to build these sides beyond a certain height, for once properly guided, the hot gases by nature will continue in an upward direction to the roof of the furnace. I wish also to call your attention to the location of the vents in this furnace. You would probably be amused if I were to ask whether or not you open your attic window in the winter time when you are trying to heat your house. Why not apply the same common sense in heating steel and keep the vents out of the roof of the furnace. The heat in this furnace is transferred to the stock by the hot gases which are the products of combustion. The stock also receives heat by radiation from the walls and arch of the furnace, and by conduction from the hearth on which the stock rests. Fig. 5 represents a furnace designed with the vents near the hearth level, the waste gases being used to preheat the necessary air for combustion.

Instead of wasting the heat from the products of combustion which pass off into the atmosphere, as shown in Figs. 3 and 4, at a temperature near that of the furnace temperature by the arrangement in Fig. 5, we transmit some of this heat to the stock, and furthermore preheat the air for combustion to about 600 to 800 deg. F., thereby saving the gas which would be required to heat the air in actual combustion.

In connection with furnace design, mention of furnace capacity and overloading is opportune. Suppose, for instance, we have a carbonizing furnace as illustrated by type Fig. 5, with side walls 8 in. high on the hearth and a height of 20 in. from the hearth level to the arch. This furnace should not be loaded with carbonizing boxes 16 in. high, resting flat on the hearth and crowded closely together, if good work is desired. The tops of the boxes will obviously heat first, as the gases have not sufficient space in which to circulate around all sides of the box and to impart to each side and bottom an equal amount of heat. If it is desired to carbonize in this furnace, good results could be obtained by using small boxes about 10 in. high, leaving a space of about 6 in. between the boxes, and raising the boxes off the hearth a couple of inches to give the hot gases a chance to perform their function. For another instance, let us consider a number of small bolts treated in the same type of furnace. The bolts have been thrown in a pile on the hearth as shown in Fig. 6. The bolts on the outside of the pile obviously heat up first, and when they are ready to quench the inner portion is still relatively cold.

If you wish to melt a dish of orange ice uniformly and rapidly you will spread it in a thin layer over the plate. The same common sense principle applies to steel treating. Overloading furnace chambers in heat treatment is a common thing in these days of maximum production, and not a little trouble may be directly traceable to it.

Over-fired furnaces also have their adherents, and much has been said of their good and bad qualities.

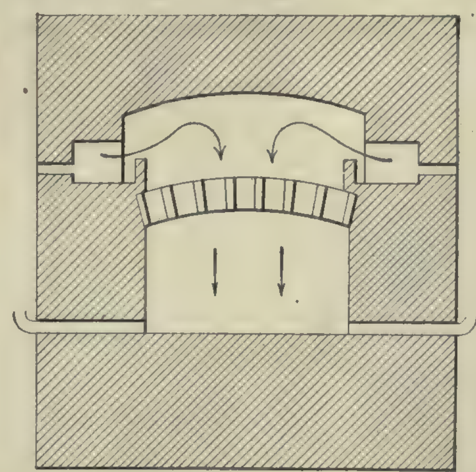


FIG. 7. AN OVER-FIRED TYPE OF FURNACE

Fig. 7 represents a type of over-fired furnace utilizing a perforated arch. This furnace is adaptable to low charges. When the charges are high there is a tendency to overheat the top. The gases, due to the peculiar construction of the perforated arch, necessarily enter the chamber at a relatively high velocity which is liable to cause decarbonization with high charges. However, the most undesirable feature, to my mind, in the over-fired furnace is the cold hearth. This argument also hits the over-fired, car-type furnace in common usage. The upkeep of the perforated arches usually runs into considerable expense, which is another decided disadvantage. The distinct advantage possessed by car-type furnaces lies in the facilities they offer for handling material.

I will not go into the design of coal-fired furnaces on account of the fact that they are rapidly being replaced by equipment using oil or gas. However, I believe powdered coal could be used to distinct advantage in some heat-treating operations. Powdered coal burning is at present in its infancy, we might say, and although it has been used in cement kilns and other places for a number of years, in my opinion it promises to become of considerable importance in other lines of work.

A few words relative to forging furnaces seems op-

portune before bringing these remarks to a conclusion. It seems to have been a prevalent idea that any manner of heating device would suffice for bringing steel to the proper (or improper) temperature for forging, and in many cases the bricklayer was placed on his own initiative in the matter of furnace design and construction. While this attitude was quite complimentary to the bricklayer, and while he must individually have profited by his experience in this line of work, there is a considerable doubt in my mind as to whether this practice proved the best for all concerned. For good forging practice a uniform temperature throughout the bar to be forged is essential. With heavy sections the tendency has been toward quick "wash heats," which often result in a cold core of metal. I have seen a "dripping" heat exhibiting this cold core in the center of a bar when it was placed under the hammer. On the other hand, long soaking heats at a high temperature are undesirable from a metallurgical standpoint. The stock should be brought up evenly to the correct temperature and then forged. Furnaces using a flame blasting against the stock, whether gas or oil fired, are bad. It is evident that these furnaces will not produce

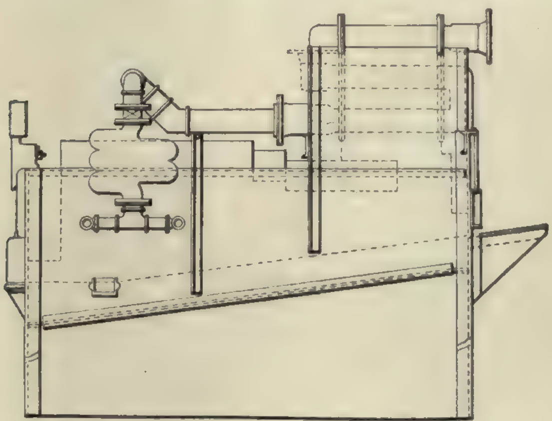


FIG. 8. CONTINUOUS FORGING FURNACE

an even heat throughout the charge of the furnace, as the stock lying near the tip of the flame will be hotter than that nearest the burner.

A continuous forging furnace which has proved very satisfactory in drop-forge work is shown in Fig. 8. The combustion takes place above the stock near the discharge end of the furnace. This, obviously, is the hottest part of the furnace. The stock resting upon the level portion of the hearth is allowed to soak at the forging temperature a very short time before removing to the hammer. The hot gases pass back to the charging or rear end of the furnace and through a system of preheaters located on top of the furnace. While this furnace is overfired it is free from most of the disadvantages named, due to its particular design. I might mention that this same design of furnace is being used to a very great extent in this country for shell forging and has proved very efficient. It is equipped with a vaporizing system for oil, which uses only 40 per cent. of the fuel oil necessary for the same heating operation in other furnaces.

In concluding this paper I desire to impress upon your minds my realization of its incompleteness in relation to the subject at hand.

I have tried only to express my own views, based on practical experience, and in so doing have really touched only a few of the high spots. However, I hope that I many have raised points that will admit of extensive, profitable discussion.

Slotting Screws

SPECIAL CORRESPONDENCE

The accompanying illustration shows a very ingenious device for slotting screwheads, which is in use at the Springfield Armory. Although this is a home-made fixture and may appear rather crude it is remarkably convenient and much more rapid than might be

SCREW-SLOTTING DEVICE

imagined. The screw is held at *A* by the block *B*, which is fixed in the pivoted arm *C* shown over the table of the hand-milling machine.

This arm is bent at *D* to form an incline or cam, which works on the roll *E* as the table is moved back and forth by means of the arm *G*, this arm being keyed to a shaft extending through the machine, and having upon its other end a lever for operating it.

As the table moves forward, the weight *F* pulls the arm down and clamps the screw before it comes into contact with the slotting saw. On the return of the table, the clamp raises the arm, releases the screw and allows a new one to be put in place. The operation of the device is extremely rapid and much more efficient than might be expected. The brush *H* is provided to keep the cutter free from chips. The screws drop into the trough shown.

Removing Burrs from Brass Screw-Machine Products

BY G. CEDARLEAF

We are producing on the automatic a quantity of small, brass disks with a hole in the center. The cut-off tool left burrs partly surrounding the hole, as is not infrequently the case, and the writer tried to take them off by the process of tumbling in sawdust.

This did not prove satisfactory as the burrs and sawdust would work into the holes and make necessary a second and tedious cleaning operation.

As an experiment a quantity of disks were put into a clean barrel with a good size bunch of waste, and after tumbling a short time the work was found to be clean and the holes clear, the burrs all clinging to the waste.

Sidelights

EDITED BY E. C. PORTER

The War Department has made a new ruling that civilian instructors will no longer be used in aviation schools and that only commanding officers will occupy these positions.

* * *

An order sent to the district officers and supervisors by the vice president and general manager, Mar. 4, directs that proper provision be made for the fencing and lighting of plants building ships for the Emergency Fleet Corporation.

* * *

The world's largest concrete ship, 7900 tons, christened the "Faith," was launched at a Pacific port in March. With the successful completion of this ship, according to her builders, the construction of 54 similar vessels will start. The "Faith" was launched six weeks after the concrete was poured into the forms.

* * *

Employment of women machinists in the factories producing Liberty airplane engines is proving satisfactory, according to the Aircraft Production Board. At present several hundred women are working on lathes, drilling machines and other machines for converting rough castings into finished parts.

* * *

Canada is setting a record in ship construction judging from the fact that during the coming year she will put more tonnage into the water than the German admiralty had estimated would be the entire annual production of the United States, England and France. The growth of the dominion's shipping program was achieved despite an unusually severe winter.

* * *

Twenty-five years ago the canals which extend to the Pennsylvania coal regions were used to carry most of the coal consumed in New York, New Jersey and New England. The Anthracite Committee, which is composed of city officials and business men of New England and the Middle Atlantic states, is urging the restoration of these canals, the chief of which are the Delaware & Hudson, the Lehigh, the Schuylkill, the Pennsylvania, the Morris & Essex, and the Delaware & Raritan.

* * *

The more important of the manufactures exported to Cuba in 1917 are approximately $10,000,000 worth of cotton goods, about $5,000,000 worth of automobiles and parts, approximately $6,000,000 worth of railway supplies (including rails, cars and locomotives), over $2,000,000 worth of structural iron and steel, $6,000,000 worth of boots and shoes, nearly $2,000,000 worth of pipes and fittings, wire, tinplate, typewriters, sewing machines, agricultural implements, cement, paper, wire nails, steel plates, barbed wire, rosin, lubricating oil, illuminating oil, gasoline, newsprint paper, wrapping paper and many other articles.

Merchandise intended for the Lyons Sample Fair will be allowed temporary admission under deposit of duty without special authorization, according to a notification from the Foreign Office to the American Ambassador. The period allowed for reëxporting these goods will be one month from the time of the closing of the fair, and no special formalities will be required. The usual customs duties will be applied to certain articles if they remain in France.

* * *

By installing a simple contrivance known as a grease trap in proximity to the different soldiers' messes, and by giving general instructions to the various camps and hospitals with regard to the saving and collecting of table refuse and even of dish water, the British military authorities at Saloniki, Greece, have succeeded in obtaining fat in sufficient quantities to make practically all the soap required by the army and also a considerable amount of dubbing and glycerine, the latter being necessary for the manufacture of ammunition.

* * *

From the beginning of the war up to Jan. 1, 1918, Russia received from the United States only 1 per cent. of the food exported from this country, or enough to feed about 10,000 men for one year. Great Britain took more than half of the total, or enough to feed about 8,000,000 men. France was next, with enough for 4,200,000 men, and Italy sufficient for more than 2,000,000 men. The three together received an excess of protein capable of supplying this portion of the diet to some 20,000,000 additional men.

* * *

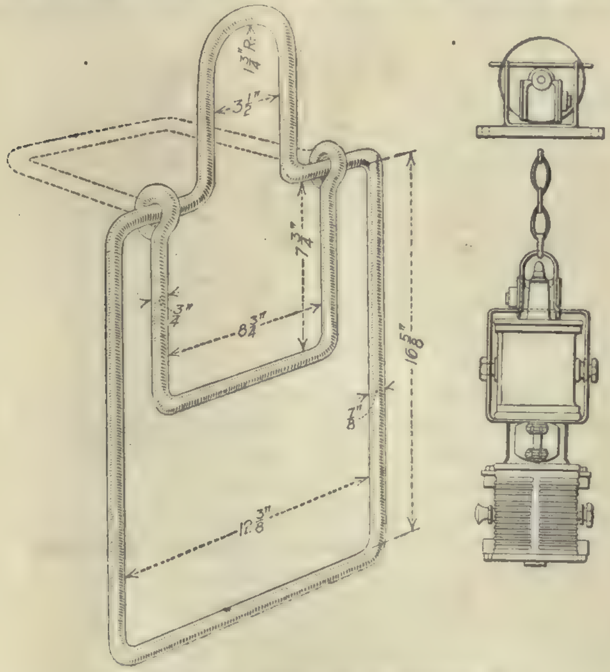
The following question has often occurred to men in the shipyards, particularly volunteers from inland communities: "How can they expect us to build ships when some of us never saw a ship?" It is a pertinent and natural question, and the Industrial Service Department of the Emergency Fleet Corporation has answered it by means of the book prepared by A. W. Carmichael, Assistant Naval Constructor, U. S. N. This book is a primer on shipbuilding. It tells the man in the shipyard what he is to do, why he is to do it, and how he should do it. A child can read it and become fairly familiar with the technical terms common to the seafaring man. The ordinary landlubber may know what a mainmast and a smokestack and bridge on a ship are. He may even know what the rudder and stern and propeller and their functions may be, but not many will understand when you talk to them about the cargo booms, the bulwark, boat deck, poop deck or forecastle. Imagine his mystification when you ask such a man to describe a shell plating. By reading this book, which is called "Shipbuilding for Beginners," the volunteer worker will not only know what these things are, but he will know why they are and how they are made. The little volume should be a valuable asset in every shipyard in the country.

Air-Pump Sling

By Joseph K. Long

A safe and efficient sling or lifting device for handling locomotive air pumps is shown in the sketch. The materials entering into its construction may be found in any stockroom and little skill is required in its construction.

The main sling is made of ⅞-in. round, wrought iron of the shape and dimensions shown. A yoke of ¾-in. rod is attached to the upper shoulders of the sling. This yoke swings back and fits over the reversing valve



SLING FOR HANDLING AIR PUMPS

chamber of the pump after the lower section of main sling is positioned under the steam cylinder. After fitting sling in place for lifting, a piece of bell cord may be used to tie it fast and prevent slipping.

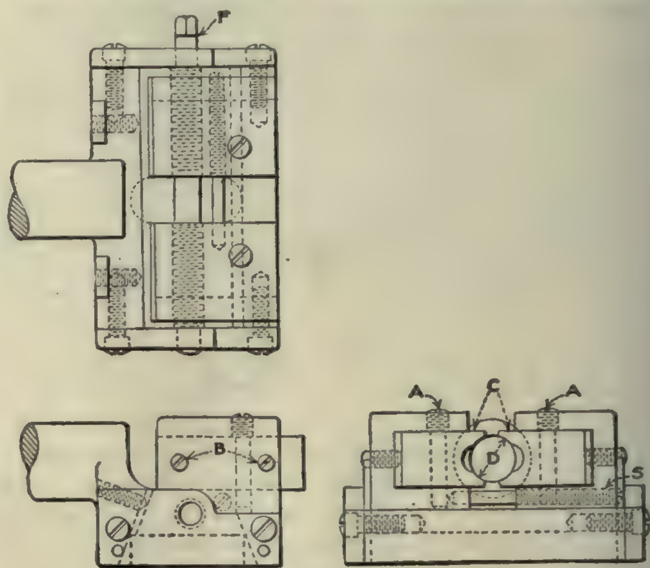
A Universal Shaving Tool

By G. A. Almorth

The turning of screw-machine parts having cylindrical shapes and requiring a fine finish to very close limits is easily and satisfactorily taken care of by using a shaving tool similar to that shown in the accompanying illustration.

The shaving cutters *C* are ground and lapped in position; the diameter at *D* must be slightly less than the desired finishing size. This will vary according to the diameter of the cylinder to be finished.

For a diameter of $\frac{3}{16}$ in. the cutter should be lapped



A UNIVERSAL SHAVING TOOL

0.182; for ⅜ in., 0.365, and for ½ in., 0.485, etc. The cutters *C* are pivoted on the studs *A*, which permits of their being adjusted to parallel position by means of the adjusting set screws *B*, which also hold the cutters in place.

A feed screw *F* having right and left threads engages the cutters for the purpose of moving the same; an adjusting screw *S* brings the cutters to a stop at a determined point.

Boring Bar for the Lathe

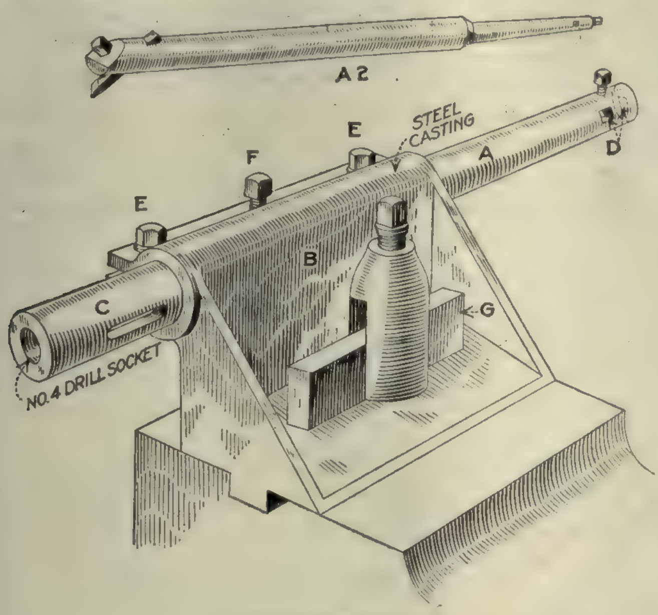
By H. L. Dungan

The illustration here shown is of a boring bar and holder which are intended for use in a lathe. The holder *B* is made to fit on the compound rest without moving the toolpost. A tool or bar of steel *G*, clamped in the toolpost, fastens it firmly in position.

The holder is split on the top as shown in the illustration, and the screws *E* and *E* are used to clamp the boring bar *A* in any desired position. The screw *F* is used to open the slot when screws *E* and *E* are slacked off, thus allowing the boring bar to be differently positioned or removed.

The boring bar *A* is of my own design. A No. 4 Morse taper hole is reamed in one end, *C*, for the inser-

tion of drills, reamers, etc. It is turned $\frac{1}{32}$ in. small for a distance covering the drift slot so any burrs thrown up by drifting-out tools may not prevent it from sliding through the hole in the holder. The other end of the bar has both cross and longitudinal square holes for



LATHE BORING BAR

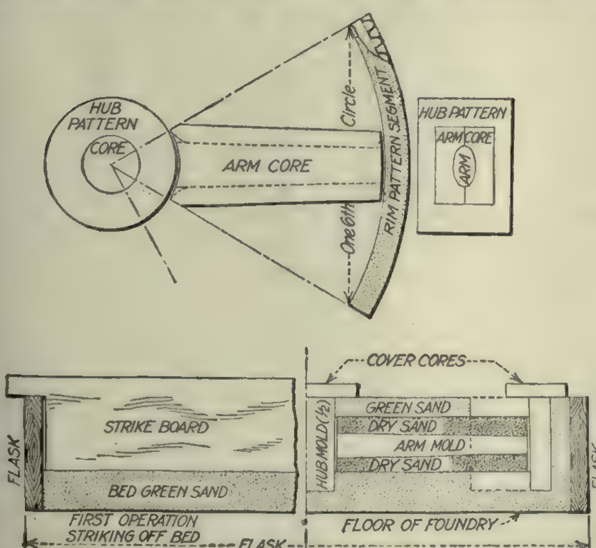
tools illustrated at *D* in order that it may be used for turning, facing and boring.

Different kinds of bars can be made and used in this type of holder. A suggestion for a very useful bar is shown at *A*2.

A Rush Job in the Foundry

By M. E. Duggan

The unexpected failure of a large gear shut down a section of the rolling mill between 7 and 8 o'clock one morning, and a rush order was immediately dis-



A RUSH JOB IN THE FOUNDRY

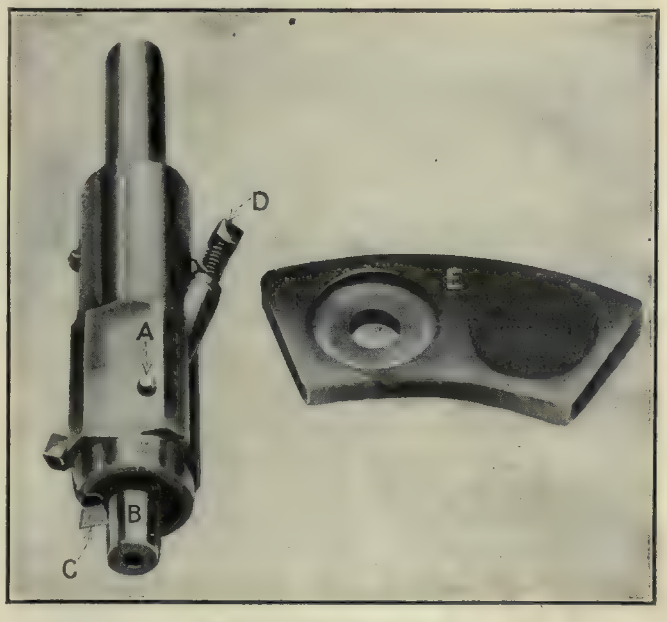
patched to the foundry for a new gear. The broken gear was 7 ft. in pitch diameter, and 6½ in. face, with 6 arms.

The pattern shop got out the strike board and the gear-segment pattern. An old cylinder pattern 8 in. longer and 1 in. larger in diameter than the hub of the broken gear was used for this part, and an old core box, though larger in cross-section than necessary and somewhat too long, enabled the coremaker by suitable manipulation to produce six sets of arm cores with the result that a serviceable gear was delivered to the mill on the same day the break occurred. The sketches show the construction of both pattern and mold.

Tool for Recessing Counterbored Holes in Friction Disks

By M. L. Lowrey

Having a large number of friction plates to make by inserting round leather disks 1¼ in. in diameter by ¼ in. thick in cast-iron plates we drilled the required number of $\frac{15}{32}$-in. holes in each plate and counterbored them to 1¼ in. diameter and $\frac{9}{64}$ in. deep. After slightly rounding the edge so as not to shear the leather the



THE RECESSING TOOL

disks were driven in with a hammer and block of hard wood. The leather disks would not stay in place, therefore we decided to make an inverted countersink in the bottom of the counterbore.

The tool for this purpose, shown in the illustration, is of somewhat unusual form, its operation being as follows: The toolholder is pivoted in the body at *A*. The pilot *B* enters the $\frac{15}{32}$-in. hole and the tool is fed down until the end of the cutter *C* strikes the bottom of the counterbored hole. This end of the cutter being rounded it does not cut, but as the feed continues it is pushed outward, forcing the cutting point of the tool into the metal.

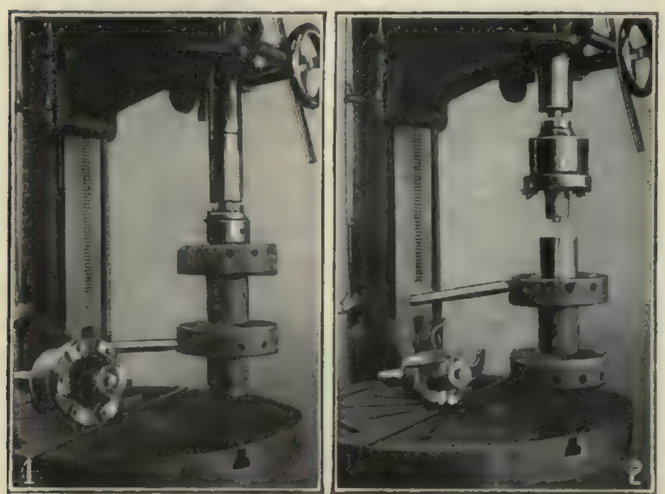
The tool is adjusted by the setscrew *D* at its upper end to finish its cut when the body of the tool strikes the bottom of the counterbored hole. A few drops of shellac is then put in each hole and the disks driven in. The force of the hammer blow swages the leather into the countersink. The work is shown at *E*, the hole at the left being counterbored while that at the right has the leather disk in place.

Machining Tractor Wheel Hubs On a Drilling Machine

By H. J. C.

The illustrations show how the drilling machine is used in an Iowa shop to perform an operation usually accomplished on the lathe, while the lathe is used for that part of the work which is not infrequently allotted to the drilling machine. The job is the boring and turning of the cast-iron hubs of tractor wheels.

For the boring operation the casting is mounted in a jig which is clamped to the faceplate of the lathe. The boring bar carries two stellite cutters to accomplish the roughing cuts, while a pilot upon the end of the bar is fitted to a $2\frac{7}{16}$-in. shell reamer. When the



FIGS. 1 AND 2. FACING THE HUB TO LENGTH AND THE HOLLOW-MILLING OPERATION

roughing cuts are through, the stellite cutters are taken out of the bar, the shell reamer put in place and the hole reamed. The casting is now set aside and a second casting is swung up and the boring cut started. As soon as the operator can with safety leave the lathe he takes up the previously bored casting and sets it in position on the table of the drilling machine, locating it by setting the bore over a plug that is fastened to the table. The hub is first faced off on the short end, then turned over and faced to length, this latter cut being governed by a stop on the head of the machine. The operation is shown in Fig. 1, a more comprehensive view of the cutter being given in Fig. 2, where it may be seen lying upon the table of the machine. This operation of facing is performed in time to allow the operator to be back at the lathe before the boring cut is finished; thus the progress of the work is practically continuous.

The turning, or more properly the hollow-milling, operation is shown in Fig. 2, the cutter being shown on the machine table in Fig. 1.

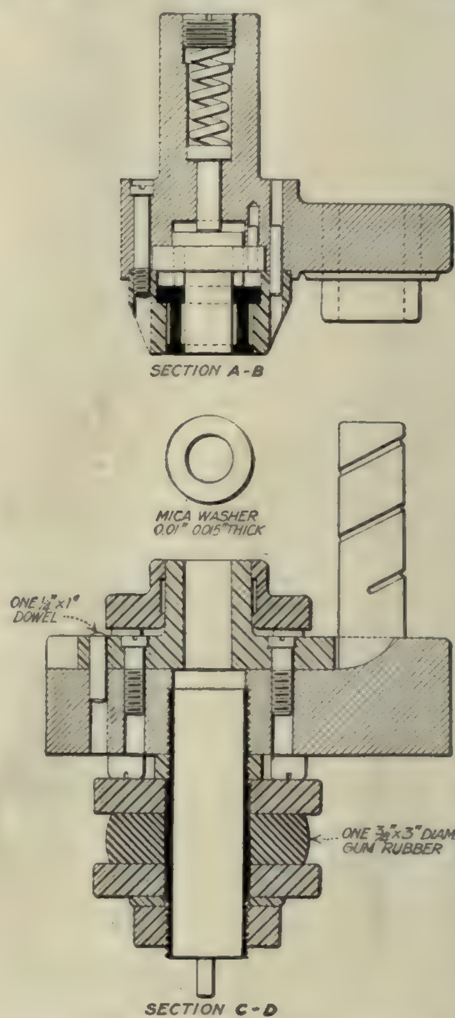
The facing tool is made of mild steel with three carbon-steel cutters, while the hollow mill has a cast-iron body with six cutters of stellite. Both tools have loose-sleeve pilots fitting the bore of the hub, and the hubs are kept from turning during the cut by a bar in one of the spoke holes bearing against the upright portion of the drilling machine. These hubs are put through in lots of 100, the operation times being as follows: boring, reaming and facing, 8.8 min.; hollow milling or turning, 2 min.; a total of 18 hours for the lot of 100. The diameter of the turned surface is 4 in. and the length of cut is $4\frac{1}{16}$ in. The castings weigh 88 lb. each.

Tools for Cutting Mica Washers

By F. R. Zimmerman

The blanking and piercing of sheet mica involves difficulties not ordinarily experienced in similar operations upon other materials, as the mica has a tendency to split into thin layers and to crumble along the edges of the cut. To prevent this action as far as possible the punch and die should be a close sliding fit and the tools should be kept reasonably sharp.

This crumbling or tearing of the mica produces a fine pasty powder that tends to clog the action of any



TOOLS FOR CUTTING MICA WASHERS

sliding parts, particularly the shedders, and the use of a lubricant only serves to increase the trouble; therefore it is desirable to make these parts with a clearance of 0.002 or 0.003 in. between adjacent surfaces wherever there is movement. A short distance back from the face of the shedder a chamber or pocket should be made wherein this powder may accumulate. These pockets would eventually fill up and clog but for the reason that before this occurs the tools will have been taken apart for grinding, and cleaned before reassembling.

America Must Use Her Machine Power

BY HENRY FORD

We Americans can win the war, but only if we throw the whole weight of our industries and tool power into the balance. This war is the greatest engineering feat the world has ever known. The side that musters the best machinery will win. We do not yet realize that our problem centers in the management of factories and the fullest use of machinery, nor have we organized to concentrate our industrial resources upon essential war work.

THE United States produces half the steel and half the coal of the world. Converted into machinery of warfare this would be decisive on the west front.

Russia, with man power of 185,000,000, was almost entirely lacking in machine power. She mobilized 15,000,000 men, but she sent them into battle poorly equipped, armed with obsolete rifles, small-caliber guns and in many cases only with clubs. This poorly equipped and poorly armed army was pitted against the vastly superior rifles, machine guns and large-caliber cannon which were turned out in vast quantities by great factories and a highly organized railroad system in Germany.

Russia lost 5,000,000 men and her power collapsed.

The lesson for us is that not numbers nor latent resources but better machinery and better organization are decisive in warfare.

Trenches can be conquered and the stalemate of the west front broken if we develop and use the right machinery. For a long time in the middle ages castles were impregnable when men attacked them with spears and catapults, but they fell easily to the new tools using gunpowder. To me it seems out of place to send men with bare bodies and rifles against trenches of concrete fortified with barbed wire, machine guns and cannon. A small tank can be made for attack that will carry two men and a machine gun with armor protection strong enough to resist the hail of machine-gun bullets and shrapnel splinters. Such tanks, if standardized to one model, could be produced at the rate of one or two thousand a day. Once production was started ninety thousand tanks could be made in three months. Distributed equally along the west front this would place one tank every eighteen feet. In each tank two men shielded by armorplate with a machine gun would have the offensive power of fifty soldiers with rifles. That advantage would come from possession of the better piece of fighting machinery. Soldiers would stand in line to have a chance to attack in such outfits.

In our food problems also we have failed to realize that the solution lies in the increase of tool power on the land. The farms of England, France and America have been drained of their men, first to fill the armies, then to fill the munition factories, so that today food production lags. For three decades men have been leaving the farm to get to the easier work of the factories and on railroads where engine power has removed the drudgery of heavy muscular labor. The curse of Adam to "labor in the sweat of the brow" still rests upon farm workers. It remains for America to carry engine power to agriculture. Until 1850 harvesting and threshing were done by human muscles using sickle, scythe and flail. Then America invented the binder and harvesting machine and shifted these two tasks to the animal. Today America must substitute engine power for human and animal muscles on all kinds of farm work.

A tractor engine will plow, harvest, seed, pull binders, make hay, cut ensilage, pump water, churn and do the chores of the farm. It will multiply the power of every farm worker and give him new joy and pride in his work. It will keep the boy on the farm. With the aid of tractors a reduced number of farm laborers can still produce a full crop.

One tractor sent to France or England now will produce fifty times its weight and bulk in wheat and food this year. One ship carrying tractors now is as good as fifty ships carrying food next fall.

In a properly organized factory running on one model an ordinary workman can build a tractor in fifteen days, and each tractor will add the working power of two or three men to a farm during the whole year. Fifteen thousand men can produce one thousand tractors a day, or three hundred thousand tractors a year.

We shall get more food not by bookkeeping and clerical regulation in the cities, but by the use of more and better machinery on the land.

NECESSITIES OF SUCCESS

Success in producing great quantities of industrial output from our factories depends upon two things—leadership and labor. These must work in confidence and harmony with each other. Absentee control can never get the best out of the factory. The heads of industry must live close to their work; they must know metals and machines and be ready to give every man a square deal.

Men don't work for money alone. Ten dollars a day will not hold men in some places. The things of life that are worth while make the strongest appeal to the workman. Above all he must have something to hope for in the future. There must be something in the plant, in the business, that he can tie to and look forward to. Many war plants are having labor troubles because the men know that the business is built on a speculation for a quick profit and will be dropped. Such plants offer their workers no hope.

The ease with which we have been able to increase production at the Ford plant was due largely to the willing coöperation of a vast army of workers. We have had no strike; no wage discussion. Our men have willingly, eagerly turned to every task that has been set for them. They deserve credit for most of the progress that we have made in the production of ships, tractors and airplane parts. They know that the company is not seeking profit from war work. Corporate and

business leadership that measures its success by war profits in the balance sheet cannot object if workmen take the same viewpoint. Profiteering breeds distrust and antagonism. Yet today smooth team work between labor and leadership are needed for the very life of our nation. Today every man must lose himself in order to find with his fellowmen his soul anew in the nation.

Our democracy is on trial. Can our institutions bring out the latent energies of our people, and the moral forces of discipline and order? Can we subordinate individual selfishness and profiteering to the welfare of the group? If so—and I am sure that we can—we shall win the war. We know that armed robbery and land grabbing belong to the primitive ages; today civilized men take their cases to court. In supporting President Wilson's national policies we stand for a reign of justice and right among nations. With him we are fighting for the birth of a new world order based upon the rights of the common people.

Work of the Cleveland War Industries Commission

A very comprehensive plan is being outlined by the Cleveland War Industries Commission, of which James H. Foster, president of the Hydraulic Pressed Steel Co., is chairman. The commission was organized through the Cleveland Chamber of Commerce and it has begun to organize industry in and around Cleveland with a view to helping the Government secure necessary war material. As a beginning questionnaires have been sent to every manufacturer to learn what Cleveland produces, what capacity is available and when contracts can be completed. The commission is also endeavoring to secure the appointment in the Cleveland district of suitable Government officials who have sufficient power to do business directly with these manufacturers. This has already been accomplished in the sectionalizing of the country, as announced recently.

The work has been divided into a number of groupings, which include casting, banking and finance, chemicals, food products, engineering, forging and stamping, automotive, rubber and textiles and clothing, and a man who is thoroughly familiar with each of these divisions has been placed in charge. Each chairman's division is then again divided to a point where each subcommitteeman has what may be termed a "one-man job." His intimate knowledge can furnish the desired detailed information on short notice, which will supplement the data secured through the questionnaire. With this information available any order which comes to his district, no matter how large, can have the desired information placed at the Government's disposal on short notice.

This is a long step toward making available the smallest shops of the country for various kinds of war work so that they can make a real contribution to the general product. It is being supplemented by the establishment of a Cleveland bureau in Washington for the purpose of acquainting the Government with what Cleveland can be depended upon to produce. Under this plan, the Government may buy a number of different parts of a certain machine from as many different manufacturers in the Cleveland district. These can be assembled in Cleveland and shipped as a whole, thus utilizing the resources of the various shops and reducing transportation to a minimum. What this virtually does is to make the Cleveland district a large workshop with a great variety of different departments and having these departments so classified at Washington that the Government can easily find out exactly what can be produced with due regard to the interests of all.

Woman—A Maker of Guns

BY MARIE RANDALL

My man has gone out to the wars;
I watched him through snow falling fast;
It shut out his face from my eyes—
Or was it the tears?—when he passed.
He's gone where the battle line holds
Face to face with the charge of the Huns;
Yet I have no time now for tears,
For I am a Maker of Guns!

□ □ □

For him is the glory of war,
Its madness and joy and despair.
What matters the risk or the cost!
He fights for his home "Over There."
For me are the dull hours of toil,
Gray dawnings, long days, setting suns,
The roar of machines in my ears,
For I am a Maker of Guns!

□ □ □

The wide ocean stretches between;
He's fighting in far-away lands;
But helping him strike every blow
Is the heart-given work of my hands.
For freedom and justice and right,
Democracy slain by the Huns,
I fight side by side with my man,
For I am a Maker of Guns!

Sanding Slippery Iron Floor Plates

When iron floor plates become worn smooth they are dangerous under foot, especially when wet. A method of roughening them slightly is as follows: Mix a small quantity of powdered sal ammoniac thoroughly with fine sand. Sprinkle the mixture over the iron floor, covering it with a thin layer. Dampen the surface with a sprinkling can, and permit the material to remain overnight or preferably over a holiday. Sweep up the sand and it will be found that a rough coating has been formed which will last several weeks. The process may be repeated until the desired roughness is obtained.—*Canadian Machinery.*

Editorials

Scientific Frightfulness

GERMANY'S enemies, despite the barbarities that have been inflicted upon them, are too good sportsmen not to recognize a triumph of German ingenuity. Admiration for the scientific achievements of the Germans, however, is tinged with regret that their energies should have been devoted so conspicuously to the perfecting of engines of meaningless destruction. It is not fear or envy, but only a perception of the waste of effort and a recognition of the destructive intention behind the accomplishment, that lessens our opinion of what they do.

* * *

The history of applied science in Germany abounds in examples of the prostitution of genius. Even so intrinsically worthy an enterprise as the peace-time development of German dye manufacture—an important contribution to chemical progress and industrial thrift—turns out to have been essentially a byproduct of munition making. The commercial submarine "Deutschland," whose successful transatlantic voyage, was hailed by Americans with no less genuine enthusiasm than by the Germans themselves, proves to have been not a peaceful trader but an emissary of diplomatic treachery against the nation whose hospitality it enjoyed.

* * *

It is in fashioning weapons against noncombatants that Germany has displayed her greatest scientific skill. Since August, 1914, spectacular engines of frightfulness behind the lines have been revealed one by one, and always with elaborate stage settings for each new terror. The much-vaunted Zeppelins, although a military failure, proved a means for attempting to intimidate civilians by destroying property and life with the wanton blindness of a tornado. The submarine, notwithstanding an indirect influence on the military situation, stands out most prominently as an agency of intimidation and destruction against noncombatants, including neutrals. The long-range gun, whose recent sensational announcement was intended to add an element of terror to the supreme drive on the western front, is without doubt a mechanical achievement of the first magnitude. But instead of being decisive, or even important, as a military factor it is only another engine of blind and futile murder that has been made use of by this country.

* * *

The diabolical perversion of genius by Germany's present rulers is the most tragic phase of the Hohenzollern war madness. Cost what it may the war lords must be dealt a crushing and final defeat. For Germany's own salvation, no less than for the future security of the civilized world, German ingenuity must be turned forever from the service of blood lust and senseless destruction to the ordinary peaceful pursuits of civilization.

Making Use of the Alien

ONE of our great weaknesses, as a nation fully as much as individuals perhaps, is our failure to plan properly for events which seem to stare us in the face. We knew that the declaration of war would make it necessary to establish war zones for aliens, yet we made no provision to transfer these workers to other sections where we would secure the benefit of their labor and obviate the resentment which naturally arises from forcing any body of people into idleness and strange quarters.

Nearly seven hundred thousand alien men of voting age were turned loose with no provision having been made for putting them to useful occupation. If we include the women these aliens exceeded a million, each resentful to a degree which makes them a menace in the aggregate. A little planning would have avoided all this and have saved much anxiety in many places.

We have never paid as much attention to the alien as we should have, not only for his good but for our own. We welcomed him when we needed cheap unskilled labor; allowed him to be robbed and browbeaten, and let him go his own gait in nearly all cases. We failed to realize that unless we Americanized our visitors from across the sea; unless we made them feel that this is their home; unless we taught them our ideals by example as well as by precept that they would always remain apart from us and be a menace in so doing.

* * *

The best way of Americanizing the alien from any land is to give him a square deal; to lend him a helping hand and show some sort of human interest in his well-being. If he can obtain a fair wage, reasonable housing conditions and be made to feel that he can become one of us he will usually respond with loyalty and trustworthiness.

But it is useless to preach loyalty without giving him something to be loyal to; he must be made to feel that he is or can become a real part of this great country of ours.

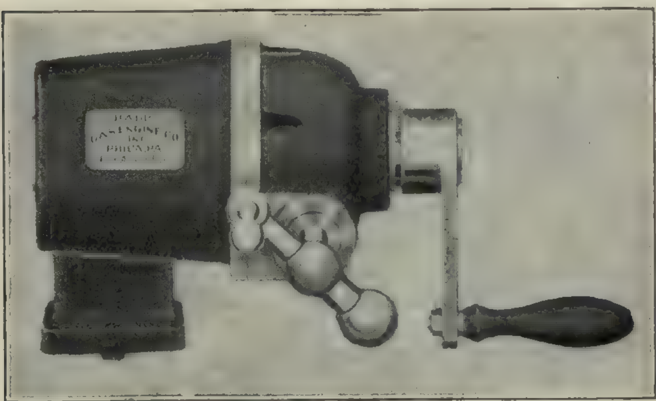
He must be induced—forced if necessary—to learn the English language, and this should be extended to the women as well. This is an essential matter, as difference in language is always a great barrier. The alien can be assisted to understand the customs of the country; can be shown its advantages, and will in most cases react to patriotic influences. But we must not forget that injustice rankles in his breast just as it does in ours, and that we too often have ourselves to blame when the alien is antagonistic and resentful.

The native-born men in the shop can do much to make the alien either loyal or disloyal, and an important part of our work ought to be to educate our men and ourselves in the proper treatment of the stranger within our gates. With this accomplished we shall have made a long step in the right direction, and there will be little to fear from disloyalty in the days to come.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Hall Thread-Milling Fixture

The illustration shows a thread-milling fixture that has been placed on the market by the Hall Gas Engine Co., Inc., Bridesburg, Philadelphia, Penn. The device is for use in cutting either internal or external threads of any form or pitch and either straight or taper. It is claimed that the device enables a full thread to be

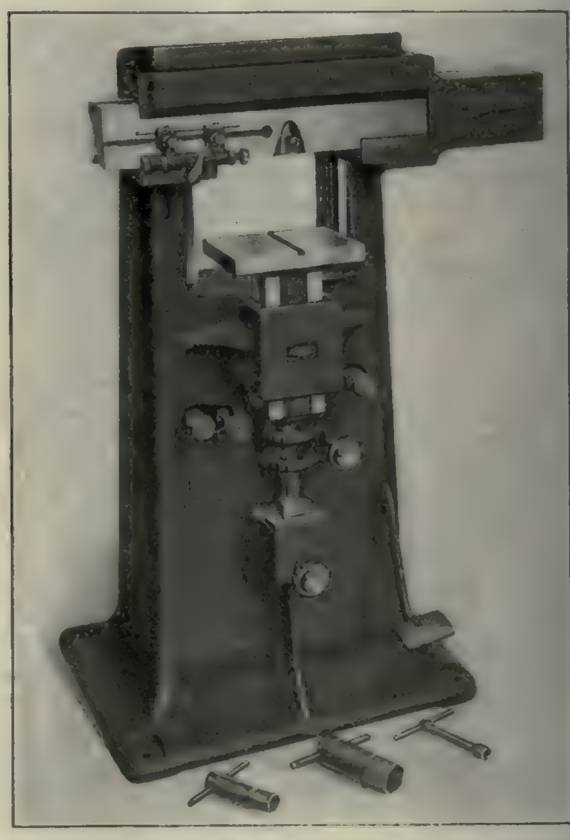


HALL THREAD-MILLING FIXTURE

cut up to a shoulder or to the bottom of a hole. The thread may also be timed to start at any point at the circumference of the work. The fixture has a hollow spindle allowing threads to be cut on any length, the work being held by a spring collet chuck. The device is intended to be mounted upon a milling machine or lathe and can be quickly removed when the machine is desired for other work. It is claimed that the device will cut threads to within 1/2000-in. tolerance.

Martin No. 12 Hydraulic Marking Machine for Metal Parts

The Martin Machine Co., Greenfield, Mass., has recently placed on the market the hydraulic marking machine illustrated. The machine is intended for marking either cylindrical, flat or irregular work, and it is claimed that it will make even and clear impressions irrespective of the uneven working surface of the article being marked. The pressure varies with the resistance of the die in impressing the lettering, and through a compounding system inside the column of the machine the pressure beneath the work table is automatically controlled. Power is received on a pulley on the rear of the machine, and operates a rotary pump for the purpose of operating the hydraulic system. By means of this pump the oil pressure is maintained, and this pressure operates both the vertical table that raises the work to the marking dies and also the horizontal die-holding slide. In operation,



MARTIN NO. 12 HYDRAULIC MARKING MACHINE

Travel of slide, 8 in.; height of machine, 50 in.; adjustment on table, 0 to 6 in.; floor space, 27 x 22 in.; weight, 900 lb.

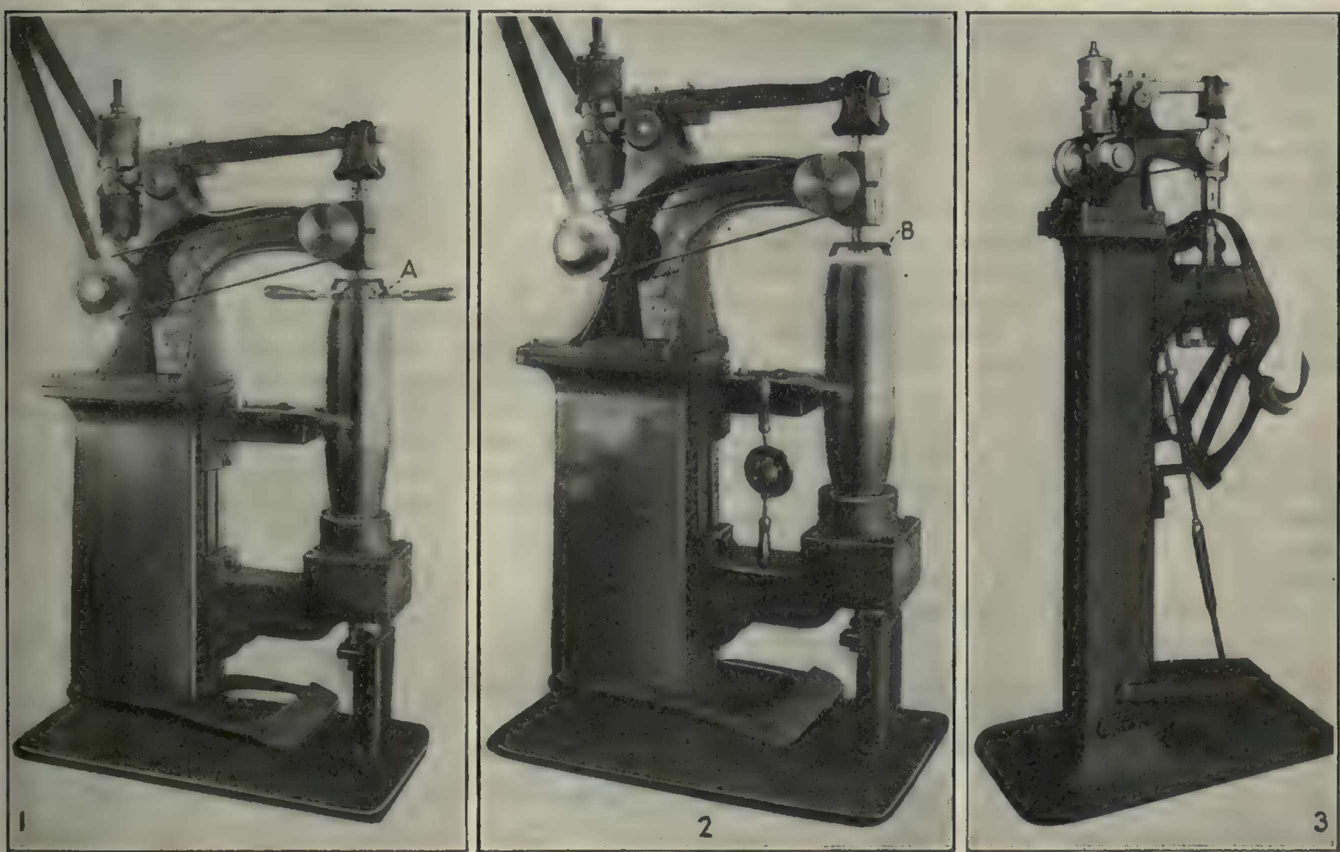
pressure upon the foot treadle causes oil pressure to raise the work-holding table to the operating point, and when this point has been reached the oil pressure commences to act upon the slide and then traverses the die across the work to be marked. As soon as the die has completed its marking, an adjustable stop on the slide trips the reverse lever, which operates the valve, releasing the pressure that has moved the slide forward and allowing the oil pressure to return the slide to the starting point. At the same time the oil pressure beneath the work table is immediately released and the table drops

back ready for the removal of the work. The machine is said to be practically automatic and so simple that it may be operated by unskilled labor. Another important feature is the universal table, which is so constructed that it will handle tapered or other irregular work. The table and slide are provided with adjustable gibs and the slide is equipped with roller bearings to reduce friction.

High-Speed Hammers

Figs. 1 and 2 illustrate two views of a hammer which has been specially adapted for caulking or peening gas checks on 155-mm. shells. After placing a shell in the machine the burring tool *A*, Fig. 1, is applied as shown. One or two revolutions of this tool by the handles when under slight pressure will remove any burrs or sharp edges from the dovetail in the base. If these are not removed there is danger that the edges of the gas check may be cut through during the peening operation. The burring tool is also used to insert the gas checks in the shell bases and to roll the edges into the undercut of the dovetail. With the gas check in place the lead gasket is dropped into position and the hammer started. Controlled elastic blows at the rate of 900 per minute are struck and at the same time the peens *B*, Fig. 2, revolve slowly, making one revolution to every 54 blows of the hammer, thus caulking the gasket at all parts. The operation is completed in less than 30 seconds.

The machine shown in Fig. 3 was designed for heading copper rivets used in holding heavy harness together. It holds the washer, or burr, tightly to the work and at the same time compresses the parts to be riveted. The hammer strikes 2600 blows per minute and will head a rivet every two seconds. These machines are made by the High Speed Hammer Co., Rochester, N. Y.

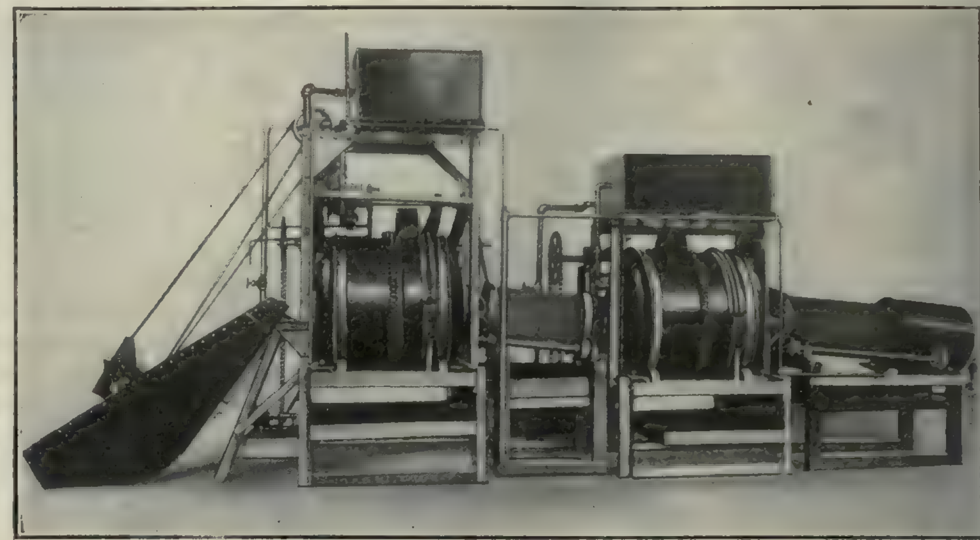


FIGS. 1 TO 3. HIGH-SPEED HAMMERS FOR SHELL AND RIVETING WORK
Fig. 1—Removing the burrs. Fig. 2—Caulking gas checks. Fig. 3—Riveting Harness.

Ideal Cleaning and Rinsing Machine for Metal Parts

The illustration shows the Ideal batch process cleaning and rinsing machine, the outfit being particularly suitable for removing heavy grease from stampings and drawn work of steel or brass, which have heretofore been cleaned by dipping in soda kettles and by tumbling in sawdust. The feature of this machine is that the work can be held in the drum, passing continuously through the cleaning solution until thoroughly clean. The essential parts are the loading skip, the washing and rinsing drums, the draining and drying screens and the tanks for heating the washing compound and rinsing water. Parts to be cleaned are dumped into the power loader which charges them into the washing drum. The interior arrangement of the drum consists of four steel blades, or half worms, extending halfway around the drum and across its entire width and ending in four cups. The action resulting from the rotating drum and the interior construction gradually impels the parts toward the discharge end and into the cups which pick them up and deposit them on the discharge chute. The discharge chute when in the operating position returns the parts to the charging side to pass again through the same cycle.

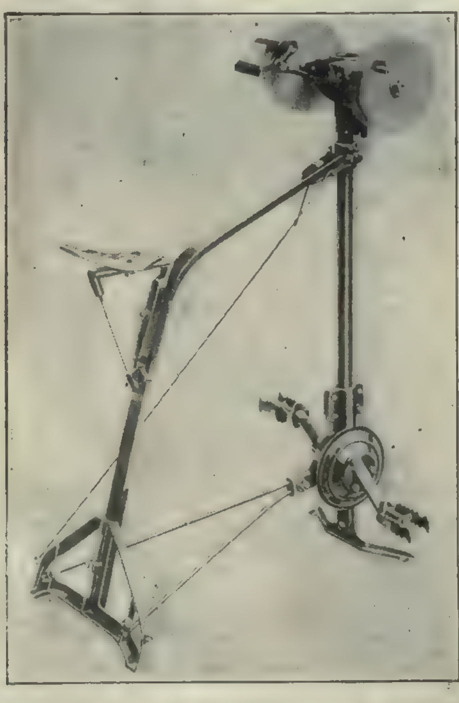
The time required to cleanse the parts depends on the amount of dirt and grease to be removed, usually from one-half to one and a half minutes. The washing compound is heated in the tank above the drum and flows through pipes into the charging opening of the drum, the level of the solution being automatically maintained below the level of the charge and discharge openings. Holes around the periphery of the drum drain it directly into a funnel leading to a drain pen connected to a pump which returns the fluid to the heating tank. After being cleaned the parts are discharged into the draining screen by turning the discharge lever which tilts the discharge at an angle opposite to that of its former position. The draining screen forms the passageway between the washing and rinsing drums. In the rinsing drum the parts are rinsed and pass through the drum directly into the drying screen, from where they are discharged into receptacles. The machine requires a crew of three men and is claimed to use less washing compound than other methods. The device is the product of the Ideal Concrete Machinery Co., Cincinnati, Ohio.



IDEAL CLEANING AND RINSING MACHINE

Luther Improved Grinding Stand

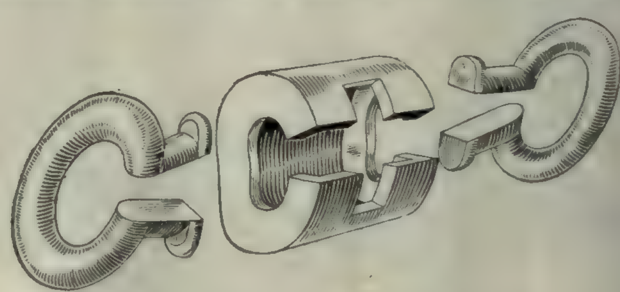
The Luther Grinder Manufacturing Co., 285-289 South Water St., Milwaukee, Wis., has recently made some improvements in its No. 271 "Hummer" grinding stand. The new model F is provided with a worm-gear drive instead of the cast bevel gears that were formerly employed. Ball bearings have also been incorporated to insure ease in running. The device is intended for use where it is not convenient to use power, the portable feature being of considerable advantage in some cases. As may be observed the device is driven by foot pedals, a seat being provided for the operator.



LUTHER NO. 271 GRINDING STAND, MODEL F

"One Minute" Swivel Repair Link

The swivel repair link illustrated has recently been placed on the market by the Cleveland Galvanizing Works Co., Cleveland, Ohio. The device is made in three sizes, with either plain or waterproof finish, and may be used either as an ordinary repair link or as a swivel. Malleable iron is used, and the only tool necessary to apply it is a hammer, a pair of pliers or a vise. The ends of the pieces of chain to be joined are hooked into the two eyes whose flanged ends are then placed inside of the collar, which is hammered or squeezed together, preventing the separation of the eyes. The diameter of the eye in the three sizes is $\frac{3}{16}$, $\frac{1}{4}$ and $\frac{3}{8}$ in., while the over-all length is $1\frac{3}{8}$, $1\frac{3}{4}$ and $2\frac{1}{4}$ in. respectively.

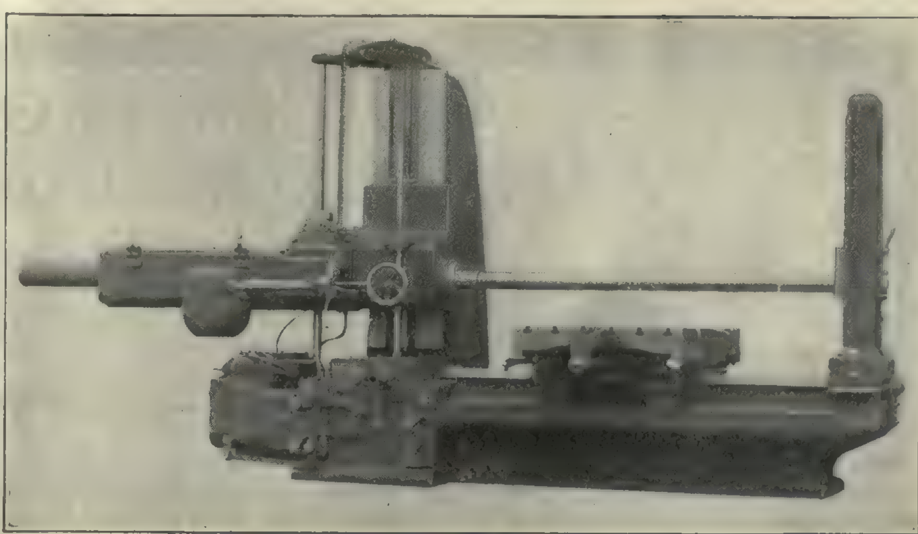


"ONE MINUTE" SWIVEL REPAIR LINK

Defiance No. 6 Boring, Milling, Drilling and Tapping Machine

The combined horizontal, boring, milling, drilling and tapping machine illustrated is one of the late products of the Defiance Machine Works, Defiance, Ohio. The bed is of cross-ribbed box construction, the machine being entirely self-contained. It rests on the floor at

three points. The column is also of box section and flares out at the bottom to give a large bearing surface where it is bolted to the bed. Hammered, high-carbon steel is used for the spindle which is ground its entire length. The spindle sleeve is a high-carbon-steel forging with a conical journal at the front turning in a solid bronze box. It has an adjustable taper sleeve at the rear also turning in a bronze box. This arrangement makes adjustment possible and allows large milling cutters to be bolted to the flange on the end of the spindle sleeve. The head slides on the column, the dovetail with taper gib being placed in the center with actuating screws between. The two sides have clearance between the column with straps at the back. A gib on the front side is set up for a free sliding fit, but helps to take any undue strain placed on the head. The spindle head and tail block are raised and lowered together, being connected by a shaft and cut bevel gears. Binder screws are provided for locking purposes. The tail block has long V-bearings. Cut helical gears are used for the spindle drive, which it is claimed give a very smooth motion to the spindle. Reverse is by means of a clutch controlled by a lever convenient to the operator which make it possible to use the machine for tapping. The gibbing of the saddle is of the square-lock form, a binder screw clamping the platen rigidly. A throw-out device regulates the movement of the platen. The saddle extends beyond the bed to give a support to the platen at its extreme positions. A taper gib is provided for taking up wear. The back rest carrying the tailstock is mounted on a base containing all necessary mechanism. To accommodate long work, however, the back rest can be moved by taking out four screws and without disturbing any mechanism. A rack-and-pinion mechanism is used to adjust the base along the bed, a binder screw being provided. The feed is applied to move the spindle in or out of the spindle head and tail block or up or down; to move the saddle along the bed, and to move the platen across the saddle. Two sets of cone gears give 12 changes of feed. A safety friction is placed in the feed box to prevent damage. It consists of a cast-iron plate inside one of the feed gears held at the proper tension by a nut. This friction is applied at such a point that it serves for both the slow and fast travel, which may be obtained in either forward or reverse directions. Hand adjustment and micrometer dials are provided for all movements. All moving parts are inclosed and oil tight, oil being pumped through the head, speed box and feed box to insure proper lubrication. All drive bearings are of the roller or ball type, and ball thrust bearings are used on the spindle and on all actuating screws. Other bearings are bronze bushed. The eight control levers are placed within reach of the operator. The machine is made in two sizes, Nos. 5 and 6.



DEFIANCE BORING, MILLING AND TAPPING MACHINE

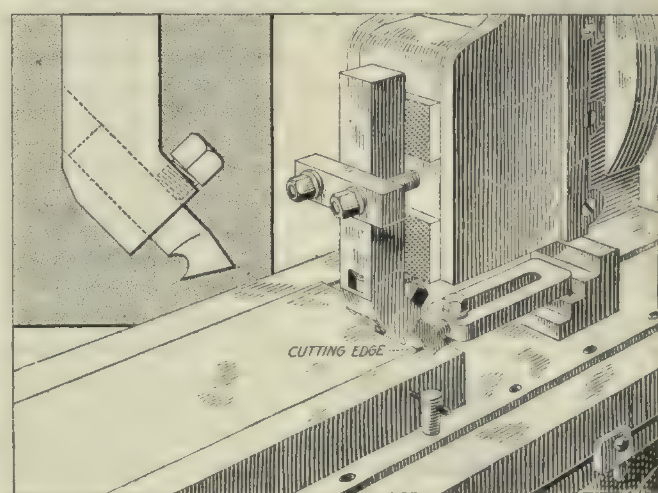
No. 5 machine: Diameter of spindle, 3 in.; Morse taper hole in spindle, No. 5; traverse of spindle, 24 in.; traverse of head, 24½ in.; maximum distance faceplate to back rest, 5 ft.; maximum distance top of plate to center of spindle, 25 in.; maximum distance top of bed to center of spindle, 33½ in.; size of platen, 24 x 48 in.; cross-feed of platen, 40 in.; number of speed changes, ten, 15 to 336; number of feed changes common to all actuating screws and spindle, twelve, 0.003 to 0.375 in. per spindle revolution; diameter of driving pulley, 16 in.; width of drive belt used, 4 in.; weight, 12,000 lb.

No. 6 machine: Diameter of spindle, 4½ in.; Morse taper hole in spindle, No. 6; traverse of spindle, 2 x 30 in.; traverse of head, 36½ in.; maximum distance faceplate to back rest, 7 ft.; maximum distance top of platen to center of spindle, 37 in.; maximum distance top of bed to center of spindle, 47½ in.; size of platen, 36 x 64 in.; cross-feed of platen, 64 in.; number of speed changes, ten, 7½ to 157 r.p.m.; number of feed changes common to all actuating screws and spindle, twelve, 0.004 to 0.5 in. per spindle revolution; diameter of driving pulley, 16 in.; width of belt, 5 in.; weight, 25,000 lb.

Reversing the Toolholder To Insure Smooth Cutting

By G. Grolluman

In cutting keyways or in other slotting operations on the planing or shaping machine, it will be found that by reversing the ordinary form of toolholder and grinding the tool as shown in the sketch, the tendency to chatter and dig is almost wholly eliminated. The same method can be pursued to advantage in finishing cast-iron surfaces by substituting a tool bit that has been upset to produce sufficient length of cutting edge.



TOOLHOLDER AND TOOL REVERSED

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., April 6, 1918—Congress is wasting valuable time in insulting and otherwise embarrassing a number of reserve officers in the Ordnance and other departments. When we recall how Congress voted itself free from the income tax it ill becomes it to call any reserve officer a slacker even if he is within the draft age. The proposition that reserve officers wear a white stripe, intimating that it denotes the "white feather," is offset by the suggestion that Congressmen wear a yellow stripe to show their attitude when it comes to help pay the bills out of their salary.

It must be remembered that Congress itself is responsible for the huge number of reserve officers. For, in spite of the known demand for engineers, Congress in its wisdom ruled that only thirty civilian engineers could be employed at a salary exceeding $1800 a year, this being the pay of a clerkship. The only way to get competent men on the payroll was to give them a commission, and even then the salary was usually far below their former earnings.

It is true that among the men within the draft age probably some are slackers, but they have company in various parts of the country. Also it must be understood that they are now trained in their work, and that if they are removed new men will have to be trained to take their places. All this means delay, which cannot be tolerated at this time even for the purpose of weeding out a few slackers to satisfy some Congressman who may or may not be sincere in his protestations.

Officers' Pay Should Be Increased

While Congress is devoting so much attention to this matter it may be in order to suggest that it also carefully considers the question of the pay of officers in responsible positions. Even the postal clerks are to get a raise in spite of Mr. Burleson—and they deserve it—but no mention is made of increasing the pay of officers in the army and navy, many of whom must have a hard time getting along on their salaries in these days. There are thousands of excellent officers all the way up the line whose devotion to duty comes up to tradition and who deserve larger salaries. Men who have devoted years to the manual of arms and have attained to majorships and colonelships are receiving much less than their ability entitles them to.

The subjects of pay and of reserve officers bring up the old question of the wisdom of commissioning engineers and business men as officers at all. If Congress can be induced to wipe out its maximum of thirty civilian engineers there are many who believe that it would be much better not to put them in army uniform. It seems unfair to the regular army officers and it ties the engineer to routine that is often not connected with his work, besides having other drawbacks that offset whatever advantages it may possess. Indications are that this feature of the case is being considered, and the outcome will be watched with keen interest in army in army quarters.

More About Inspection

Inspection is such a trying problem in all kinds of manufacturing that it is not uncommon to find "horrible examples" of how not to do it. When we find them, therefore, it is proper to correct them quickly and so prevent delays and increase production.

The lack of uniformity in specifications from different departments is largely responsible for much unnecessary inspection. One instance shows this in a particularly noticeable manner. A certain firm is making instruments for three branches of the service. These instruments are almost identical, the exception being that on one fiber piece the army uses one color, the navy another and the Signal Corps still another. This one piece must be made up in red, black and green not for purposes of identification but because these colors were selected by the respective designers.

The fact that they are being made for three departments necessitates, under the present practice, an inspector from each department. One man could handle all the inspection, but there is no coördinator, or "get-together" man, who can put work of this kind together. The President is the one man who can do it, but he has several other things to do just at this time.

This lack of coöperation brings to mind an incident where a civilian in a certain department was assisting all three branches of the service. One day a young naval officer came to his desk and bade him a fond farewell. The civilian, of course, thought the officer was going across and responded accordingly. Imagine his surprise when he found that the affectionate parting was not because the officer was going away but that he had heard that the civilian had been detailed to work with the army and consequently he could have no further dealings with him.

After one has seen for some time nothing but the inspection of munitions, and has seen in too many cases a complete failure to discriminate between the finish and accuracy on vital and on nonessential parts, it is quite refreshing to see the engines being built for the Emergency Fleet Corporation. Crankpins, shafts,

thrust bearings and the like are well finished and kept to within reasonable tolerances. But the crank cheeks are not finished on the outside; they are not rejected for slight surface flaws that do not hurt them in the least; and in general they are being inspected just as a good mechanic would when he knew that emergency service and not fancy finish was the main requirement.

This is not a new problem by any means. The columns of the *American Machinist* have carried lengthy arguments on both sides of the question by well-meaning mechanics. This discussion waxed furious about 15 years ago when one side argued for the best work possible on all occasions, and the other group stood for the sound principle that unnecessary accuracy or finish was an economic waste; in other words that, considering the use to which a piece of work was to be put, it was unwise and uneconomical to spend time and material in making the piece any better than its use called for.

Many a man has been discharged because he could not discriminate between the amount of work he put on a pattern that was to be used only once and the pattern that was to be used in making a standard product; that he never knew when it was good enough for its purpose, and, this is still a common complaint. A man who is uneconomical for a private employer is equally uneconomical for the Government. Only those whose training does not allow them to discriminate between essentials and nonessentials will consider this a plea for an attempt to secure the acceptance of inferior work or material. Every engineer knows that nothing is further from the truth.

The question of inspection is cropping up in many quarters, and not always in a pleasant manner. As every shop man knows, there are inspectors and inspectors, even in peace times and in the best-regulated shops. Some inspectors seem to think it is their duty to see how much of a product they can reject, while others believe that it is their duty to pass as much as is satisfactory for the use to which it will be put. Needless to say the latter are right—and also scarce. But when you suddenly expand your business to unheard-of proportions, as did the Ordnance Department, you naturally get a lot of men wished on you who are not 100 per cent. efficient by a long way. And some of these are sure to be inspectors.

Add to this the effect of putting them in a war garb, at a time when war is the dominant thought in the world, and you have a combination which has great potentialities for trouble, for the small-bored man, be he inspector or anything else, becomes unbearable when given any kind of authority. Put into a uniform which demands a salute by any of our boys in khaki whom he happens to meet and the result is easy to foresee.

It is not altogether the uniform or the man or the system, but the unfortunate combination of the three. It simply aggravates the condition we meet in everyday shop life, and it is more annoying because we are all more or less keyed up by the war tension. It is a time for forbearance, even when both sides *know* they are right. Personal animosity gums the game, delays production and handicaps our boys in France.

That should always be the first thought—does it hurt our boys in France?

Shipyard Workers

With the advent of the volunteer workers Uncle Sam will have about 450,000 skilled men actually at work in shipyards. That shows what can be done in a little over a year's time. The following figures speak for themselves. In 1916 the wage earners in the shipyards of the country numbered: Steel shipyards, 43,582; wood shipyards, 1380; total, 44,962. On Jan. 1, 1918, the workers numbered: Steel shipyards, $181,273; wood shipyards, 23,437; total, 204,710. Add the 250,000 men who will respond to the call for shipyard volunteers and the grand total when we get into full swing will be 454,710 shipbuilders.

The Message of the Shops

By L. C. Randolph.

We take the curse from Labor, ages old,
And make men glory in their honest toil;
Within the hollow of our hands we hold
Humanity, to prosper or despoil.

In times of peace we build the dreams of man,
His haughty cities and his roads of steel;
We harness waterfalls and rivers span,
And in a thousand ways improve the wheel.

We civilize the nations and we bind
In common interest the lives of men;
We feed and clothe and shelter humankind—
And wreck the social order now and then.

For when Red Ruin stalks the world abroad.
And bugles call, and men go out to fight,
We rise to meet the foe, in one accord,
With all our nation's congregated might.

We make of war a contest of machines,
And win for those who organize us best;
For far behind the lurid battle scenes
We forge the weapons that decide the test.

America, the shops uphold your hands!
Unconquerable Industry assails
The enemy of freedom-loving lands—
And in the end 'tis Industry prevails.

Personals

W. E. Perrine, director of production of the Standard Parts Co., Cleveland, Ohio, was recently appointed assistant general manager.

A. C. Burleigh, formerly of the Chicago Pneumatic Tool Co., has joined the sales force of William K. Stamets, machine-tool dealer, Pittsburgh, Penn.

Robert J. Carroll, son of P. J. Carroll, late owner of the Carroll Foundry & Machine Co., Bucyrus, Ohio, has been elected president and treasurer of that company.

Donald W. Douglas, formerly aeronautical engineer in the aviation section of the Signal Corps, has been appointed chief engineer of the Glen L. Martin Co., Cleveland, Ohio.

C. M. Robertson, formerly with the E. L. Essley Machinery Co., Chicago, has become associated with the Dale-Brewster Machinery Co. of Chicago as manager of the machinery-sales department.

W. J. Lynch, formerly superintendent of the plant of the Washington Tin Plate Co., Washington, Penn., has resigned to become general manager of the sheet mills of the Mahoning Valley Steel Co. at Niles, Ohio.

Julius Nahoum, who resigned as managing director of the Vulcan Trading Corporation on Jan. 30, 1918, has accepted the management of the Bi-Continent Trading Corporation of 50 Broad St., New York City.

J. W. Leers has been appointed Eastern manager for the Peerless Machine Co. of Racine, Wis., manufacturer of hacksaws, with offices at 50 Church St., New York City. The Peerless hacksaws will be carried in stock in New York under Mr. Leer's direction.

Business Items

C. H. Westerberg, 39-41 Cortlandt St., New York City, who specializes in metal cutting tools and equipment, is moving to new quarters at 54-56 Barclay St. and 9-11 West Broadway.

The Hendey Machine Co., of Torrington, Conn. manufacturers of lathes, shaping and milling machines, has opened a branch office in Rochester, from which it will handle direct business in northern and western New York.

The Aborn Steel Co., Inc., at 22 Clarke St., New York City, 269 Drexel Bldg., Philadelphia, Penn., and 133 Andrews St., Rochester, N. Y., has been appointed sales agent for the Century Steel Co. of America, Inc., manufacturer of crucible steels, Poughkeepsie, N. Y. The Century Co. has given up its New York office and warehouse.

The American Brass Novelty Co., of Grand Haven, Mich., has sold its controlling interest to Charles D. Reeve, former vice president and general manager of the Grand Rapids Brass Co., and D. J. Gorman, formerly Eastern representative of the Keeler Brass Co. Harry L. Ackerman will act as assistant superintendent and Charles Dalvini will have charge of the machinery department.

New Publications

Practical Electricity — By Terrell Croft. Published by McGraw-Hill Book Co., Inc., New York City, 1916. Cloth; 5½ x 8 in.: 646 pages, 548 illustrations. Price, $2.50.

Heretofore the opening chapter in most books on elementary electricity and magnetism treated either static electricity or magnetism; but in this, Mr. Croft's latest book, he has broken away from the established precedent and has gone back to the present accepted theory of what matter and electricity are. The opening section, "Matter and the Electron Theory," to which 24 pages are devoted, is probably the most remarkable attempt ever made to present the electron theory in a practical way, so that it may be understood by a student of elementary electricity and magnetism. This theory is made use of where desirable in other parts of the book, in explaining the theory of magnetism and electricity. In this feature the book is of interest not only to the student of elementary electricity, but also to the more advanced reader.

The work is divided into 52 sections, of which ten are devoted to magnetism, electromagnetism, construction of electromagnets and their application. Seven sections are given over to the fundamental ideas concerning electricity, electromotive force, electric current, resistance, Ohm's law, and the generation of electrical energy. The subjects of storage batteries, primary cells, and electrolysis are treated in four sections. Electromagnetic induction is discussed in six sections. Principles of the electric generator, construction of direct-current generators, their voltage, rating, efficiency and characteristics, are considered in eight sections. Four sections are devoted to the direct-current motor. In eleven sections the subjects of characteristics of alternating-current circuits, principles and construction of alternating-current generators, power and power factor, polyphase circuits and systems, etc., are treated. One section is devoted to transformers and one to three-wire distribution systems.

These sections are divided into 869 subsections. Each subsection is given a title and number and is indexed according to its number and title, 14 pages being devoted to this index. The work probably represents the greatest amount of labor ever devoted to illustrating any single volume on electricity and magnetism, and in so far as possible the pictures have been so made as to tell their own story. Many of the illustrations used to explain the theory of electricity are radical departures from those found in other books of this character. Numerous examples are worked out throughout the book showing the application of the 290 expressions given for obtaining different values in electricity and magnetism.

The author in his preface states that "the primary object of the book is to present the fundamental facts and theories relating to electricity and its present-day applications in a straightforward, easily understood way for study by any man of little mathematical training, who desires to acquire working knowledge of the subject. Secondarily, the book was designed for university graduates who desire a medium whereby they can with minimum effort review, refresh and reconstruct in line with modern theory and practice their concepts of electricity and magnetic phenomena." These objects the author seems to have admirably accomplished, and the work is one that should be of value to almost everyone who is interested in the subject of electricity and magnetism.

Steel and Its Heat Treatment—By Denison K. Bullens. Second edition. Four hundred eighty-three 6 x 9-in. pages; two hundred eighty-five illustrations and numerous tables. Published by John Wiley & Sons, Inc., New York City. Price $4.

In this second edition the scope of the work has been broadened to include additional information of a practical nature to further illustrate the application of principles in everyday commercial practice and to encourage a consideration of every element in the cycle of operations from the initial heating of the steel for the forging process to the final heat treatment. In the section on heat, additional data are given to explain the difference between combustion and generation of heat and the application of heat to useful work; the difference between the mere indication of uniform temperature and uniformly heated product; the relation between temperature, time, mass and surface in the determination of uniformly heated product; the influence of furnace design and operation on the quality and cost of finished product; the weakness of relying upon pyrometer readings without considering other equally important factors, and the factors governing the selection of furnaces and fuels and the use of both. The section on forging has been materially enlarged to show the relation of forging to heat treatment, the effect of temperature, time and uniformity of heating upon the structure of steel; also a number of original micro-photographs have been added to illustrate the variation in structure under distinctive conditions. The human element is considered and elaborated upon. The chapter on annealing has also been enlarged by the addition of matter of interest to the practical man. Altogether the revision has been thorough and adds greatly to its value. The various chapters cover the testing of steel, heat generation, heat application, the human element, forging, the structure of steel, annealing, hardening, tempering and toughening, case carburizing, casehardening, thermal treatment, carbon, nickel, chromium, chromium nickel, vanadium, manganese, silicon, tungsten, molybdenum and high-speed steels, tool steel and tools, miscellaneous treatments, pyrometers and critical range determinations.

Forthcoming Meetings

The American Gear Manufacturers' Association will hold its second annual convention at White Sulphur Springs, W. Va., Apr. 18, 19 and 20, with headquarters at the Green Brier Hotel. The secretary is F. D. Hamlin of the Earle Gear and Machine Co., 4701 Stenton Ave., Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting, first Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers. Spring meeting at Worcester, Mass. June 4, 5, 6 and 7, with headquarters at the Hotel Bancroft.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

The sixth annual meeting of the Chamber of Commerce of the United States of America will be held in Chicago, Apr. 10, 11 and 12, 1918. Elliot H. Goodwin, Riggs Building, Washington, D. C., is general secretary.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

The National Gas Engine Association will hold its eleventh annual meeting at the Hotel Sherman, Chicago, Ill., June 3 and 4. The headquarters of the association are at Lakemont, N. Y.

The spring convention of the National Machine Tool Builders' Association for 1918 will be held Thursday and Friday, May 16 and 17, at the Marlborough-Blenheim Hotel, Atlantic City, N. J. Charles L. Taylor of Hartford, Conn., is secretary.

The National Metal Trades Association announces the following program of its forthcoming convention, which will be held at the Hotel Astor, New York City: Monday, Apr. 22, 10 a.m., executive committee meeting; 7 p.m., secretaries' dinner. Tuesday, Apr. 23, 10 a.m. to 5 p.m., council meeting; 10 a.m., meeting of local secretaries; 6:45 p.m., alumni dinner. Wednesday, Apr. 24, 9:30 a.m. and 2 p.m., convention; 12:30 p.m., buffet luncheon; 7 p.m., banquet. Thursday, Apr. 25, 9:30 a.m., and 2 p.m., convention and meeting of the incoming administrative council. Homer D. Sayre, People's Gas Building, Chicago, Ill., is the secretary.

A joint convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held at Cleveland, Ohio, May 15-17. Among the important subjects to come up for action will be Government control of fuel, transportation and shipping of materials and price fixing. The coöperation of labor in war activities will also be discussed at length.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

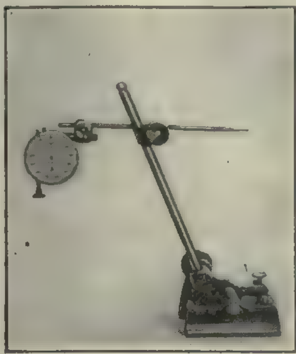
Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Indicator, Dial, "Atlas"

B. L. Gates, 125 South Wells St., Chicago, Ill.

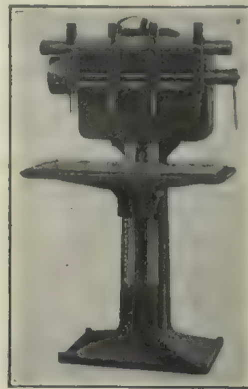


"American Machinist," Mar. 28, 1918

The device is shown attached to a surface gage. The connections are universal, a bent connecting-rod not shown being claimed to be very useful. The indicator measures up to 0.130 in., the graduations being in thousandths of an inch. If desired an extension is provided which will enter a small hole and reach to the depth of 3 in. This is made of tool steel and is hardened. The plunger is placed at one side of the dial center, which it is claimed allows the use of the indicator in close places, corners, etc.

Grinding Machine, Valve, No. 50

Defiance Machine Works, Defiance, Ohio



"American Machinist," Mar. 28, 1918

This machine for grinding-in the valves of gasoline engine cylinders is made with four, six or eight spindles, the oscillating movement being obtained through spur gears which it is claimed decreases the amount of vibration. Minimum center distance of spindles, $1\frac{5}{8}$ in.; maximum center distance of outside spindles, 22 in.; distance from spindles to face of column, 7 in.; vertical travel of spindles, 3 in.; maximum distance from nose of spindles to top of table, $21\frac{3}{4}$ in.; minimum distance from nose of spindles to top of table, $9\frac{3}{4}$ in.

Grinding Machine, Universal

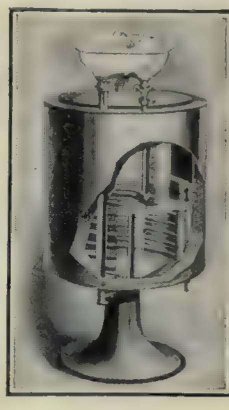
Manhattan Machine and Tool Works, 42-50 Market Ave., N. W., Grand Rapids, Mich.

"American Machinist," Mar. 28, 1918

Table dimensions, 6 x 42 in.; working surface of table, 6 x 22 in.; longitudinal movement of table, 22 in.; transverse movement of table, 8 in.; vertical movement of table, 12 in.; maximum diameter of work, 9 in.; distance between centers, 21 in.; center of wheel to top of table, 12 in.; distance from floor to center of spindle, 47 in. Equipment includes internal-grinding attachment, one pair of central head and tail centers, one pair of offset head and tail centers, one faceplate 8 in. in diameter, one chuck for center head, one 5-in. swivel-base vise, six pairs of wheel flanges, six driving dogs $\frac{3}{8}$ to 2 in., one height gage, one tooth-rest socket, seven extension bars, three spring-tooth-rest springs, six T-slot bolts and countershaft complete.

Drinking Fountains, "Ebco"

D. A. Ebinger Sanitary Manufacturing Co., Columbus, Ohio

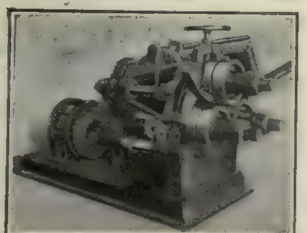


"American Machinist," Mar. 8, 1918

The illustration shows the fountain mounted on a cooler. It will be noticed that the construction is such that the stream of water flows up at an angle from beneath a guard, this feature making it impossible for anyone to place his mouth on the nozzle. This type of jet also enables one to fill a glass without utilizing an extra outlet. The angular stream is secured by means of two intersecting jets of varying velocities. The fountain itself is made of vitreous enamel ware, and is also made up in such form that it may be mounted on the wall.

Angle Bending Machines

Kane & Roach, Niagara and Shonnard Sts., Syracuse, N. Y.

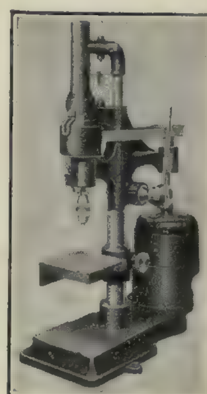


"American Machinist," Mar. 28, 1918

Made in three sizes, No. 22 handling angles up to 3 x 3 x $\frac{3}{8}$ in., No. 23 for angles up to 4 x 4 x $\frac{1}{2}$ in., and No. 26 for angles up to 6 x 6 x $\frac{5}{8}$ in. I-beams, channels, Ts, rounds, squares, pipe or flat stock may also be bent by making filling-in collars or rolls to match the work. Either one or two angles may be bent at a time as desired. The machines are made with the rolls close to the floor, which eliminates much lifting. The rolls are also placed close together, which reduces the length of the flat spot at each end. It is also claimed that having the rolls close together allows the bends to be started from the straight piece, thus eliminating hand bending at the start.

Drilling Machine, Bench, Model E

High Speed Hammer Co., Inc., Rochester, N. Y.

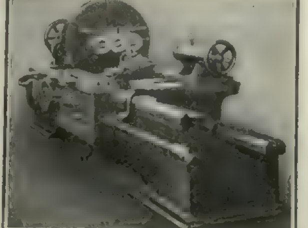


"American Machinist," Mar. 28, 1918

Capacity up to $\frac{3}{16}$ in.; spindle speeds, two, 2100 and 6000 r.p.m.; working surface, $5\frac{1}{2}$ x 5 in.; working surface of base, 4 x 6 in.; height, 24 in.; motor, $\frac{1}{10}$ hp.; diameter of spindle, $\frac{7}{16}$ in.; spindle feed, $2\frac{1}{4}$ in.; distance from center of spindle to column, 3 in.; height of work accommodated on table, up to $4\frac{3}{8}$ in.; height of work accommodated on base, up to $7\frac{1}{2}$ in.; dimensions of base, $7\frac{1}{2}$ x 18 in.; weight, 60 lb.

Lathe, Heavy-Duty 40-In.

A. W. Needham, Long Island City, N. Y.

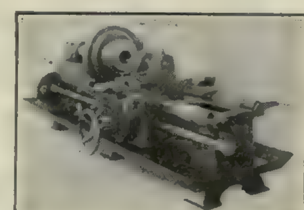


"American Machinist," Mar. 28, 1918

This lathe is of rather radical design, being built with the intention of securing a rigid machine with moderately large swing capable of producing accurate work under heavy sustained cuts. Length of bed, 12 ft.; height from floor to top of front shear, $34\frac{1}{2}$ in.; center to center of shears, 27 in.; height of front shear above back shear, $9\frac{1}{2}$ in.; transverse movement of head and tail stocks, 14 in.; front bearing of spindle, 6 in. in diameter by 8 in. long; rear bearing, 4 in. in diameter by 6 in. long; hole in spindle, $2\frac{1}{4}$ in. clear through; diameter of faceplate, 36 in.; width of faceplate, $5\frac{1}{2}$ in.; maximum swing, 40 in.; swing over carriage, 14 in. (this is with the carriage extension in place; without this extension the swing in all places is 40 in.); length between centers, 8 ft., weight complete, 14,000 lb.

Lathes, Heavy Shell

Gisholt Machine Co., Madison, Wis.



"American Machinist," Mar. 28, 1918

This machine is made in two sizes, 16- and 25-in., which are especially adapted for boring 3- and 6-in. shells respectively. Specifications for 25 in. size: Standard length of bed, 10 ft., normal swing of lathe, 25 in.; hole through spindle, $6\frac{1}{4}$ in.; spindle front bearing, $8\frac{1}{4}$ x 12 in.; spindle rear bearing, $7\frac{1}{4}$ x 9 in.; spindle nose diameter, $12\frac{1}{2}$ in.; headstock cone, diameters, 20 and 16 in.; width of belt, 8 in.; ratio of back gearing, 8 to 1; spindle speeds, 12, 16, 20 and 27 r.p.m.; countershaft cone diameters, 17 and 13 in.; friction pulleys on countershaft, 20 x 6 in.; speed of countershaft, standard, 160 and 200 r.p.m.; weight, about 8000 lb.; cu.ft., about 300.

Patent Applied For

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Mar. 28, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$27.00
No. 2 Southern Foundry, Chicago......	37.00	33.00	35.50
*Bessemer, Pittsburgh	37.25	37.25	36.95
*Basic, Pittsburgh	33.95	33.95	30.95
No. 2X, Philadelphia	33.75	33.75	34.75
*No. 2, Valley	33.95	33.95	36.00
No. 2, Southern Cincinnati	35.90	35.90	29.90
Basic, Eastern Pennsylvania	33.75	30.75	30.50

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Apr. 4, 1918	One Month Ago	One Year Ago	Apr. 4, 1918	One Year Ago	Apr. 4, 1918	One Year Ago
Structural shapes ...	$4.195	$4.20	$4.10	$4.20	$4.10	$4.20	$3.75
Soft steel bars	4.095	4.10	4.00	4.20	4.00	4.10	4.00
Soft steel bar shapes.	4.095	4.10	4.00	4.20	4.00	4.10	3.75
Plates, ¼ to 1 in. thick	4.445	4.45	5.15	4.20	5.00	4.45	4.75

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Apr. 4, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.25
Warehouse, New York	4.70	3.75
Warehouse, Cleveland	4.10	3.95
Warehouse, Chicago	4.10	3.75

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Apr. 4 1918	New York One Month Ago	New York One Year Ago	Cleveland Apr. 4 1918	Cleveland One Year Ago	Chicago Apr. 4 1918	Chicago One Year Ago
*No. 28 black	5.00	6.445	6.445	6.00	6.385	5.50	6.45	5.40
*No. 26 black	4.90	6.345	6.345	5.90	6.285	5.40	6.35	5.30
*Nos. 22 and 24 black	4.85	6.295	6.295	5.85	6.235	5.35	6.30	5.25
Nos. 18 and 26 black	4.80	6.245	6.245	5.80	6.185	5.30	6.25	5.20
No. 16 blue annealed	4.45	5.645	5.645	5.45	5.585	5.20	5.65	5.45
No. 14 blue annealed	4.35	5.545	5.545	5.35	5.485	5.10	5.55	5.35
No. 10 blue annealed	4.25	5.445	5.445	5.30	5.385	5.05	5.45	5.30
*No. 28 galvanized	6.25	7.695	7.695	5.25	7.635	5.00	7.70	5.20
*No. 26 galvanized	5.95	7.395	7.395	8.00	7.335	7.25	7.40	7.50
No. 24 galvanized	5.80	7.245	7.245	7.70	7.185	6.95	7.25	7.20

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Apr. 4, 1918	One Year Ago
New York	List plus 10%	List plus 20%
Cleveland	List plus 10%	List plus 20%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Apr. 4, 1918	One Year Ago
New York	$15.00	$9.50
Cleveland	15.00	7.50
Chicago	15.00	6.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16, No. 8, 5/32 and No. 10, ⅛, No. 12, 3/32, No. 14 and 1/16, No. 18, No. 20	21.00@30.00

*Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Apr. 4, 1918	Cleveland Apr. 4, 1918	Chicago Apr. 4, 1918
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel..	7.50	8.00	8.25
Spring steel (crucible analysis)	11.00	11.25	11.25
Coppered bessemer rods..	7.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel....	9.00	8.25	8.25
Floor plates	6.19½	6.00	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4.....	45%	33½%	2¼ to 4.......	29%	17%
4½ to 6......	44%	32½%	4½ to 6.......	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings. Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Apr. 4, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	37.00
Tin, in 5-ton lots	85.00	85.00	54.50
Lead	7.25	7.25	10.75
Spelter	7.50	8.00	11.00

*Government price.

ST. LOUIS

Lead	7.10	7.10	10.50
Spelter	7.25	7.75	10.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Apr. 4 1918	New York One Month Ago	New York One Year Ago	Cleveland Apr. 4 1918	Cleveland One Year Ago	Chicago Apr. 4 1918	Chicago One Year Ago
Copper sheets, base	31.50-33.00	32.00	44.00	35.00	46.00	35.00	43.00
Copper wire (carload lots)	32.00	32.00	39.50	34.00	44.00	34.00	39.00
Brass sheets	30.75	30.75	45.50	30.00	45.00	35.00	43.50
Brass pipe base....	36.50	36.50	47.50	41.00	52.00	41.00	47.50
Solder ½ and ½ (case lots)	62.00	62.00	45.50	41.50	33.50	48.00	33.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Apr. 4, 1918	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	35.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:
Carload lots f.o.b. mill................................ 19.00

	In Casks Apr. 4, 1918	In Casks One Year Ago	Broken Lots Apr. 4, 1918	Broken Lots One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	20.00	23.00	20.50	23.25
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Apr. 4, 1918	One Year Ago
New York	13.50	31.00
Chicago	16.00	32.00
Cleveland	16.25	34.00

TRAINING INSTRUCTORS ACCORDING TO THE GISHOLT IDEA

BY FRED H. COLVIN

This, the first article, outlines the underlying principles of a plan which has grown from small beginnings to the attainment of very practical results in training men not only to become expert operators themselves but how to instruct other men to operate and, in turn, to teach still more. The results obtained in this service course have been so practical and far reaching that even the most hard-headed materialist must admit that environment and mental suggestion, somewhat vaguely known as "atmosphere," are factors to be carefully considered. A second article will give concrete examples of the way in which the plans are carried out.

THE great need for skilled workers and large production makes any plan by which men can be trained quickly of double value at this time. The greater need, however, is for instructors who can instruct, and this is just what the Gisholt idea satisfies.

The soundness of this reasoning is clearly shown by the adoption of the idea for the officers' training camps for the National Army. These were established before the men for the new army were drafted, so as to have them ready to train the men. A three month's course of intensive training gave our new army thousands of young officers who had been given a thoroughly practical course in military training, said to be nearly as much actual instruction as the four years at West Point devote to this particular part of the officer's education.

The country's need has so stirred the patriotism of the owners of the Gisholt Machine Co. as to lead them to give out the full details of the Gisholt idea of intensive training for instructors and mechanics—an idea which has been proved to contain the germ of great possibilities in industrial training.

This is not a plan for training men and women in one-operation work. It is much broader and more important. It takes any intelligent mechanic with from three to five years' experience and gives him a thorough groundwork in the fundamentals of machine building, in machine operating, in laying out tools for and in setting up for any class of work, in repairing the machine and keeping it in order, in sketching for all shop purposes, and in estimating the time required for any job. And, more than all this, he not only knows these things himself but he can even impart his knowledge to others.

For he not only knows how he was taught, but he also can teach others, because the actual teaching of a new man is part of his own course of instruction.

The training of mechanics runs back hundreds of years to the time when boys were bound to master craftsmen for a long term of years. The methods and customs have undergone many changes since then, even within the recollection of the present generation. In fact, the old apprentice system has almost disappeared, and in many cases nothing has taken its place. The result is too well known to need comment. Any shop manager can tell of his difficulties in securing trained men in almost any line of machine work and, worse yet, there seems to be no one to train them. Here is where the training of instructors is particularly valuable and timely.

As with most worthwhile innovations the Gisholt idea has developed far beyond the first dreams of its originators. It began with a course of special training to fit some of their own men to install machines in new plants, to repair old machines and to increase production in the shops of their customers by demonstrating what the machine could do. Then came the training of men so that buyers of machines could also secure skilled operators from the Gisholt plant.

But this had its drawbacks. The human equation outside the shop interposed numerous difficulties. Family ties and the good-fellowship of real friends made it hard to secure the right kind of men who would settle in any part of the country when the purchaser of a machine needed an operator. The problems of housing and transportation were factors to be considered.

SOLUTION OF THE PROBLEM

The solution of this came with the decision to establish a school for the training of men from the plants of the buyers of Gisholt machines, as this would sow the seed of the Gisholt knowledge in the shop itself instead of transplanting as before. No home conditions were disturbed, and the benefit of the training is likely to be more permanent because the man is more apt to remain with his company, and thus utilize his knowledge for both the company's interest and his own.

The Gisholt idea came into definite shape about six years ago, although the foundation had been laid years before perhaps without its being realized at the time. Back of it all is the idea of service to the end that the customer, the man, and the country may secure greater productive efficiency.

It is not easy to put on paper just what I mean by the Gisholt idea, but I shall try to do so before taking up the details of the instruction course. There is more good psychology tucked away in the whole idea than perhaps the originators of the ideas dreamed of in the beginning. Even six years ago the psychology of the machine shop was very little appreciated. Fortunately

we are beginning to see a little light on the subject which we formerly left to the high-brow professor.

In most cases the moment a man is selected to take this course of training he assumes a new line of thought. The very fact that he is chosen to go to Madison to be specially trained gets him out of the rut of everyday happenings in the shop. It is either a mark of appreciation for past efforts or the belief that he can become a more valuable man. In either case it is up to him to show whether he can measure up to the opportunity. With this in mind he begins the training with a different mental attitude from that which he held toward his regular work day after day, and for this reason the effect of sending a man to a different city to be trained may be worth all the extra cost, even though the same training could be given in the home shop. In either case the man's selection as being capable of absorbing an intensive course of instruction is a mark of distinction which has its effect even on those that are apparently callous to such influences.

The first desire of the average man is to make good, and having been selected for a special course which involves the use of his brains as well as of his machine-shop experience he goes to the new task in a receptive mood. He may be a little skeptical as to the ability of anyone teaching him more than he knows of his work, but he believes it is up to him to learn something new or to explain why he could not do so. Thus his mind is much more alert than before. This then may be said to be the *beginning* of the Gisholt idea—the paving of the way for the new training by getting the man's mind out of its regular channels.

The First Steps

The manner in which the new man is received at the Gisholt shop school lays the foundation for his success. The shop atmosphere is everywhere apparent, and after seeing that the newcomer is comfortably located in a good boarding place he spends the first day in going through the whole shop, observing how the work is carried on, how the machines are built and absorbing much of the atmosphere of good-fellowship that is everywhere apparent. Another point which increases his confidence and raises his hopes of success is that his guide, in selecting a temporary home and in his tour of inspection, is a fellow student who is at least halfway along on his own course and usually almost ready to leave. The enthusiasm of the man who has been taking the course for a few weeks is so contagious that the newcomer is filled with the desire to do likewise and he starts in with great anticipation of the lessons to come.

Without going into any details of the lessons in this article it is necessary to mention briefly one of the features which plays a much more important part than the skeptical may be willing to admit. After the first day in the shop, and at suitable intervals thereafter, the student receives a printed lesson in addition to his actual work on the machines themselves. Each of these lessons include a carefully chosen selection of terse sayings which have a direct bearing on some of the many phases of a man's character, which either fit him for advancement or doom him to failure.

They are not preachments in the usual sense, but have been so well selected for the particular place in which they are used that even a man of average intelligence and little education cannot fail to see their application. Taken by themselves, or handed to a man who was not in the receptive attitude of the student who is seeking new knowledge, their effect would be greatly lessened, but the impression they make is so clearly shown in its effect on the men as to be unmistakable. Then too the wisdom of the planners of the course is shown by the fact that no attempt is made to examine the men as to their remembrance of these sayings. They are never mentioned unless by the students themselves, but there can be no question as to their effect on their personality, and this influence will probably extend much further than we may think.

More of the Psychology

Probably most of the men who take the service course have been Gisholt operators. As such they know how the machine works because they have handled it. But the "why" of it all is not often within their opportunity to learn. For this reason they appreciate the chance to take down a complete machine and see just how every part fits in with and affects the others, to know what may go wrong at times and, when so, how to fix it. It transforms him from a mere operator to a man who can find out what is wrong, who can remedy the difficulty, who can readjust the machine or any of its parts, and give him a greater confidence in his ability and in himself than could be secured in any other way. In other words it trains him to think logically along definite lines.

This spirit of self-confidence is quite noticeable in many ways. In conversation and correspondence the men fairly bubble over with enthusiasm and with confidence in their ability to not only do the necessary work themselves but to direct others in doing it. With students taking the course this might perhaps be attributed to the influence of the Gisholt atmosphere, which is very noticeable in every department. But when this is just as apparent in the letters from men who have gone back to their old shops to more responsible positions and with the confidence of assuming responsibility for repairs and adjustments which was unknown to them before, and who are making good to such a degree that their employers are as enthusiastic as they are, it can hardly be classed as a temporary or hypnotic effect. The sound fundamental principles on which the course is based, the way in which it is given to the men, and the feeling of fellowship and coöperation which grow up between the students and the representatives of the Gisholt company, all play their part in making this course the success it has proved to be.

The Advantage of Intensive Training

An extremely interesting phase of the question is the way the time required for training has been shortened. The first men were given a course extending over a year. This was being gradually reduced; but the need of more men in a shorter time has resulted in a concentration of effort into a most intensive training course, and with astonishing results. Just what this may lead to ultimately is somewhat conjectural, but the course at present is covered in eight weeks, with every indication that it can be reduced to four weeks, or even a trifle less, by making slight modifications. These changes are al-

ready planned, and there seems to be no reason for the results not being entirely satisfactory.

The shortening of the course to eight weeks instead of being a disadvantage has proved to be a benefit, and here the element of psychology comes in once more. With the long course there seemed to be no particular incentive to finish the lesson today. There was always a tomorrow, and it was a long time to the end of the course.

Shortening the course to eight weeks changed this attitude completely. Here was a certain definite number of lessons to be learned in a much shorter period, and evidently there was no time to be lost or wasted. The necessity for crowding in a full course in a given time, and that a short one, put the student on his mettle and showed him the need of concentrating his mind on the course. All else must wait till this was done.

Results of the Intensive Schedule

In other words, the intensive schedule awakened him to the urgency for intensive work and he went to work with a will. How far this can be carried remains to be seen; there is a limit to all things. But those who have made these courses the study of years are confident that this can be condensed into one month and still give the student who is willing to work hard all the advantages of the longer training.

Just how widespread the effect of training of this kind would be on the nation as a whole it is impossible to say. But who can doubt that it would be of great benefit in many directions? There are many instances where it has transformed those who have undergone the test into more desirable citizens. In fact it might almost be called a course in citizenship in addition to its purely mechanical side. The principles which are absorbed, perhaps unknowingly, from the "sayings" in the fifteen lessons are sure to bear fruit in the future as they have in the past.

Possibilities of the Future

There are great possibilities in the development of this Gisholt idea in other lines, particularly at this time when the rapid training of men is of such vital national importance. The need of thousands of workers on the ships for the new merchant marine emphasizes even more strongly the need for instructors of these men just as the draft of the National Army showed the need for officers of the new troops.

The value of this plan at this time is to enable the establishment of training courses for these instructors. This can be done for almost any line of work by simply modifying the principles outlined in this to suit the work in hand. The course for machine work has been so thoroughly worked out as to require few changes for its introduction into other machine-tool or machine-building centers. And the men at the Gisholt plant will gladly render any necessary assistance to establish such centers in other sections. It is their desire to forego any advantages which might accrue from their hiding this light under a bushel at this time. And it is earnestly hoped that all who are interested in the proper development of our industries which need trained men will act promptly to give the Gisholt idea the opportunity of rendering its maximum service to the country.

This work can perhaps best be undertaken first by the larger concerns in the machine-tool line, any well-equipped and well-organized shop of several hundred men being in a position to inaugurate such a method of training. The principles involved in this course are broad enough to allow of their being readily adapted to suit almost any kind of industry.

Cutting Prices Versus Raising Wages

By Entropy

Whenever the turn of business is such that employers no longer stand at their doors and accept applications from those who must have work, but actually have to persuade men that theirs is the best shop in which to work, it is natural for them to do the thing that they would if it were necessary to quickly unload a stock of goods; that is, instead of cutting prices on their goods they raise wages.

Experience has proved to the majority of sales managers that price cutting is a very unprofitable method of meeting competition. It is probable that employment managers and shop superintendents will also discover that raising prices merely for the sake of attracting men who already have good jobs is neither sufficient to attract the best men nor profitable in the long run.

It does not attract the best men because their employers can as well afford to meet any kind of price competition as the one who makes the offer. It does draw many men of mediocre or poor quality because their employers are glad to let them go to competitors to increase their cost of production, and it draws many more men even further down the scale who are hired simply for the reason that they worked for "White Manufacturing Co." and that the other men who came from there were good.

It is a catch phrase to say that money is not everything; but we are too apt to say it and then act as if it were. The more desirable men are those who are able to see that permanency of employment and the conditions surrounding it are of more value in the long run than the immediate wage paid. A concern that has a reputation for stability both as to work to be done and patience with its employees has a strong hold on men. A shop that lays off a lot of men every few months, whether for lack of management or because the superintendent believes he must keep fear in the hearts of his men, in the end pays out more in wages than the shop with steady work and a tolerant management. A shop where men can work in comfort and safety; where cranes and other handling devices are plenty and efficient; where transportation or housing is good; where foremen can remember when they worked at the bench themselves and how it felt, can generally hold its more desirable men against temporary increases offered by competitors.

This condition of course is not permanent. No one can or should be able to hold his men in the face of world conditions that make the cost of living jump overnight; but all these things help to make workmen efficient and happy and have a big influence in keeping together an organization besides saving a big slice of the payroll by cutting down the labor turnover and the consequent high cost of training new men and smoothing out the fluctations in the wage rates.


F.R.Calkins
UNLIMBER every effort in your individual daily tasks – that extra cartridge may keep the white Star from some mother's Service flag.
SUFFER your share to save for him who is willing to sacrifice his all that your children may continue as becomes God's men.
ANNIHILATE the assaulting hordes with an overwhelming bombardment of dollars – the THIRD LIBERTY LOAN is one more stride toward VICTORY –
Now is THE time

Manufacture of the 4.7-Inch Gun

Model 1906—II

By E. A. SUVERKROP

The operations of spotting and telltaling the tube having been completed, as described in the previous article, and the boring tools having been made, the tube is ready for rough and finish boring so that it can be star gaged previous to the operation of shrinking on the jacket. The following article covers the operations of boring and star gaging the tube; telltaling, spotting and boring the jacket; star gaging the jacket; turning the tube and shrinking on the jacket.

THE lathe used for gun boring is simply an elongated engine lathe with a few added conveniences for the boring operation. The long bed is necessary to accommodate the boring bar and the requisite mechanism for traversing it. As in all boring operations where a true hole is desired the work rotates, and except for its advance the bar is stationary. The bar is an ordinary cylindrical one, with oil tubes set in milled grooves in its sides and connecting with the oil ducts in the boring head. The other ends of the oil tubes connect by piping with an oil pump and reservoir

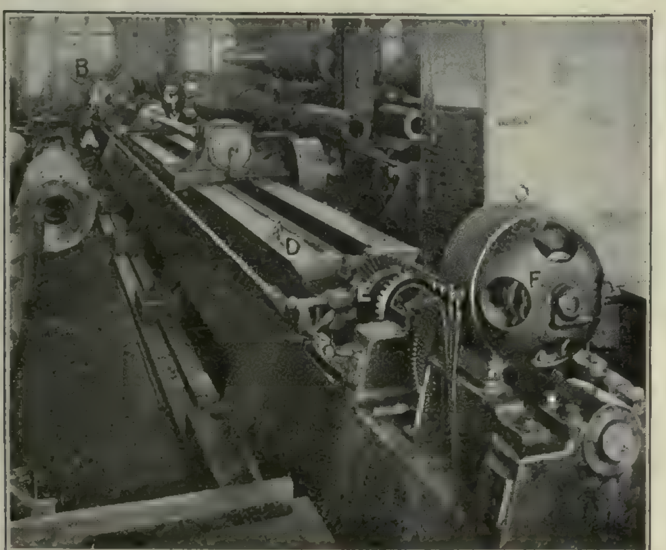


FIG. 11. GUN-BORING LATHE

in the base of the lathe. As a cut lubricant a mixture of mineral lard oil, two parts, to kerosene, one part, is used, and at only moderate pressure. There is, however, considerable quantity, so that the cutters are kept flooded and cleared of chips while they are at work.

While there are a number of modern gun lathes at the arsenal they are so large and so closely placed that no satisfactory photograph could be obtained of them. The one shown in Fig. 11 is of one of the older lathes, but in principle it is the same as the later ones.

The work A is driven by the chuck B. The boring bar C is traversed by the screw D, which is rotated by gearing driven by a shaft at the back of the lathe. This shaft is driven by gearing from the headstock. The direction of rotation of the feed screw D can be reversed

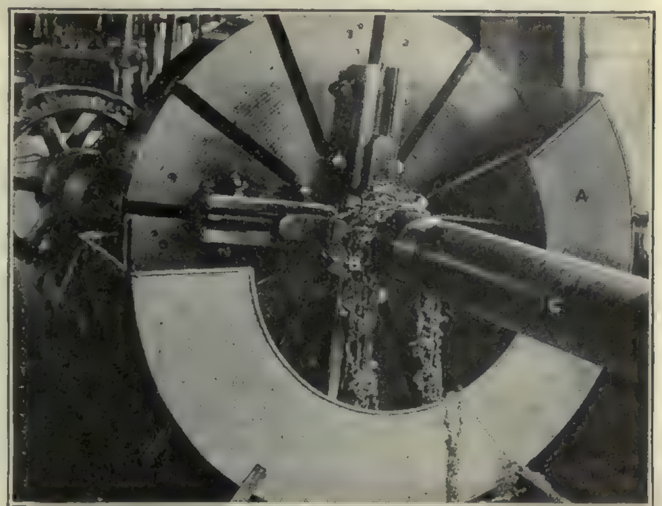


FIG. 13. OIL GUARD AT CHUCK

by means of a clutch mechanism E controlled from the carriage. High-speed rotation of the feed screw, and consequent high-speed traverse of the boring bar in either direction, is provided for by the motor F. There are various feeds to conform to the requirements for boring the different sizes of tubes handled.

The breech end of the tube is gripped in a four-jawed independent chuck, while the muzzle end is located in the steadyrest adjusted on the spot turned for that purpose. With a parallel across the ways of the lathe and a surface gage mounted thereon the operator adjusts the jaws of the chuck so that the spot at the breech end runs true. The boring bar (without the boring head) is run forward so that its forward end just enters the internal spot in the end of the tube. With the aid of feeler gages the operator then adjusts the jaws of the steadyrest till the end of the boring bar is concentric with the spotted hole in the end of the tube, the adjustment of both ends of the tube obviously being carried on simultaneously.

When the axis of the tube is positioned in alignment with the axis of the boring bar the bar is run back and the boring head inserted in the tapered hole provided for it in the end of the bar. The keys, shown in Fig. 7, are then inserted and the wedge driven home. This seats the head firmly in its tapered seat, and the taper and the keys prevent it from turning under pressure of the tube the boring bar is run back and the finishing reamer substituted. The feed is altered to 0.050 in. per turn of the work during the finish-boring operation. The speed of the work for finish boring is reduced to from 14 to 16 ft. surface speed per minute. Owing to the toughness of the stock the finishing reamer produces very long chips which are carried by the oil

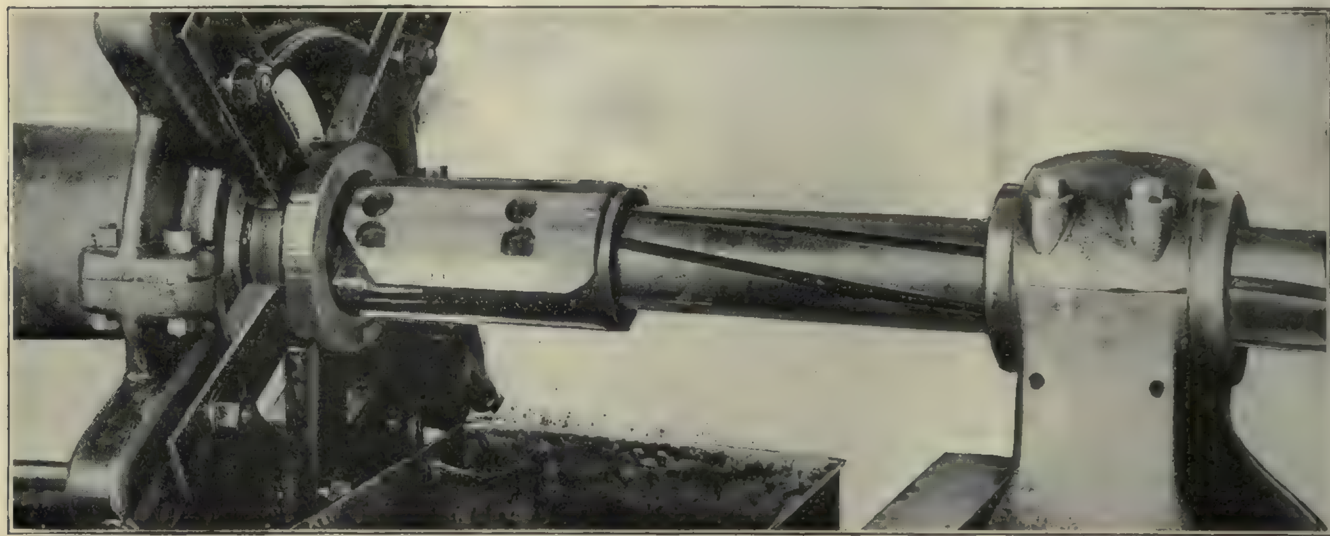


FIG. 12. HOG-NOSE TOOL ABOUT TO ENTER THE TUBE

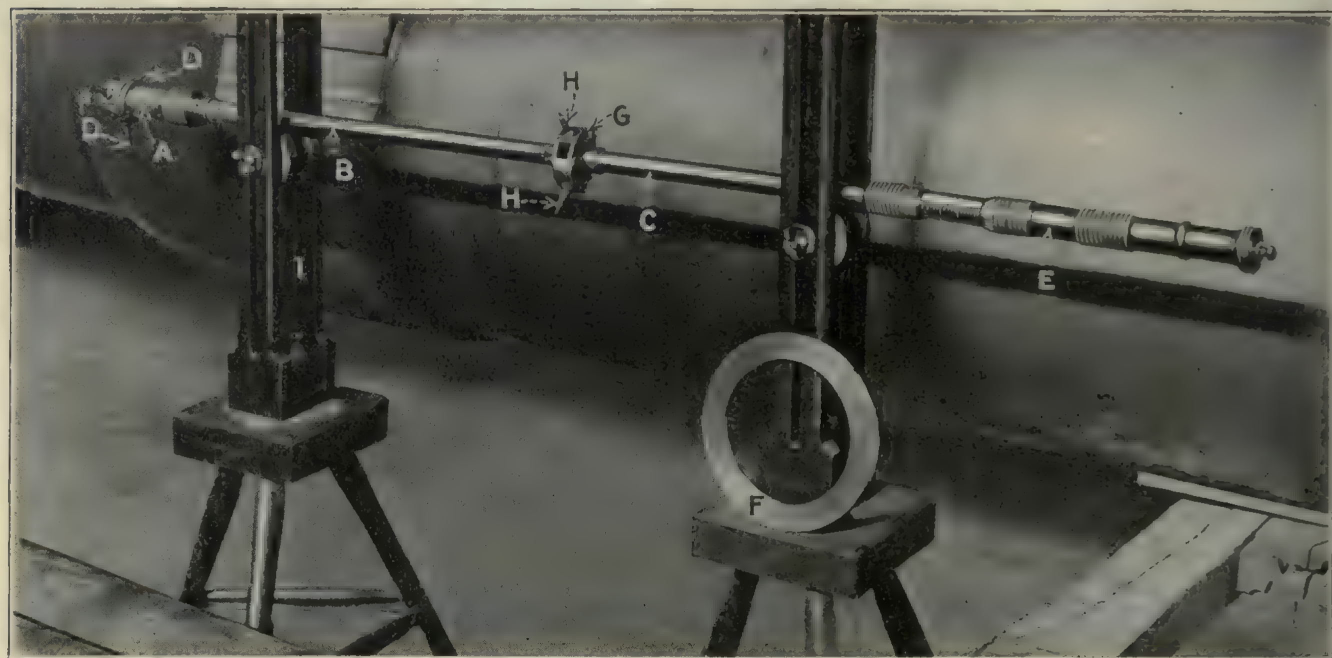


FIG. 16. THE STAR GAGE

of the cut. The first boring tool used is the hog nose, which is 4.52 in. in diameter. The set-up, as the hog nose is about to enter the bore, is shown in Fig. 12. The rough-boring operation is carried on at a surface speed of the work of about 20 ft. per minute, depending on the hardness of the stock and on other variables. The amount of lubricating oil used is sufficient to flood the cut and carry the chips to the chuck end of the job. A large sheet-iron guard *A*, Fig. 13, at the driving end prevents the chips and oil from being thrown all over the floor; the feed is approximately 0.025 in. per revolution of the work.

When the hog nose has traversed the entire length through to the faceplate, where they are caught by the jaws and work back to the end of the work, as shown at *B*, Fig. 13. After the finishing reamer has been passed through the tube the bar is run back and the tube *C* removed from the lathe and usually taken to a shorter one for turning the outside to the shrinking sizes for the jacket. However, before this is done the jacket must be bored to shrinking size and star gaged to ascertain the sizes to which the tube must be turned. The reason for this is that it is obviously much easier to turn an external surface to compare with a given inside surface than it is to bore an internal surface to compare with a given external surface. This will be recognized as espe-

cially true when the length of the shrinking surfaces are taken into consideration.

The spotting and telltaling of the jacket are carried on in precisely the same manner as are the similar operations on the tube. In Fig. 14 is shown the rough forging for the jacket, and in Fig. 15 are the details. The breech end of the forging is gripped in the chuck; the muzzle end is mounted on a revolving cone center, while the spot *A*, Fig. 15, is turned; a narrow spot is also turned at *B*. The muzzle end is then run in the steadyrest and the hole is telltaled. If necessary the spot is corrected in the same manner as described in connection with this same operation for the tube. The operator then proceeds to internally spot the muzzle end for the rough and finish boring operations precisely as described in connection with the internal spotting of the

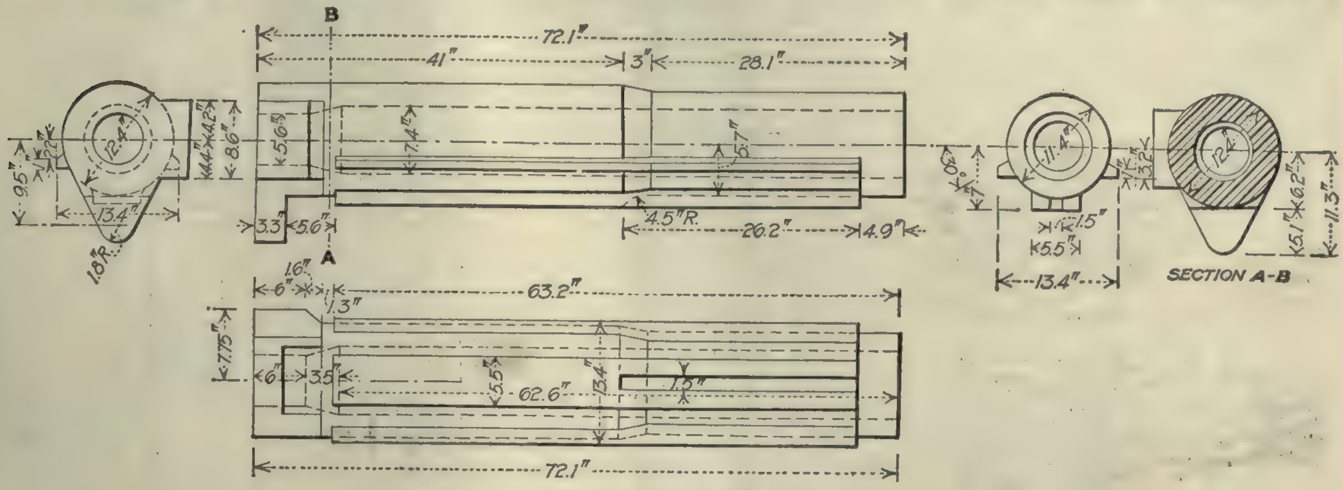


FIG. 14. ROUGH FORGING FOR THE JACKET

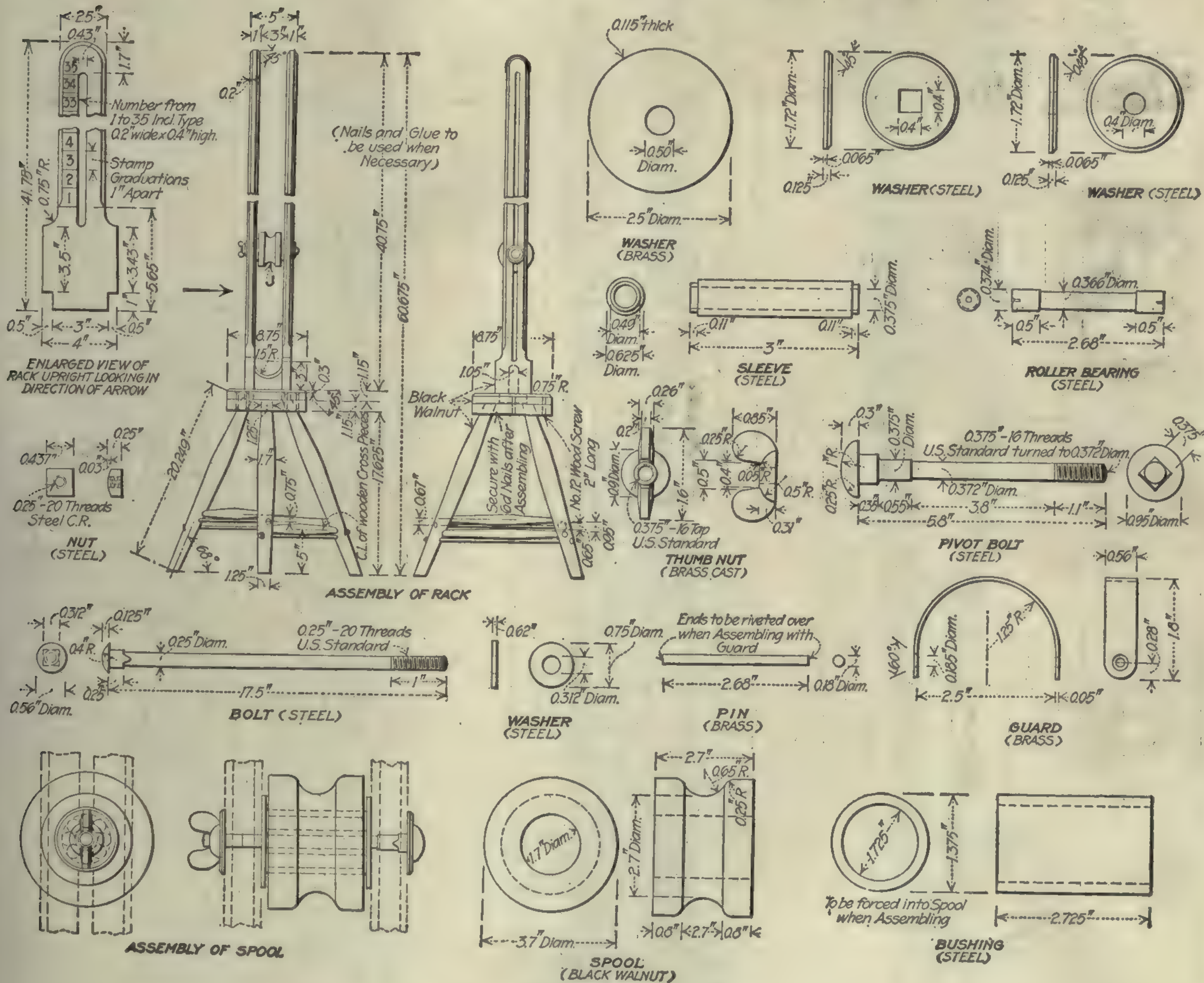


FIG. 18. THE STAR-GAGE RACK

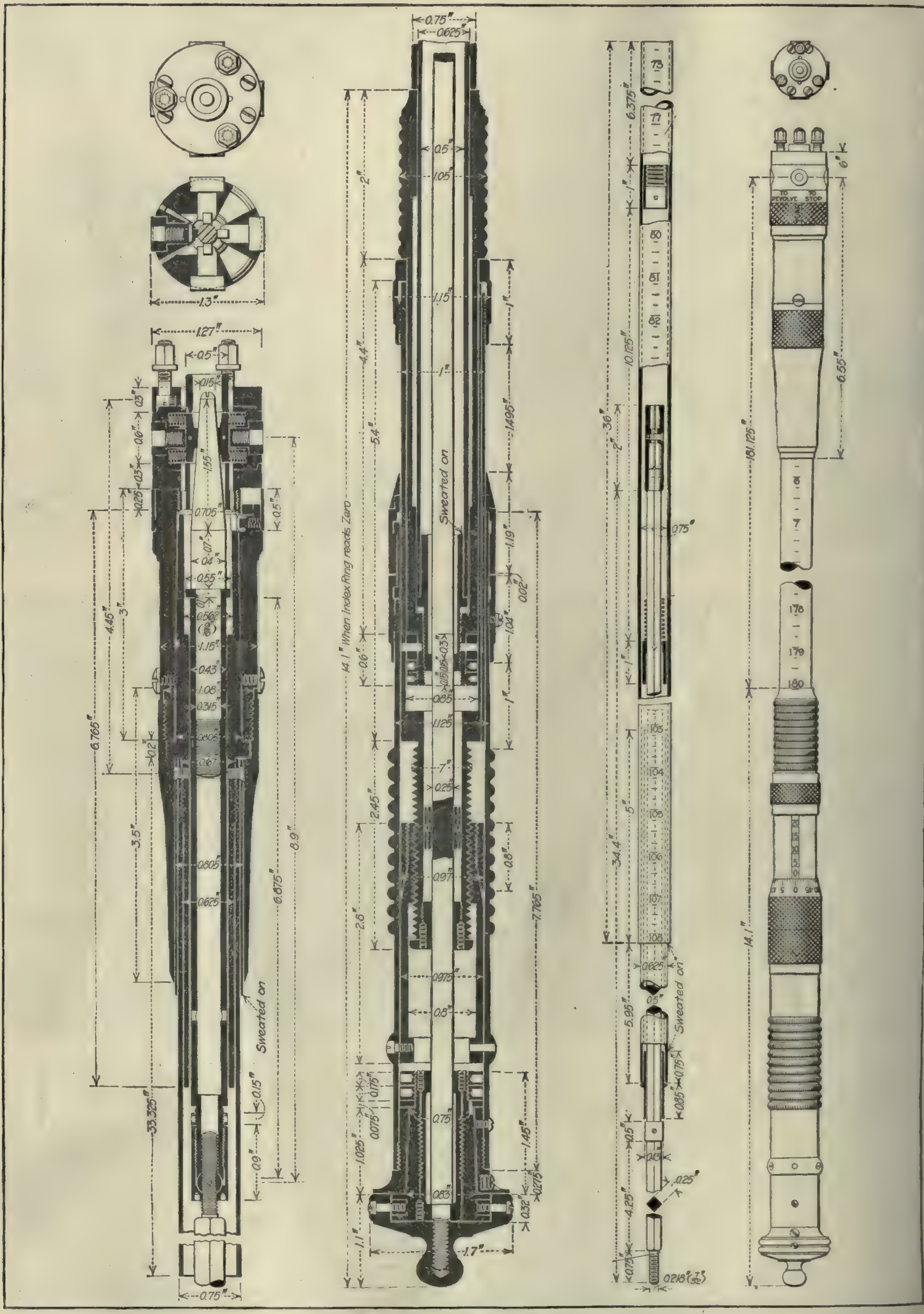


FIG. 17. DETAILS OF THE STAR GAGE

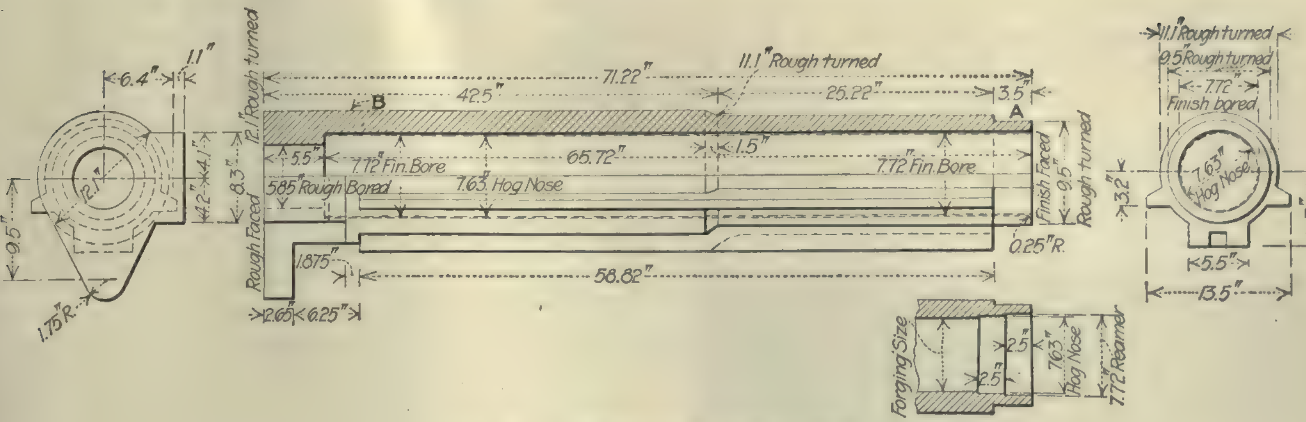


FIG. 15. DETAILS OF THE JACKET

tube. The hog nose and finishing reamers, 7.63 in. and 7.72 in. diameter, except as regards their size, are similar to those used for like operations on the tube. The boring speeds and feeds are about the same as for the tube. The jacket having been finished-bored and

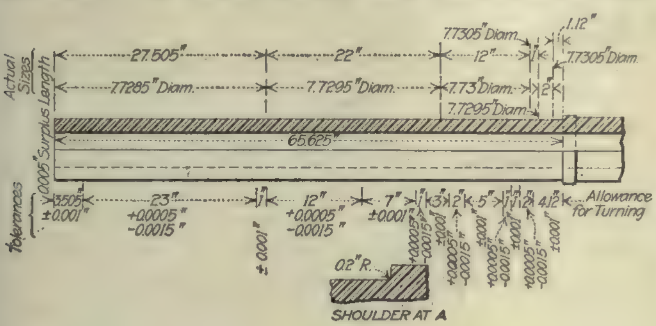


FIG. 19. SHRINKING DIMENSIONS FOR THE JACKET

the muzzle end faced it is taken out of the lathe and turned over to the inspectors for star gaging.

A fair idea of the star gage can be had by referring to Figs. 16 and 17, the latter giving entire details. The principle of the star gage is as follows: The head *A*, Fig. 16, is mounted on the end of a tube *B*, which in turn may be screwed on the end of another tube *C*, and so on till the desired length is obtained to reach through the work under inspection. The head *A* is provided with four circumferentially disposed blocks which carry the measuring rods *D*. These blocks are so arranged that

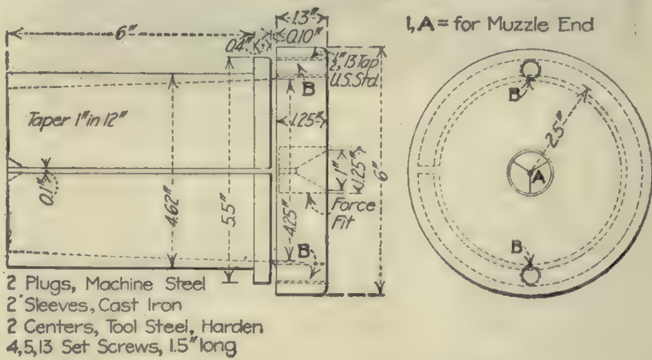
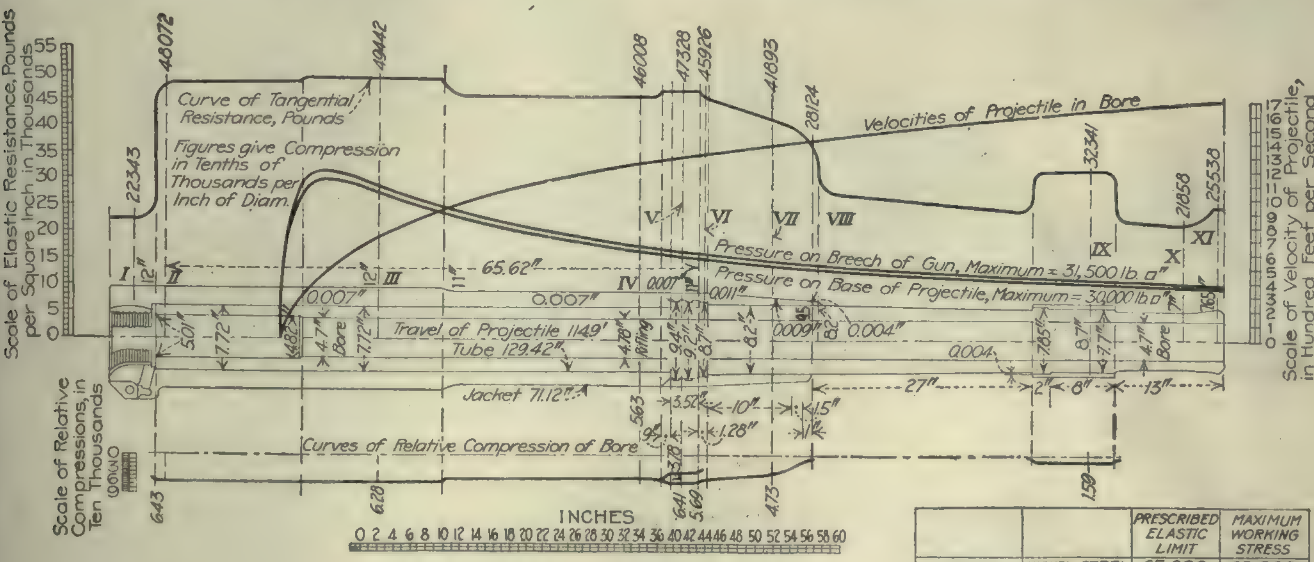


FIG. 22. EXPANDING CENTERS

they can all be used when positioned at 90 deg. to one another, or one can be dispensed with and the remaining three can be used disposed at angles of 120 deg. from one another, as shown in Fig. 16. If necessary two of the measuring rods can be disposed in a horizontal plane on opposite sides of the head, and the third



		PRESCRIBED ELASTIC LIMIT	MAXIMUM WORKING STRESS
TUBE	NICKEL STEEL	65,000	65,000
JACKET	" "	60,000	54,641
LOCKING HOOP	" "	65,000	57,784
CLIP	" "	65,000	44,372

FIG. 21. SHRINKAGE PLAN OF 4.7-IN. GUN

one be placed at the bottom to support the measuring points and hold them at the center height of the hole. The measuring rods D are interchangeable and are made in sets of four of each length, so that by changing the measuring rods the star gage can be used to measure a wide variety of sizes.

Inside the tubular extensions B, C, etc., and capable of being moved endwise therein, are square steel members,

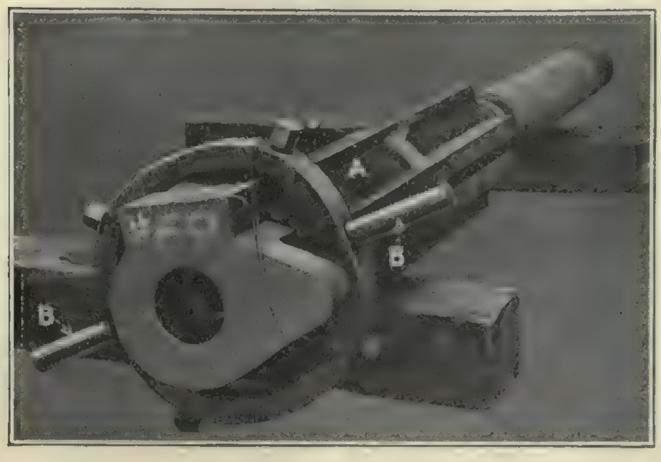


FIG. 20. 4.7-IN. TUBE WITH JACKET SHRUNK ON

one for each tubular extension. The forward end of the first steel member in the head is turned to a known taper. The inner ends of the measuring rods D come to rest on this tapered part and are kept in contact with it by means of light springs. The other end of the square steel member is threaded so that it can be coupled threaded joints, so that rotation of the thimble E imparts endwise movement to the square steel members as a whole. The conical end of the square steel member in the head A as it advances or recedes causes a simultaneous expansion or contraction of the radially disposed measuring rods in the head of the star gage. The brass extension tubes B, C, etc., are graduated for each inch of their length, so that the position of the measuring head within the hole, relative to the end of the work under inspection, can be seen readily.

Star gaging requires the services of two men, and is performed in the following manner: The proper measuring rods D are screwed into the radial blocks in the head of the star gage. The inspector, to obtain his original setting of the star gage, then takes the ring gage shown at F, Fig. 16, and turning the thimble E expands the measuring rods D against the inner walls of the ring F. The thimble E is provided with a frictionally held graduated ring on its forward end, so that without altering the setting of the measuring rods its reading can be set to start at zero and thus have all subsequent measurements taken from a known zero, i.e., the size of the ring gage F.

It will be noticed that there is a small bracket at G, Fig. 16; this has two radially extending legs H whose object it is to support the star gage within the tube and eliminate the sag. The operator enters the star gage in the hole about two feet; the bracket G, Fig. 16, is then located just within the mouth of the hole with the two legs resting on the bottom of the hole astride an imaginary center line. In this position the bracket G is clamped on the brass tube by means of a screw pro-

FIG. 23. TUBE READY FOR SHRINKING THE JACKET

to the similar square steel member in the adjacent extension, and so on.

The recording end E of the star gage is provided with a graduated head similar to a micrometer. The thread with which the thimble engages is cut on the cylindrical end of the final square steel member inclosed in the tubular handle of the star gage. The square steel members are joined one to another by male and female vided for that purpose. The star-gage rack, shown in detail in Fig. 18, is then moved up and the roll J so adjusted that it just takes the weight off the legs H of the bracket G, Fig. 16. The gage is then drawn back, and by manipulating the thimble the size of the front end of the hole is taken and recorded by the operator. The thimble is then operated in the reverse direction, the star gage points contracted and the instrument ad-

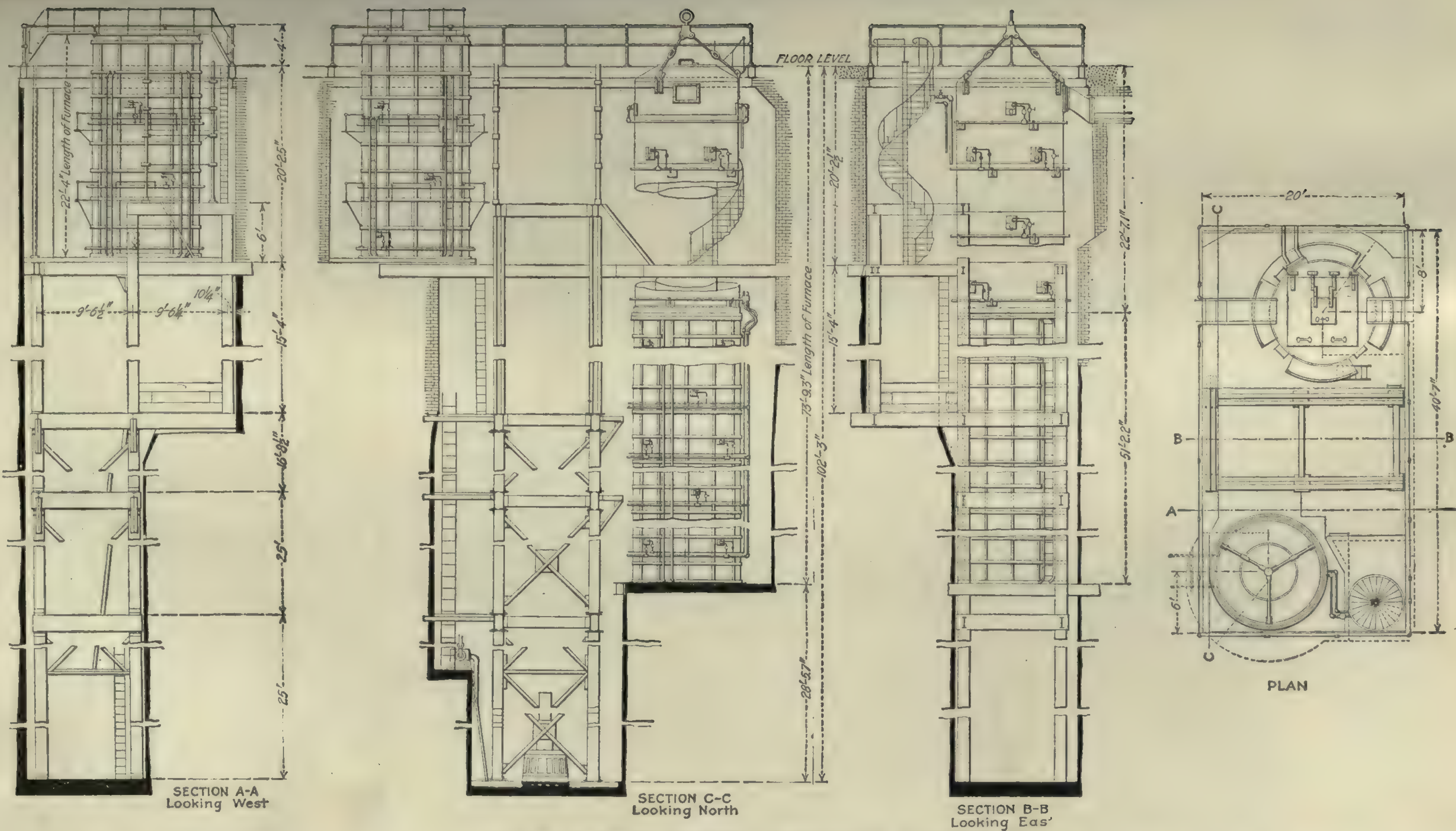


FIG. 24. GENERAL DRAWING OF SHRINKING FURNACES

vanced to the next inch graduation of the brass tube. The measuring rods are again expanded, the reading taken and recorded and the remainder of the tube, inch by inch, measured in the same way. One operator manipulates the thimble while the other regulates the distance of the star gage within the tube and records on paper the measurements (as stated by the first operator) and their distance from the end of the work under inspection. Having measured and recorded each inch the record goes to the inspection department, where a copy is made which, with the shrinking allowance added, is turned over to the operator who is to turn the tube. While positive sizes are given for the various parts on the gun drawings it is not commercially possible to strictly adhere to those sizes, and as the stresses set up by shrinking operations must be within certain limits records must be made of the actual sizes to which the parts are made. When making the part that is to fit (in this case the tube) any variation from the drawing can be allowed

for so that the shrinkage stresses will be within the required tolerance.

A serial number is assigned to each gun when its manufacture is ordered. This number applies to each of the main parts entering into its construction. On completion of the gun the serial number is stamped on the muzzle. Later when repairs or replacements become supposed to be bored 7.72 in. in conformity with the dimensions given in the detail of the jacket in Fig. 15. The actual sizes to which it was bored are given in Fig. 19. The figures at the top give the star-gage readings and those at the bottom the tolerances.

In Fig. 21 is shown the shrinkage plan for the 4.7-in. gun, model 1906, where it will be observed that the

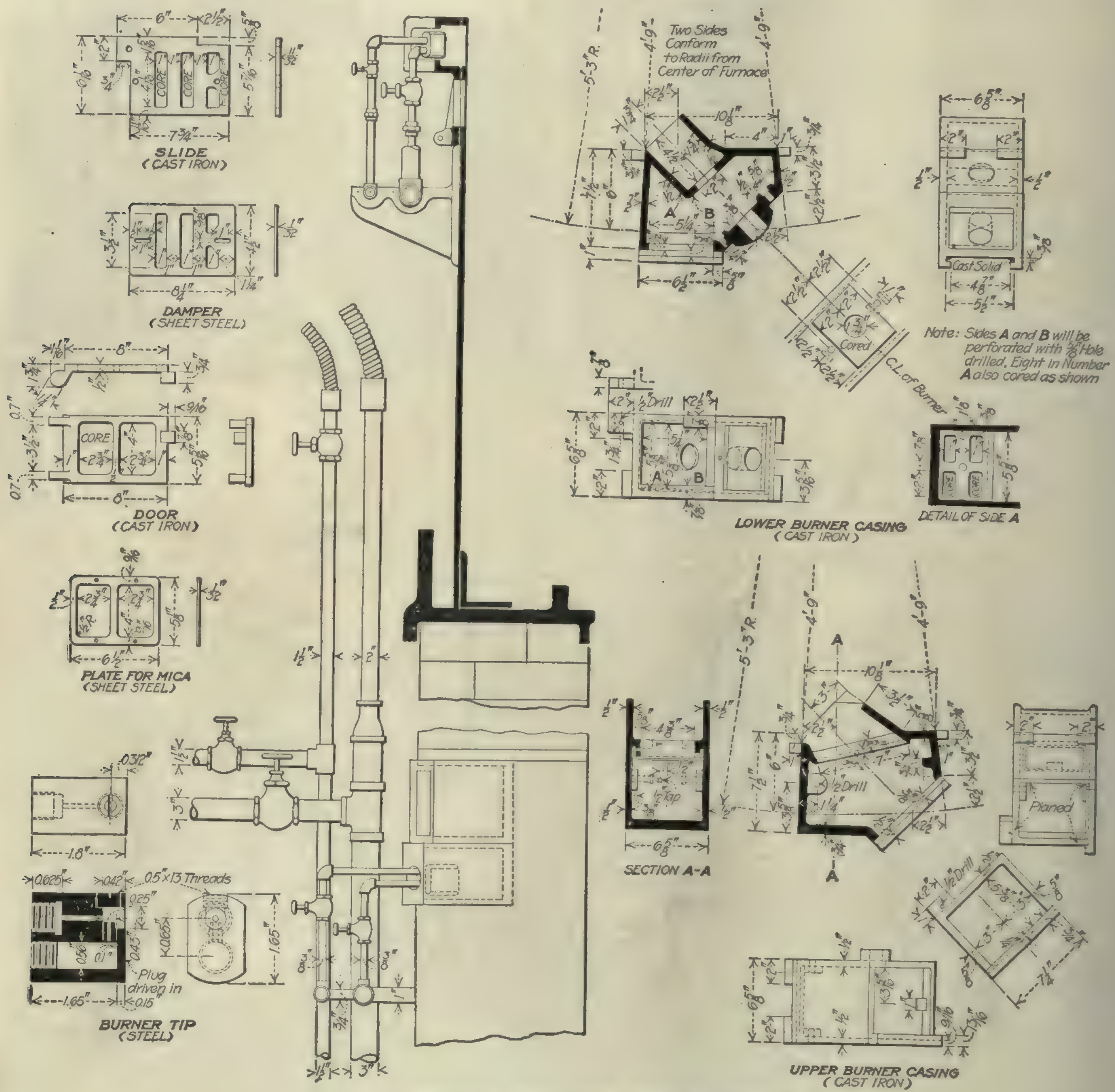


FIG. 25. GENERAL DRAWING OF THE BURNERS

necessary there are in the inspection department records of sizes and other data covering the gun on which repairs or replacements have been ordered.

The dimensions as given on one of the record sheets are shown in Fig. 19. They cover the actual sizes obtained by star gaging the jacket of a 4.7-in. gun.

The tube is turned to shrinking size in an ordinary engine lathe. For shrinking the jacket only the breech end of the tube is turned, the muzzle end being left in the rough to assure sufficient stock for subsequent operations. The jacket *A* of the gun shown in Fig. 20 was shrinkage allowance for the jacket is 0.007 in. The tube is turned 0.007 in. larger than the sizes in Fig. 19.

The turning of the tube is done between centers. Expanding centers, Fig. 22, are placed in each end of the tube. These expanding centers are made of machine steel and have inserted centers *A* of hardened tool steel. They are readily inserted, the sleeves being put in first and then the tapered plugs. Two threaded holes *B* at the edge of the flange of the tapered plugs provide a ready means for removing them by screwing in two ordinary setscrews.

As previously stated the turning speed is approximately 20 ft. surface speed per minute. Having turned the breech end A and the flange B, as shown in Fig. 23, the tube is ready to be removed from the lathe, after which the plug centers are removed. The tube and jacket then go to the shrinking pit for the first shrinking operation.

A general drawing of the shrinking furnaces is shown in Fig. 24 and the details of the burner in Fig. 25. Gas, gasoline, electricity and kerosene have been in turn used, but highly satisfactory results are now obtained with ordinary fuel oil.

At the time the photographs for Figs. 20 and 23 were taken two jackets and tubes were ready for the shrinking operation, so both jackets were placed in the furnace at the same time. On this size gun the shrinking temperature is 800 deg. F., and the furnace on this occasion was lighted at 7.20 a.m. Four burners were used, two on opposite sides at the bottom and two similarly placed at the top. From a pyrometer attached to the furnace at 9 a.m. it was noticed that the desired temperature of 800 deg. F. had been obtained. The furnace man, watching the temperature carefully, kept it as near 800 deg. F. as possible. The jackets were allowed to soak at 800 for about five hours, which is correct practice for this size of gun. While the heating is going on another of the shrinking pit men attends to the setting of the tube ready for shrinking. Owing to the difficulty of getting a photograph one will have to allow somewhat for the distortion in Fig. 26 which was taken from the rim of the pit at a height of 20 ft. above the chuck.

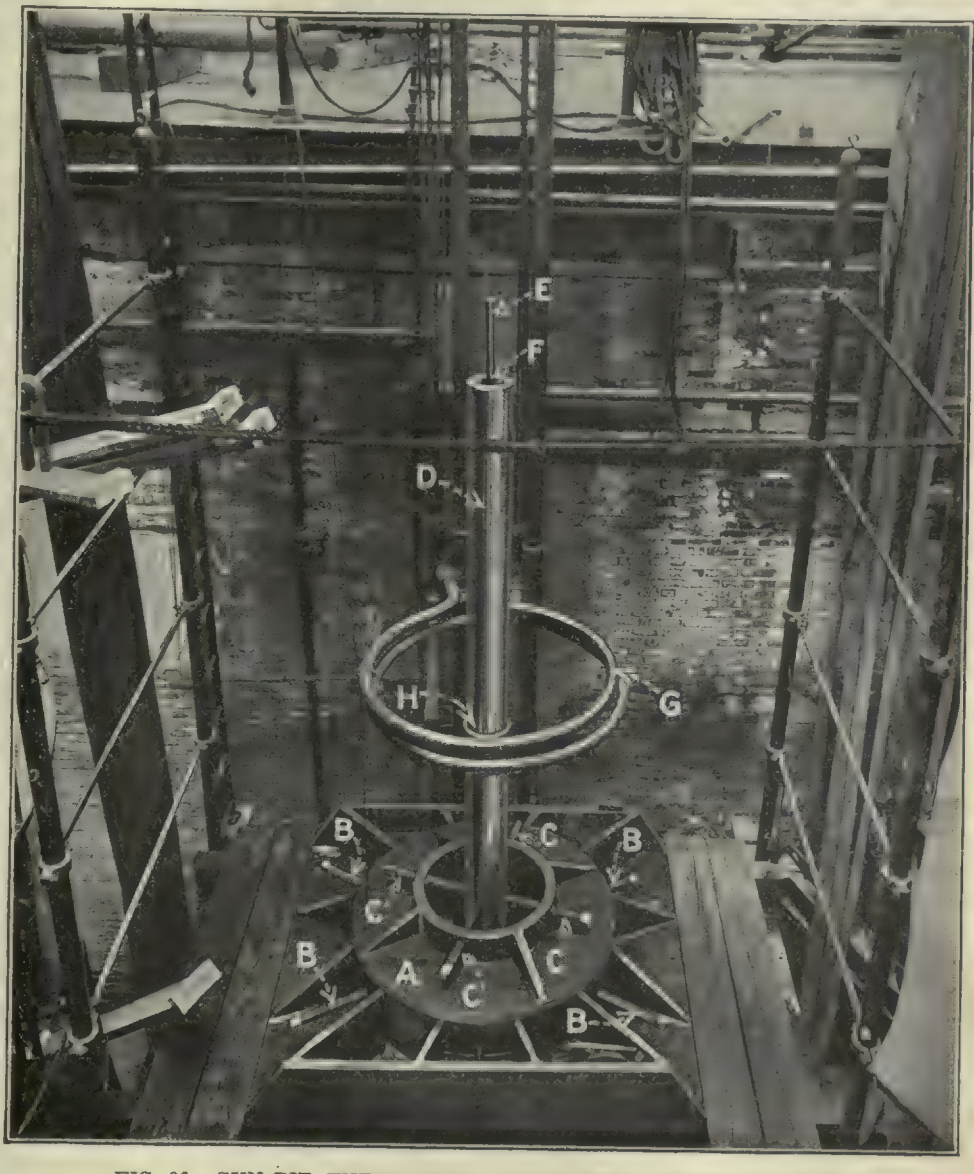


FIG. 26. GUN PIT, WITH TUBE SET FOR SHRINKING THE JACKET

At A is a heavy cast-iron chuck provided with four screws B, and four screws C, which are tapped into the chuck and pass clear through into the opening in the center. The gun tube D has a long bolt passed through it and an eye nut screwed on the upper or breech end for lifting purposes. The tube D is then lowered into the chuck until it rests on the bottom of the central hole. The eight screws B and C are then tightened on the tube. The pit man then takes off the eye nut and proceeds to set the tube perpendicular with the aid of a level placed on the finished-faced breech end of the tube. His helper in the pit tightens the screws B and C as directed by him. The operation of setting the tube perpendicular consumes but a few minutes. It will be noticed that there is a shoulder seat on the tube at H, Fig. 26, and B, Fig. 23, for the jacket to abut against. Now if the heated jacket were merely placed over the tube and allowed to rest on this shoulder until it cooled, shrinkage would take place almost uniformly throughout its entire length, with the result that the jacket would possibly grip near the center and shorten from both ends, drawing away from the shoulder against which it is intended that it shall abut. To offset this and to produce correct shrinking effects the shrinking pit is provided with an elaborate system of water service. It will be seen that there is a coil of pipe at G, Fig. 26. This coil is provided on its inside with a large number of perforations about $\frac{1}{8}$ in. in diameter. Its object is to control the shrinking by hastening the shrinking operation at any desired point or points.

When the jacket has soaked in the furnace at the desired heat for the prescribed time, the traveling crane is brought overhead, the hinged lid of the furnace is swung back and the lifting gear is hooked on the two lugs B of the clamp, Fig. 20. The pit man then gages the hot jacket to be sure it has expanded sufficiently to go over the tube. It is then lifted perpendicularly over the tube D in the chuck A, Fig. 26. In spite of

their great size (they are capable of lifting 16-in. guns) the cranes are very sensitive. The shrinking-pit boss and his helper, with asbestos gloves, take hold of the lower end of the jacket and direct the craneman till the bore is directly over the end of the tube. It is then rapidly lowered till it brings up against the shoulder *H*, Fig. 26.

The moment the jacket hits the shoulder *H* a U-clamp is placed over the end of the tube, washers and a nut placed on the bolt *E* and two men with a 6-ft. wrench tighten it down as hard as they can. The water is then turned on in the coil *G*, which is at such a height that the jets from its perforations strike the hot jacket just where it abuts the shoulder. The jacket closes in on the tube at this point and sets solid on it. The coil *G* is then raised slightly and another section of the jacket is cooled, and so on, the movement of the jacket endwise being all from the upper or breech end toward the shoulder *H* on the tube, at which point the jacket has already shrunk tight.

When the jacket and tube in their assembled state are sufficiently cool, the eye nut is screwed on the end of the bolt *E*, the setscrews *B* and *C* are loosened and the assembly is lifted out of the pit and laid on blocking, as shown in Fig. 20.

The outside of the shrinking furnaces is of firebrick built around cast-iron tubular sections. Within the furnaces are cast-iron tubular shields into which the parts to be heated are set while they are being heated. The object of these is to prevent the flame and soot from the burners coming into direct contact with the work.

A high degree of skill and speed are the essentials in making successful shrinks, and even though equipped with those prerequisites there are occasions when parts stick before they are properly assembled. When this happens the operation has practically to be reversed. The whole job is heated in the furnace; but first the central part (as for instance the tube) is provided with a flange at each end, held in place by a bolt that passes through the bore of the tube, and means for lifting and nipples for water connections. The work when heated is then lifted out of the furnace, the water connections made and the water turned on to cool and shrink the interior. In this way the tube can either be lifted out or the packet seated in its correct position.

Air-Turbine-Driven Grinding Wheel

By W. J. Nene

One of the most pronounced difficulties associated with the electric welding of cast iron in the small shop is the tendency to leave the weld so hard as to be practically unworkable by any form of tool short of an abrasive wheel.

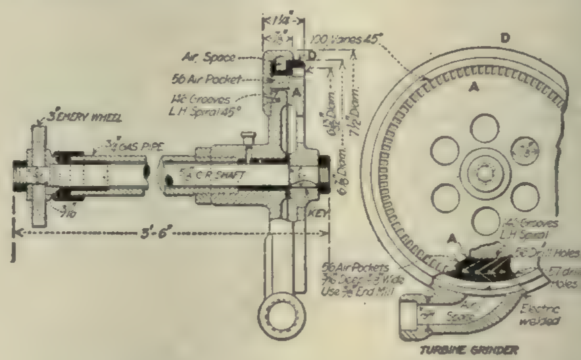
This is especially true when joining small parts to a larger body, where the mass of metal adjacent to the weld is sufficiently large to conduct the heat rapidly from the welding point; and with the usual perversity of inanimate things these hard spots are generally located at places most inaccessible to the ordinary form of grinding apparatus.

While this trouble may be minimized by the introduction of silicon by means of the welding rod or directly into the weld it has never been wholly eliminated, and to give the operator a quick and efficient means of working down these hard spots the grinding machine illustrated herewith has been devised.

This machine is simply an air turbine of special design, carrying an abrasive wheel on the end of its rotor shaft and combining simplicity of construction with lightness and ease of manipulation.

I do not claim originality in the application of the air turbine to the hand-grinding machine, but merely submit the following description and vouch for the machine's efficiency. The turbine furnishes ample power at 90 to 100 lb. pressure to drive a 3-in. wheel at 6500 r.p.m., which is aproximately correct for a wheel of this size.

The machine as used for grinding welds is usually held in the operator's hands, and being well balanced there is practically no vibration except it be caused by wear of the grinding wheel during the actual grinding operation. It has also been used for internal, external and center grinding, being held in the toolpost of a lathe, and as a hand-polishing wheel for certain parts of locomotive side rods, etc.



DETAILS OF THE TURBINE GRINDING MACHINE

All parts are made of mild-steel forgings except the ring *D* and the bearings, which are of hard brass, and the ball races, which are of tool steel hardened and ground. The air connection, or intake, was electrically welded in position after the other parts were machined.

The compressed air enters the annular chamber marked "air space" on the cut; thence flowing through the air ports (that is, the fifty-seven $\frac{3}{64}$-in. drilled holes) and impinging at high velocity on the air pockets in the rotor *A*, imparting to it the first rotary impulse. At this point the air divides, part flowing through the $\frac{1}{16}$-in. holes in the rotor and thence toward the center, where it exhausts through the six $\frac{3}{8}$-in. holes, while a larger portion of the air flows through the $\frac{1}{32}$-in. opening between *A* and *D*, where it comes in contact with the vanes or wings which form part of the rotor and are set at an angle of 45 deg. with the axis of the rotor.

As the combined area of the 57 air ports is approximately 0.098 sq.in., a $\frac{3}{8}$-in. air hose would furnish an ample supply of air, but the usual standard connection for small hose is $\frac{1}{2}$ in., and for this reason the air intake of this machine is made of this size.

A feature of this turbine is that when running at full speed it seems to use very little air; in fact it is necessary to hold the hand quite close to the machine in order to feel the exhaust.

Acceptances

By W. G. AVERY
Assistant Manager Foreign Department, Guaranty Trust Co. of New York

Trade acceptance is a new name for an old method of transacting business. The disorganization of the credit system, which followed the Civil War and brought into existence the rule of "cash discount," was one of the main causes of the breaking up of the trade acceptance. Through the efforts of the American Trade Acceptance Council with the approval of the Federal Reserve Board the trade acceptance will no doubt occupy again its important place in trade financing.

THE acceptance is more or less new, or rather having fallen into disuse for many years, appears to be so. Naturally many objections are raised to the use of acceptances, as is inevitable in any new scheme. These, no doubt, will be gradually eliminated when the advantages of the system are realized.

There are two classes of acceptances—trade acceptances and bank acceptances—and I will take them up individually in that order.

It has always seemed to me that "commercial acceptances" would be a much better name to use to designate paper which we now call "trade acceptances." The word "trade" does not in my opinion cover in the right sense the object attained by acceptances made to settle commercial obligations, and possibly is liable to misinterpretation.

The National Credit Men's Association, doubtless due to the business qualifications of its membership and because it was necessarily more vitally interested than any other body, was the first to commence any organized effort to popularize the "acceptance." This effort has been greately encouraged by the Federal Reserve System (which made the commercial acceptance an instrument of ready negotiability) and by the exigencies of war financing.

Importance of Acceptances

The commercial acceptance has for many years been an important factor in European money markets, and had it not been so it is doubtful whether Great Britain, for instance, could have financed herself and her allies to the unprecedented extent required by the present war.

It was largely with this in view that at a convention in Atlantic City in September last year, called together to discuss the most effective means by which business could assist war financing, the trade acceptance was decided upon as a medium probably more useful and effective than any other. And following the lead of the National Credit Men's Association a systematic campaign has been launched in the shape of what is called the American Trade Acceptance Council, which is composed of that association, the Chamber of Commerce of the United States and the American Bankers' Association. This council has received the unqualified approval of the Federal Reserve Board, and it is to be hoped that its efforts will meet with well-merited success.

The acceptance is not new in American history. It was in use before the Civil War; but the disorganization which followed that war developed a demand for cash which popularized cash discount, and this practice has continued in favor down to our times. The creation of the Federal Reserve System has, however, made possible the development of the acceptance method by means of the rediscount privilege.

To the lay mind, especially outside of the large commercial centers, the commercial acceptance seems to be a strange and wonderful thing. An instance of this came to my attention the other day. A man took an acceptance to his banker in a small town not very far from New York. The banker looked at it on both sides and then handed it back to his customer with the remark that he didn't know enough about the kind of thing it was to want to handle it. I hope to be able to demonstrate, however, that it is a simple and effective way of improving business conditions generally.

Hitherto the principal basis upon which business has been financed with banks has been by commercial paper or promissory notes. The acceptance, you will readily see, is more desirable in that it bears at least two names, while a note has only one.

Method of Use

The operations involved in a trade-acceptance transaction are as follows: In general the seller when rendering an invoice for any single purchase of merchandise, if the amount is reasonably large and is payable by an agreement within a certain specified time, will accompany the invoice with a trade-acceptance form duly filled out for the amount due, or in cases where a buyer purchases of the seller several bills of small amounts during the month the seller when rendering a monthly statement will accompany the same with a trade-acceptance form duly filled out for the total amount. Upon receipt the buyer has the option of either paying the bill in cash, deducting such cash premium or discount as may be allowed, or he may accept the draft by writing across its face the date and the words "Accepted—Payable at —— Bank," and then signing and returning it to the seller, thus closing the first stage of the transaction. The seller will then either retain the acceptance in his portfolio until a short time before it is due, when he will forward it for collection through his bank for presentation to the bank designated on the acceptance, or if he finds himself in need of funds he may, instead of borrowing from his bank on his single-name promissory note, prefer to take a number of trade acceptances and discount them with his banker, or sell them in the open market through brokers or dealers in such paper, thus converting into available live assets the dead capital which is now practically unavailable, being locked up in open book account.

In this connection I want to point out that as a matter of law the place of payment of a trade ac-

ceptance, unless a different place is designated on its face, is at the office of the acceptor; that is, the buyer of goods. But the acceptor may, if he so desires, designate his own bank as the place of payment, provided the bank is located in the same city as his principal place of business. On presentation at maturity the bank is then entitled to charge the acceptance to the account of the acceptor without first referring the matter to him. In case the acceptor desires to have the acceptance made payable at a bank located in some other place than his home city he must arrange with the seller to have such a designation, or authority to make it, incorporated in the body of the acceptance at the time it is made by the seller. Otherwise it may not conform to the Negotiable Instruments Law.

Special Inducements

The question has been very much discussed as to whether any inducements should be offered to the buyer to give his acceptance. Opinions on this point differ; but I think it should not be done, because such practice might be abused, and at any rate the advantages to the buyer should obviate the necessity of any other inducements.

A corporation which has had experience in the use of the trade-acceptance system says: "Except where unusual circumstances have existed we have not found it necessary to offer any special inducement to obtain acceptances from our customers. Such cases have been rare and the maximum concession has been a few days extra time. In no case have we allowed any extra discount and it has been rarely requested." This seems to prove that the buyer understands that by accepting he will be benefited in other ways. It must be borne in mind that a commercial acceptance cannot be renewed. If the acceptor requires an extension of time he must give his promissory note.

Advantages for Buyers and Sellers

The question is often asked, "What advantage is it to the buyer to give his acceptance, especially when he has been accustomed to pay cash for his purchases?" The advantages are many, and though some of them may not appear to be attractive on paper they invariably prove so in practice. Some buyers object to the acceptance because they consider it a promissory note and certain sellers hesitate to urge the use of acceptances for fear of losing trade. The acceptance enables the seller to handle his business at a smaller operating cost and therefore to sell at lower prices without decreasing his profits, an advantage which no buyer could fail to see. It develops careful buying; enables him to know just where he stands financially and, even better, what he can or cannot do on his capital. It strengthens his credit, though many firms hesitate to use it because they think it does the opposite. Of this I will speak later.

When using trade acceptances the buyer knows definitely the dates on which he has to make payments, and this develops a habit of promptness in fulfilling obligations, which is bound to have an appreciable effect on his business in general. Their use enables the buyer of modest standing to compete more effectively with larger firms. It gives him a better credit rating because his business is on a definite financial basis, which it cannot be when his debts are on open account with no means of ascertaining when they will be liquidated. In this connection a buyer who gives his acceptance is stimulated to meet his obligations promptly. We all know how easy it is to get the habit of procrastination in making payments if no definite date is set. With an acceptance we cannot say "Tomorrow will do," but we have to say "Pay now." These, I think, are the main advantages to the buyer in giving his acceptances for his purchases.

Benefits to Seller

The benefits accruing to the seller are more obvious. In the first place the open-account method is admitted on all sides to have many objectionable features. It places a firm carrying them in the position of being unable to determine with any degree of exactness what its financial condition will be on a given date. The chief evil, of course, is the tie-up of capital. If I am not mistaken there is at the present time an average of some four billions of capital in the United States continuously represented by open accounts. By the use of acceptances a great part of this capital would be released for further business operations.

When the buyer gives his acceptance covering a bill of goods the onus of proving the incorrectness of the delivery devolves on him, and this is a material benefit to the seller. On the other hand the buyer does not waive legal claim against the seller merely because he has given his acceptance.

Other Advantages to Buyers

Other advantages to the buyer are as follows: Acceptances are essentially liquid assets, whereas open accounts, though designated as such, are very often found to be far from liquid. Expenses are reduced in the matter of collections, and the possibility of having to sell open accounts at a high discount is obviated. The seller's financial standing is materially strengthened because the nature of his accounts can easily be ascertained and because he himself is in a better position to gage the reliability of his customers. Borrowings are confined only to the actual necessities of business.

The seller, by requesting the buyer's acceptance, is morally assisting him to fulfill his contract as he intended to do, but which he might have a tendency not to do if he carried his obligation on open account. The seller is enabled accurately to gage what his incoming collections will be, covering a stated period. The acceptance stimulates and expands business by making capital more elastic. This is of benefit to both sides. The buyer is enabled to take to his bank paper which commands a lower rate of discount than straight commercial paper. The acceptance will eliminate many losses by bad debts, over-extension of business, cancellation of orders, return of goods without sufficient reason and the practice of taking unearned and unauthorized discounts.

Disadvantage of Open Accounts

To revert to the open-account system with its indefinite time of payment, this is a business habit with many disadvantages. As I stated before, the first and foremost defect is that it forces the seller to carry the financial burden of the buyer, and moreover ties up the seller's invested or borrowed capital for an

indefinite period. The commercial acceptance is everything that the open account is not. It does not lessen the advantage to the buyer, but it secures his credit for a definite instead of an indefinite time.

As assets, open accounts are neither quick nor sure. They are generally slow and uncertain of realization. Even the best of them are seldom available for a loan of more than 50 per cent. of their face value. In the form of eligible acceptance open accounts can be fully converted into cash at a better rate than is commanded by promissory notes. With the advent of the acceptance the promissory note is becoming merely an auxiliary of business.

Other Defects

Another defect of the open-account system is the ease with which payment can be put off, and if it becomes necessary to sue in order to collect the correctness of the book entries must first be proved. The buyer thereupon may raise objections and cause much delay. The acceptance is an acknowledgement of the receipt of the goods and proof of the validity of the debt.

The open account is costly. The expense involved in collecting slow accounts, in payment extensions, in the return of goods, in the abuse of sale terms, in trade discounts, and in the assignment of accounts receivable—all characteristic of the open-account system—in the aggregate constitutes a heavy tax on business.

All these disadvantages are eliminated by the use of the acceptance, which gives stability to commercial credit and transforms deferred obligations into definite assets and liabilities.

A Few Interesting Statistics

In passing perhaps a few statistics will not be amiss to demonstrate the undesirability of the open account. Among manufacturers the terms are usually 60 days less 2 per cent. discount for cash in 10 days. Reports show that when the bills are discounted, instead of being paid in 10 days they have averaged 15 days, and for those who take an option of 60 days the average payment is from 75 to 80 days, and at least 10 per cent. take 90 days or more.

As to wholesale distributors the reports indicate that the country throughout generally from 40 to 50 per cent. of buyers discount their bills within 15 days after purchase, while of those who take the 60-day option from 25 to 30 per cent. pay "promptly" or within one month following the 60 day maturity. Of the remaining 20 per cent. only about one-half pay in the period between three and four months after purchase, while the other half pay in from four to six months, or never, notwithstanding that the terms of sale agreed upon were for a credit of only 60 days.

Thus it is much safer to sell on longer time with acceptance than to sell on so-called short time with open accounts, the date of payment of which is most uncertain.

I mentioned a short time back that the acceptance strengthens credit rather than hurts it. The reason for this is more or less clear to the business man. It will be readily seen that a firm which is willing to put itself on record by means of its acceptance will meet its obligations at a certain maturity, will have a better standing and is a better business risk than one whose obligations are of such an uncertain maturity as those carried on open account. For this reason also the acceptance must be regarded as a more businesslike arrangement than the account, and if more or less universally in use will tend to improve the character of the country's business generally.

Will Help Win the War

The last inducement to use the trade acceptance but I am sure not the least, is the fact that the use of such acceptances will assist the finances of the country and help to win the war, and that object is one we all are interested in, heart and soul.

Not Complicated

The acceptance method does not present a complicated problem by any means. The very definition of a trade acceptance as set forth by the Federal Reserve Board will evidence that fact:

> A trade acceptance is an unconditional order in writing addressed by one person to another, signed by the person giving it, requiring the person to whom it is addressed to pay at a fixed or determinable future time a certain sum in money to the order of a specified person. The bill must be drawn by the seller on the purchaser of goods sold and accepted by such purchaser.

It is an exceedingly simple, direct, economic method of covering credit obligations arising from the sale of merchandise. There is no mystery about it; it promotes sound business, and it is not antagonistic to any proper business method now in use. Above all it represents substantial value to the nation in times of stress.

Our Duty

To quote from an eminent authority and an indefatigable worker in the interests of the commercial acceptance:

> The line of duty for us is clear—buyers and sellers and bankers, American business men all, should get squarely behind the trade acceptance and follow this splendid movement in its interest, which has been put upon such a definite basis. Let us think in terms of war, and war necessities and conditions after the war, and not in terms of a business past, now as clearly removed as is the past of the Pharaohs.
>
> Let us realize that there has come into the world, and particularly into this great Western world of our own, a new spirit—a new dispensation, new responsibilities, and new obligations, which we dare not disregard. The acceptance is here—is here to stay—is a part of the business and financial life of this community whether or not the occasional banker or business man would have it so. The only question is how soon will it be possible to bring this fact definitely to the attention of the business of the country?

Functions of Bank Acceptance

Now a few words as to the bank acceptance. This in its functions is somewhat different from the trade acceptance, as its definition, which follows, implies:

> A bill of exchange, of which the acceptor is a bank or trust company, or a firm, person, company, or corporation engaged in the business of granting bankers' acceptance credits.

An acceptance by a bank of a draft drawn on it by its customer or by some other party for his account is essentially the extension of the bank's credit to that customer, which by prearrangement the bank agrees to do for an adequate consideration. This consideration is usually in the shape of a commission averaging ⅛ per cent. per month. This commission

must not be confused with discount, which is an entirely separate function.

Of course, the fact that a bank permits a customer to use its name and credit greatly enhances the standing of that customer, as a bank necessarily does not agree to do so unless it is perfectly satisfied as to a customer's responsibility and character.

When a bank accepts drafts drawn by a person or firm other than the customer, but for his account, the transaction is accomplished by means of a letter of credit from the bank in which it agrees upon certain terms and conditions to accept bills drawn on it up to a certain amount. It is easy to understand that by means of such an arrangement the customer is able materially to increase the scope of his activities, because when he is able to give his seller a bank credit he does not necessarily have to be known in a particular market.

Creating a Bank Acceptance

To give an example in detail of the method of creating a bank acceptance we will suppose that my friend Mr. Bush buys from a firm in New York a bill of goods which he is unable to finance without assistance. He requests his bank to finance him by way of an acceptance credit. The bank agrees to write to the New York concern to the effect that they will accept drafts drawn by that firm on them with documents attached covering the said goods. When the drafts are presented the bank accepts them, taking possession of the documents as security for their liability.

Mr. Bush now may desire very particularly to have the merchandise delivered. As his reputation with the bank is very good and his financial responsibility undoubtedly the bank lends him the documents until he is able to get value for them. He undertakes, however, to provide funds in order that the bank shall have cover to meet its acceptances at maturity.

If, on the other hand, a customer wishes to finance the transaction himself he draws his own drafts on his bank and gives as security bills of lading or warehouse receipts, or if he is of undoubted credit and high financial rating the bank may not require security.

Eligibility for Purchase

As to the eligibility of bankers' acceptances for purchase under the regulations of the Federal Reserve Act, eligible bills are those which have a maturity at the time of purchase of not more than three months, exclusive of days of grace, and must have been drawn covering a transaction for any one of the following purchases:

> The shipment of goods between the United States and any foreign country, or between the United States and any of its dependencies or insular possessions, or between foreign countries; or the shipment of goods within the United States, provided the bill at the time of its acceptance is accompanied by shipping documents; or the storage within the United States of readily marketable goods, provided the acceptor of the bill is secured by warehouse, terminal or similar receipt; or the storage within the United States of goods which have been actually sold, provided that the acceptor of the bill is secured by the pledge of such goods; or it must be a bill drawn by a bank or banker in a foreign country or dependency, or insular possession of the United States for the purpose of furnishing dollar exchange.

In closing I wish to mention the viewpoint from which I imagine you are most interested in the subject of acceptances. Banks are generally ready and willing to invest surplus funds in first-class acceptances which, of course, they have the option of holding until maturity or of selling in the open market should the surplus they have invested be needed. These acceptances are an excellent short-term investment. The discount rate is based finally on the Federal Reserve Bank rate, though it is impossible to give any method of calculation as a general principle, because there are so many circumstances surrounding each acceptance, among them being the names, the desirability of the business, the indorsements, etc. These acceptances can be disposed of either through the Federal Reserve Bank or in the acceptance market consisting of banks and brokers.

Buying and Selling

A broker will ask a bank if they will sell or buy a certain amount of prime acceptances, specifying the time of delivery and the length of time for which the required acceptances are to run; for instance, $1,000,000 First National Bank under 60 days or 60 to 90 days. Banks also sell and buy between themselves in the same way. The average profit in this trading in acceptances should be at the rate of about ¼ to ⅜ per cent. The denominations most in demand are from $10,000 to $25,000.

You will readily see that the good standing of the accepting bank makes this paper most desirable, as purchasers are not then under the necessity of scrutinizing closely the credit standing of the drawers because the acceptor is the party primarily responsible.

Rag Washing and Oil Reclaiming

The London (England) General Omnibus Co., Limited, for about three years has been working a central recovery plant for oil and grease absorbed in the materials indicated in the heading of this article, which so washes the cleaning material itself that it can be used over again many times.

The depot is situated at Riley St., Chelsea, London, S. W., and the plant consists of a horizontal return-tubular boiler, three centrifugal steam-driven oil extractors, two hydroextractors, three rotary washing machines and one rotary drying machine, together with a calender and ironing machine to deal with the washing and pressing of women's overalls. The plant in effect is a typical laundry-machinery equipment.

In connection with it there are three steam-heated oil-cleansing, or settling, tanks, each with a capacity of 900 gal., which deal with the oil reclaimed from the rags and also with refuse oil sent from the unit cleansing plant installed at the various garages of the company.

The recovery of oil in respect of approximately 1700 motorbuses works out on an average at 360 gal. a week, apart from the additional economy in cleaning rags, wipers, waste, etc., which new today costs the company 35 per cent. above the prewar rates.

The recovered oil is used to run two Diesel engines of 80 hp., and is found to be far more satisfactory than the ordinary residue oil commonly used in these engines. The surplus oil is sold.

The plant cost the company £2253 ($11,265) and was paid for out of the profit on working within approximately three years.

V. The Receiver—IV

Devices for gaging important cuts are considered here, and methods of hollow milling and drilling are illustrated along with special apparatus for cutting out the receiver slot in a shaving process. The fixture for this is used in the shaping machine and embodies many worthy features.

REFERENCE has been made in the preceding chapter to the milling of the slot, or groove, along the bottom of the receiver for the reception of the guard or grip slide. This cut is originally made from the rear end of the receiver forging to a point near the base of the front lug for the gear case. The straight channel thus formed is afterward under-cut at the sides to form a guide like a T-slot for the grip slide. After the receiver has passed through various succeeding operations, it is ready for operation No. 34, which consists in profiling the continuation of the grip slide cut to form the seat for the gear case.

This profiling cut is tested for accuracy of width and depth by means of the gage, Fig. 45, which also determines if the cut is correctly positioned on the center line of the receiver. The gaging fixture carries an offset bracket with head projecting over the center of the fixture, and through this head are bored two vertical $\frac{3}{8}$-in. holes in which are fitted a pair of sliding plugs *A* and *B* which carry at their lower ends two flat gages *C* and *D*. When the gages are seated properly at the bottom of the slot in the work, the tops of the $\frac{3}{8}$-in. plugs are exactly flush with the top face of the gage head. This forms a convenient means of gaging the slot depth.

A profiling fixture for the ejector-clearance slot in the left side of the platform top is shown in the illustration, Fig. 46. The form plate for the profiler-guide pin is seen quite close to the work at *A*, where the shape of the opening for the taper-guide pin is clearly indicated.

The gaging fixture for depth and position of this slot is illustrated by the line drawing, Fig. 47, and like other examples of gaging apparatus at this plant it has numerous features of interest.

The gaging fixture holds the receiver at the same angle as the profiling fixture, and in inspecting for depth of opening and lateral position in reference to the center line of the four plugs *G* and *H* are pushed straight downward into the profiled slot, the top of the gage plugs coming flush with the upper face of the gage head when the plugs seat properly in the slot. The four plugs are flatted at the lower ends to a thickness of $\frac{5}{32}$ in., and when slipped down in service the two inner plugs *H* have their flatted portions parallel with the length of the slot, while the two outer plugs *G* rest with their gaging portions crosswise of the slot, so that they test the latter for width and position in reference to the receiver center line, plugs *H* giving the test for depth.

The length of the slot and its position endwise in the receiver is gaged by the two fingers *J* which are pivoted at an angle in the gage head so that the rounded inner ends may contact with the end walls of the slot and the outer ends come flush at *K* with the corresponding surfaces of the plates upon which they pivot.

Drilling-Machine Work

Following the profiling cut in the fixture in Fig. 46 there are several drilling-machine operations on the receiver, two of the most interesting being shown in Figs. 48 and 49. Duplicate jigs are used on the two multiple-spindle machines in these views, and these jigs are slid back and forth between the two machines.

The operations consist in hollow milling the round boss, or hub, at the front and top of the receiver, and

in drilling, reaming and chamfering the hole in this boss.

A drawing of the jig is reproduced in Fig. 50 and shows the method of locating and securing the receiver in position. It also shows the large bushing in the top plate for guiding the hollow mills and for receiving an auxiliary slip bushing for the smaller tools—the drill, reamer and chamfering counterbore.

Referring to Fig. 48 it will be seen that there are two hollow mills used in the process of machining the outside of the magazine boss, and one cutter for facing the top. These mills divide the cut, leaving a fairly light chip for the finishing cutter. The outside surfaces of the hollow mill bodies are ground to fit the guide bushing in the jig, and the shank for each mill carries a pair of large stop collars to limit the depth of operation.

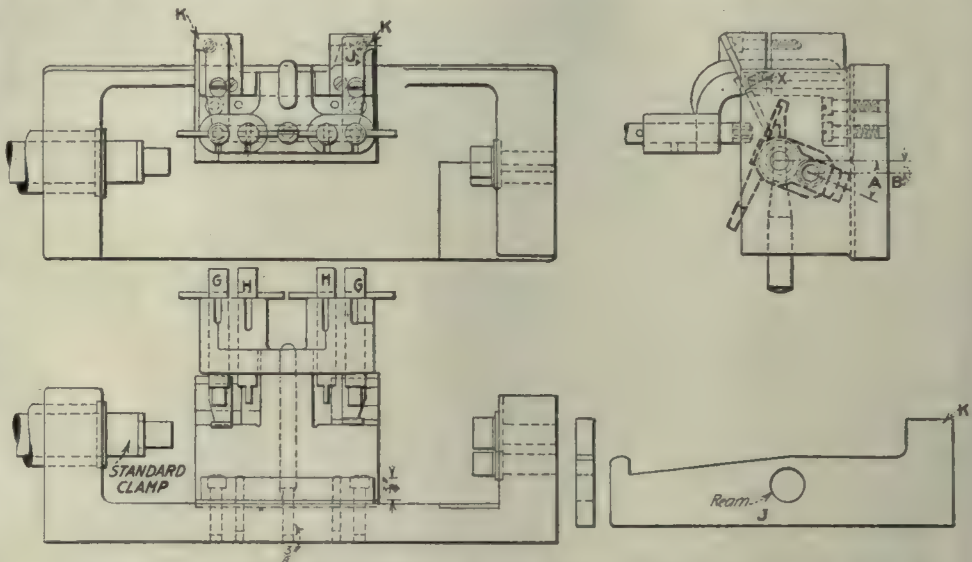


FIG. 47. DEPTH AND POSITION GAGE FOR EJECTOR CLEARANCE CUT

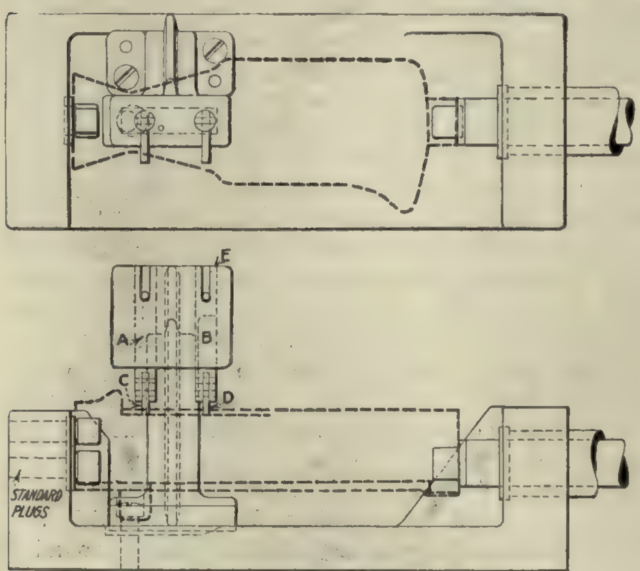
The finish mill is of novel form, as will be seen upon inspection of the one near the front corner of the drilling-machine table.

The hollow mill has four teeth and is split at four points for adjustment in its sleeve, which has a tapered mouth to correspond with the conical portion at the cutting end of the mill. At the rear end of the mill there is a thread for adjusting the tool in its socket, the adjustment being effected by an internal wrench which is slipped up inside of the mill. The same wrench operates a locking nut from the inside.

In making the hollow mill the blank is bored slightly larger than finish size, then closed a trifle and ground out near its cutting edges, leaving a little clearance behind the lips. The method of adjusting in the socket, or holder, by an inside wrench is a convenient one, and the interior locking nut is a positive safeguard against changing of the size through accidental slipping of the mill.

In the six-spindle machine, Fig. 49, there are two sets of drills, reamers and chamfering counterbores; the tools at one side of the machine are for roughing, the other set for finishing.

Gages are provided for testing the size of hole, the depth of chamfer and the depth of the hole bottom. The depth gage for the hole is a flush-pin device with a rectangular head which is adapted to rest upon the upper face of the fixed bushing in the jig. The method of applying this depth gage is shown in Fig. 49. A similar class of gaging tools is provided for the operations on the boss in Fig. 48, where the gage set is shown in the wood case at the front of the jig holding the receiver.



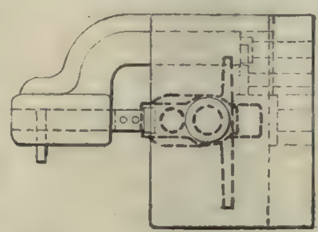


FIG. 45. GAGE FOR PROFILED SLOT

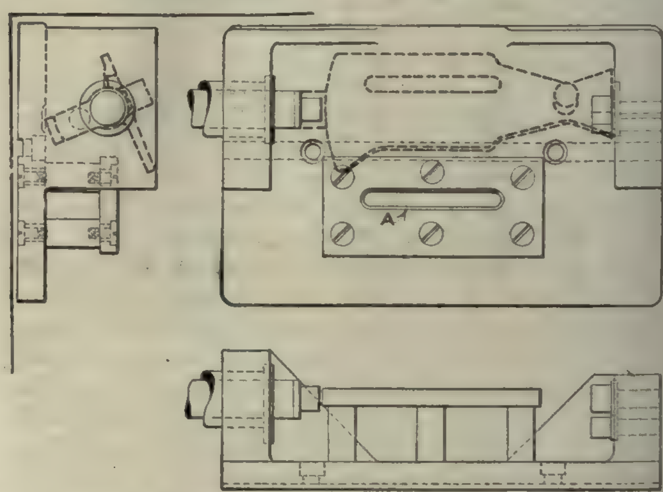


FIG. 46. PROFILING FIXTURE FOR EJECTOR-CLEARANCE CUT

Passing along now over a number of milling and profiling operations we come to a very interesting method for shaving out the metal between the two long holes through the receiver to form the bolt-locking-

lug clearance slot. This is done by means of a special fixture used on the shaping machine, as shown in Fig. 51. In this view two receivers will be noticed in the pan at the front of the fixture, one before the shaping

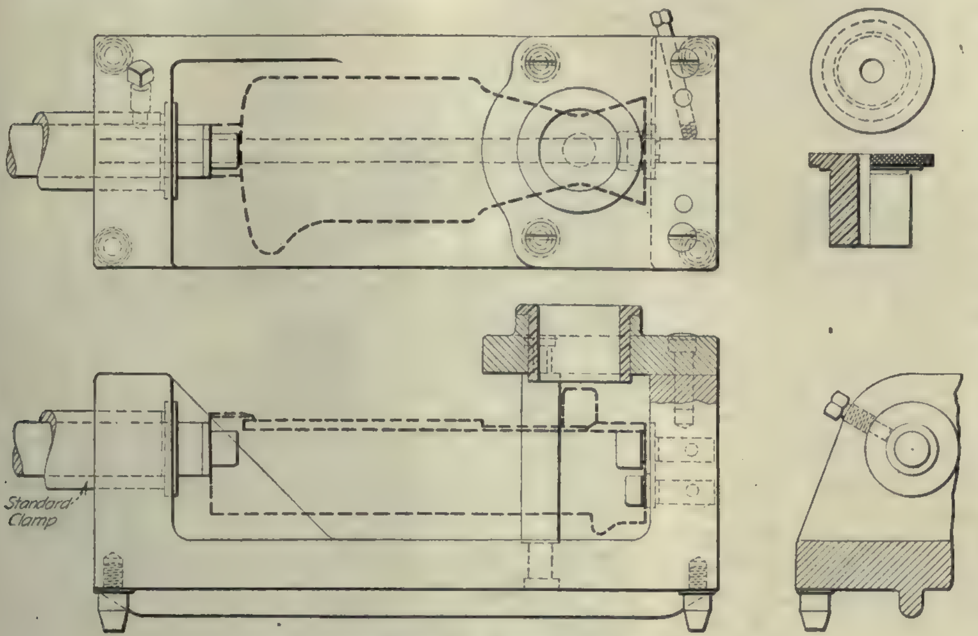


FIG. 50. DRILL JIG FOR MAGAZINE BOSS

operation has been done, the other showing the end of the completed slot formed by cutting out the metal between the large hole and the piston bore in the receiver.

This apparatus is used also for cutting out certain other internal clearance slots in the receiver for the bolt lugs; but as this operation is identical for the different cuts the following description will be confined

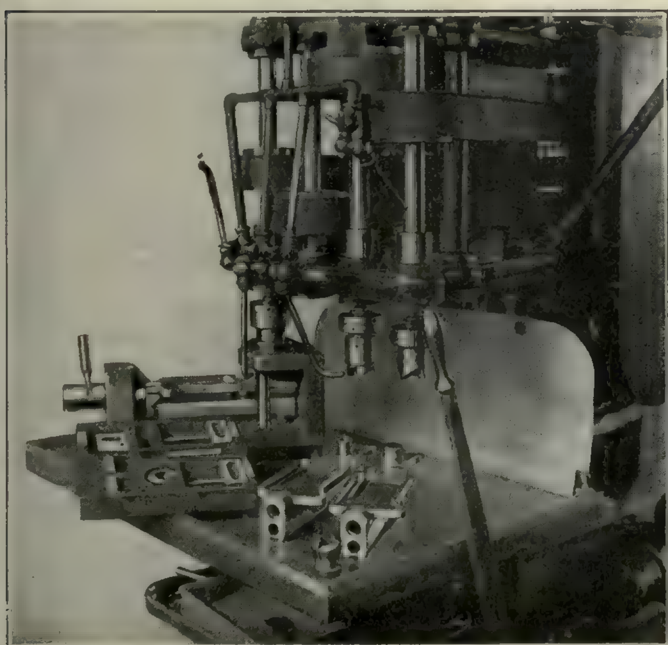


FIG. 48. HOLLOW MILLING THE MAGAZINE BOSS ON THE RECEIVER

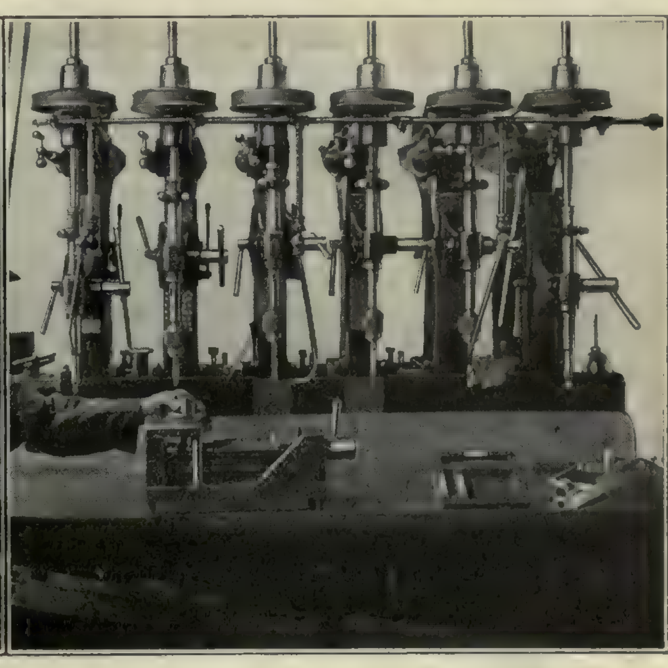


FIG. 49. DRILLING AND REAMING-MAGAZINE BOSS ON THE RECEIVER

principally to the application in machining the wide slot for the locking-lug clearance referred to in the preceding paragraph.

An assembly drawing of the shaping or slotting fixture is shown in Fig. 52. The cutting tool and its bar are not in position in this engraving. In Fig. 51 this cutter bar will be seen extending through the work and connected with the special head on the shaping-machine ram and with the feed mechanism at the outer end of the fixture.

Referring to Fig. 52 it will be seen that the special ram head *A* carries an operating shaft *B* which travels back and forth in a guide bushing in the end of the fixture and which reciprocates the cutter bar for shaping out the metal in the receiver. At the outer end of the fixture is located the head *C* for guiding the outer end of the cutter bar and feeding the shaping tool to the cut.

The end view shows the pawl arrangement for rotating screw *I*, by means of the ratchet teeth on the large head or disk at *J*. Pawl *K* is carried by a vertical plunger which has a beveled lower end acted upon by the corresponding end of feed slide *L*. This feed member is ⅝ in. square and extends through the whole length of the slot planed in the bottom of the fixture. When the shaping-machine ram approaches the end of its forward stroke a stop screw *M* strikes the rear end of feed slide *L*, and moving that slide forward against the action of compression spring *N* causes the bevel end plunger *O* to be lifted and the pawl to act upon the ratchet head screw *I*. The travel of feed slide *L* is varied to give any desired amount of feed to the cutting tool by the adjustment of the stop screw at *M*.

The ratchet head *J* of the hollow feed screw *I* carries an adjustable stop plate *P* which may be set to throw out the pawl *K* at any point and thus disengage the feed for the cutting tool.

The receiver to be slotted is supported on the long arbor *Q*, which fits the small bore in the receiver and which is flatted off the entire length of its top to provide clearance for the shaping tool when it has cut downward through the wall of metal between the two holes. The feed head *C* at the end of the fixture is pivoted at *R* and locked in place by a T-head screw at *S*, which given a quarter turn allows head *C* to be swung back out of the way to facilitate the removal and replacing of work in the fixture.

Special Drawhead

The special draw head, which reciprocates the cutter bar, is drilled out and tapped for oil-pipe connections, and the oil channels leads to a chamber at the center through which lubricant is forced under pressure to and through the hollow cutter bar to the working edge of the tool. This head carries an adjustable member which has a hexagonal opening fitting the corresponding shoulder on the operating bar. By turning the opposing screws the bar may be rotated slightly to adjust the cutter bar, thus bringing the cutting tool into truly central position for starting the slot.

The cutter bar *D*, Fig. 53, is in the form of a hardened steel tube. The hollow cutter bar is slotted near the middle of the length to form an opening for the cutter *E* which in working position is confined endwise between the spring plug *V* at the rear and the sloping surfaces of the wedge *F* and the bevel end of the slot at the front.

There is a V-notch in the front end of the plug to form a seat for the taper and rounded rear end of the cutting tool *E*, and in the outside of the plug there are four narrow grooves for oil passages.

The cutter is confined sidewise between guiding surfaces formed by two segmental strips *Z* which are secured on opposite inner sides of the tube by sweating in place.

The operating wedge *F* is ground cylindrically to fit the bore and flatted on its sides to enter between the cutter-guide plates. The series of notches across the top of the wedge come opposite another slotted opening in the tube and form a means by which the wedge may be withdrawn after the work is completed so that the cutter may swing up into the tube.

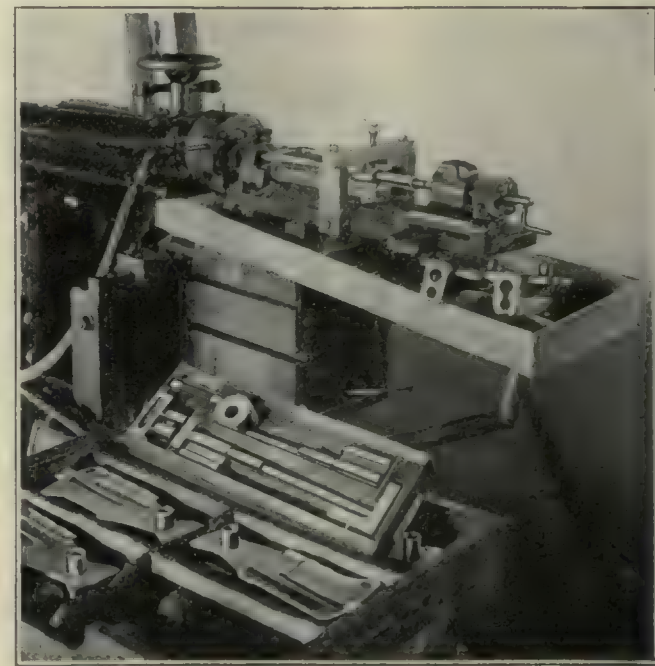


FIG. 51. SHAVING FIXTURE FOR CLEARANCE SLOTS FOR BOLT-LOCKING LUG

The wedge, like the operating screw at its rear, is made of tool steel. The screw referred to is $\frac{9}{16}$-in. in diameter having a quadruple V-thread, 16 pitch, $\frac{1}{4}$-in. lead, right-hand. This gives a very steep helix on this small diameter screw. A tension member to assure snug adjustment to the thread in the nut is provided in the form of the copper strip *G′*, which is retained in a groove in the screw by two small fillister-

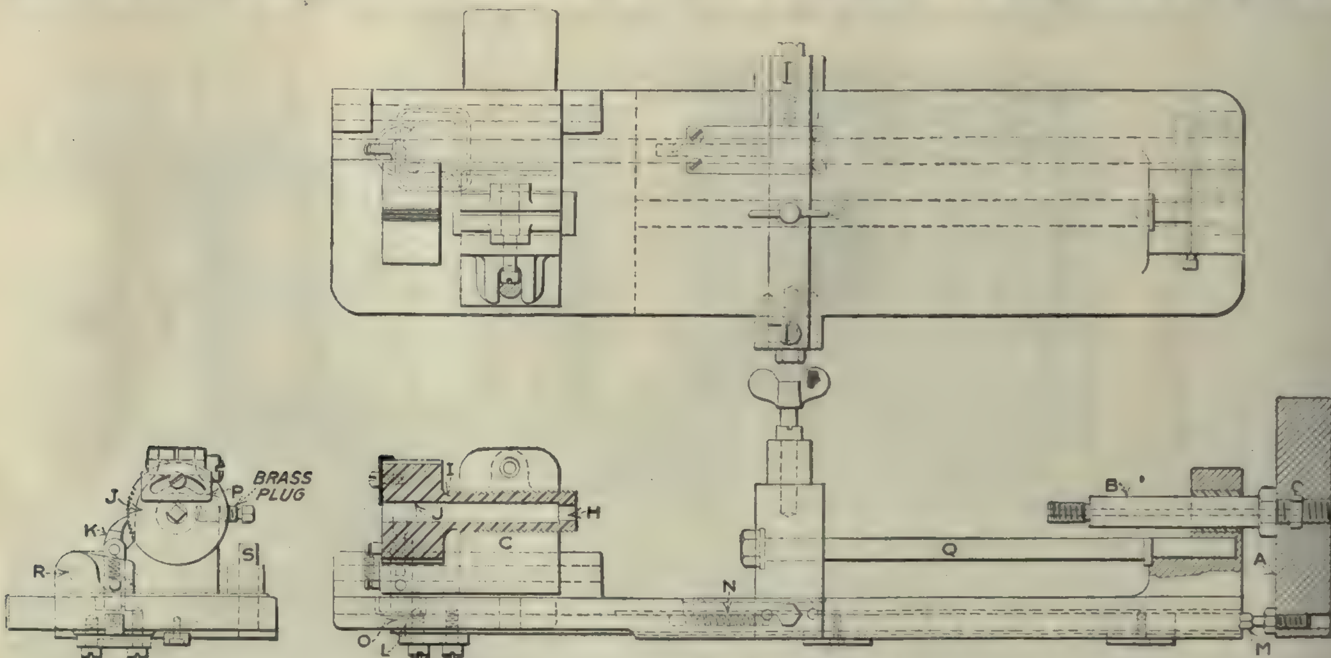


FIG. 52. THE SHAVING FIXTURE ASSEMBLED

head screws. The copper strip is threaded in position in the screw, and when in place in the nut it is forced outward by the two short springs in the body of the screw G, this adjustment being provided for by the clearance under the heads of the retaining screws which are used.

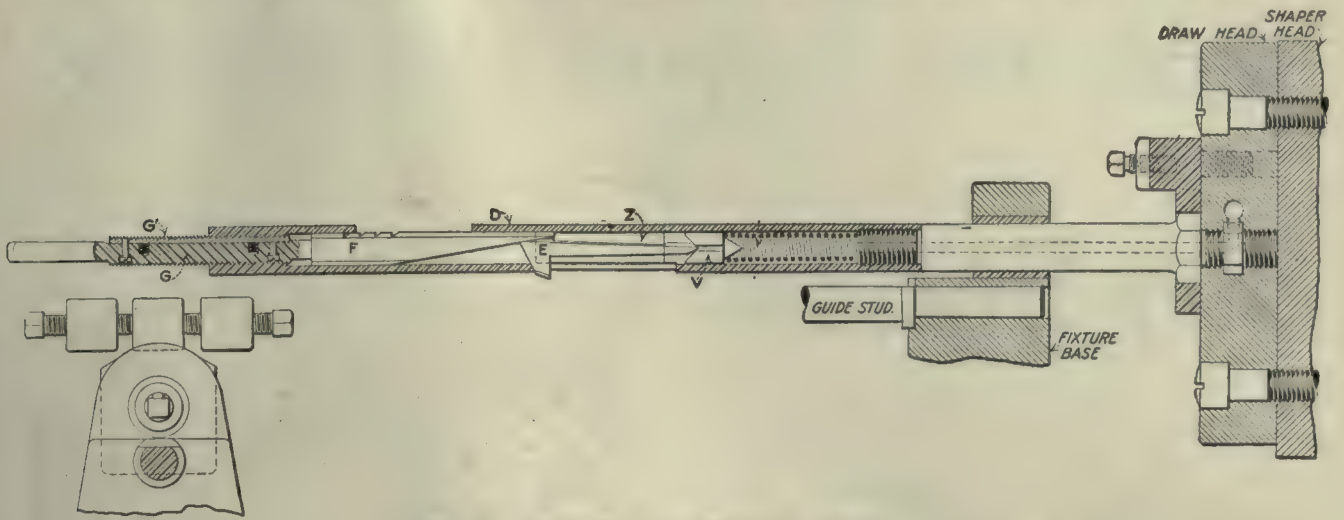


FIG. 53. CUTTER BAR AND TOOL DETAILS

Industrial Conditions Prevailing in England

BY DON J. O'BYONE

Ever conservative and always patriotic the British machine-tool manufacturer has entirely lost sight of his individual interest in the worthy effort of prosecuting the war. He has sacrificed his art of invention and all theories of production to the dominant task of the moment. He is taking no chances with Mars. The tool or the machine that was not absolutely necessary to war efficiency has been lost sight of, and the consequence is that in these days a great part of the everyday Britisher's life is lived in a fashion that suggests a reversion to the primitive. The consequence is that five of the largest machine-tool manufacturers in the United Kingdom have gone into liquidation during the past year—one voluntarily, the affairs of the other four being wound up by the Board of Trade.

The Machine Tool Association, Limited, the great organization of manufacturers, has joined in the appeal for the Industrial Reconstruction Council. The object is to conserve the industrial health of the nation that now exists and to revitalize industries. Of course such a scheme of reconstruction deals with varying elements, such as the bringing together of labor and capital, the creation of demand, etc.; but the machine-tool men have injected a positive demand for government subsidy to enable them to keep up their battle in the economic arena. At their meeting to discuss ways and means, Feb. 21 last, J. Judson of the Judson-Jackson Co., of London and Birmingham, one of the largest firms in the big-tool trade, complained that excess profits were based wrongfully on the prewar standard of profit. He referred to the enhanced price of American machine tools and said he doubted if a single member of the association was receiving half the sum for British-made goods. He looked forward to German competition after the war and said that the practical isolation of the Central Powers during the past three years had compelled them to manufacture their own tools and thus stimulate their genius as well as their capacity for production. Speaking of all postwar competitors as a class Mr. Judson summarized the government's duty to the machine-tool men and the manufacturers' duty to themselves in the following words:

"If they [competitors] travel we must travel; if they advertise largely so must we; if they plane a given-sized lathe bed in ten hours so must we; if they machine a certain-sized pulley in two hours so must we; if they adopt more up-to-date machinery so must we. What is the remedy for the state of affairs with which we find ourselves surrounded? At present the nation is spending about £7,000,000 ($35,000,000) a day on destructive purposes. Let it spend an equivalent amount for constructive purposes. By allotting a few hours' war cost to the machine-tool people the government would be restoring a most important industry to an absolutely sound basis."

The great length to which Britishers have gone to efface their personal desires and to concentrate on war efficiency is an interesting chapter. Nothing is made except the absolute necessities of life for the stay-at-homes. The only pleasures the average Londoner allows himself are his ale and the theater.

The reversal to the primitive in manners of living has had a serious effect on all manufacturers whose plants could not be adapted to war needs, and the recital of simple living to which the people have settled down might sound ludicrous in this enlightened age were they not the annals of patriotic self-sacrifice. Everything advertised in the newspapers and magazines must have a war use or the advertisement is frowned upon. The inventor with ideas other than tried and proved ones finds no market for them.

Shoe machinery should be in great demand, but the British manufacturer literally "sticks to his last." This is no time to make a change in his methods of production and he will not. Again, the people are encouraged to repair their own boots and shoes, and the writer has seen women who were more at home in the refinement of their own homes than in the environs of cobbler's shops proclaim their genius as shoe menders.


Bonds are the Foundation of All that Support Our Liberty
"Buy Bonds"

Problems and Opportunities After the War

IN AN address entitled "Looking Forward: Problems and Opportunities After the War," delivered Apr. 2 by Francis H. Sisson, vice-president of the Guaranty Trust Co. of New York, before the Cleveland Chamber of Commerce, American business men and manufacturers were urged to take full advantage of the great opportunities which the future holds for them. Mr. Sisson said in part as follows:

In unmasking her own diabolical designs Germany has opened the eyes of the world. Paradox though it seems she has taught us to look forward through glancing backward. Neither Germany nor any other equally unscrupulous nation, if such there shall ever be, will be able in the future to carry on its political scheming by means of economic imperialism.

The lightnings of this war have stripped these machinations of all their camouflage and revealed them in naked relief to all the world. We understand now that the immense efforts of Germany to produce, transport and sell in foreign countries were not exclusively economic in their object. We realize at last that Germany has struggled for more than commercial prosperity abroad, that she has assiduously and insidiously sought influence over the resources, the industries, the banks, the transportation facilities, the politics and the very life of the peoples with whom she traded—all in preparation for The Day, which she thought had arrived on Aug. 4, 1914.

Only a few farseeing ones—prophets crying in the wilderness, as it were—saw and pointed out the perils to which most people preferred to close their eyes or were too nearsighted to visualize. But today we comprehend the extent and the significance of the hold Germany had acquired in Russia, in Italy, in Belgium, in South America, as well as the advantages she had gained in France and England.

Guarding the Future

When this war is finished Germany will not be permitted to continue her nefarious work under the same conditions and with the same objects in view. She has awakened all democracies to the necessity of standing firmly together if they are not to perish from the earth. She has created a world-wide determination to guard against further danger of her kind. And therefore it behooves us to look forward, wary of the pitfalls of the past, individually and nationally alert alike to peril and to opportunity.

What the War Has Done

Not only has the war increased the knowledge of nations regarding other nations, but, whether belligerent or neutral, every nation has been well started on the way to finding itself. Those that have had valuable mineral deposits, but never the enterprise to produce more from them than they needed for direct consumption, have become large exporters. Others have developed their farms, their mines, their forests, their industries, seeking to get from them commodities to exchange for what they in turn needed and striving always to produce more than they consumed, to sell more than they bought. Wherever the necessities of war have not decreed the imposition of restrictions there has been a speeding up of industry and commerce under the impulse of prices fixed in accordance with the law of demand and supply.

Release Productive Energy

We have had a part in this general release of productive energy, this enterprise of distribution. Enormous sums have been invested in war industries and in those which arose because old sources of supply were cut off. Raw materials and manufactured goods have gone to every market in the world, and a favorable balance of trade has increased our gold supply and credit balance enormously. In the year ending June 30, 1914, our imports reached a value of nearly one and a half billion dollars, while our exports were almost two and a half billion, or a total of nearly four billions. In the year ending June 30, 1917, our imports amounted to two billion six hundred millions and our exports to nearly six billion three hundred millions. The balance of exports over imports was nearly three billion six hundred and thirty-five millions. That is to say that up to the end of the last fiscal year the total of our foreign trade showed an increase of over 110 per cent. as compared with the last fiscal year before the war, and an increase of 166.2 per cent. in the value of exports.

Our Foreign Trade

An analysis of this foreign trade would show that in recent months our imports from Europe have fallen 50 per cent. as compared with those of the corresponding months in 1914, while those from other parts of the world have increased 150 per cent. It would also show a greater percentage of gain in exports to countries outside of Europe. The figures are corroborative of what has been said about new markets and new sources of supply for United States products and imports.

While these data are encouraging and indicate that we have made excellent progress in building up our foreign trade it must be remembered that the figures represent values rather than volume. An increase of one dollar in the value of exports or imports under present conditions does not necessarily represent an increase in the volume of goods sold or bought.

A report of the Department of Commerce shows the encouraging fact that there was during 1917 a considerable gain in the position of American shipping. The amount of foreign tonnage cleared for different sections was considerably reduced, but the figures for several years back show that American ships have been gaining steadily as carriers of the world's commerce.

Extraordinary Circumstances

These are facts concerning what we have done in the last few years. It is not necessary to point out that they arise from a most extraordinary condition of affairs. The mere fact that while during the ten years preceding the war our domestic trade increased about a billion and a half a year and our foreign trade about a quarter of a billion a year, the former increased eighteen billion three hundred millions during 1917 and our foreign trade has increased for three years at an annual average of one billion seven hundred million, will convince anyone that circumstances have helped us wonderfully. Certainly there must have been a tremendous increase in the amount of labor and capital at work to accomplish these things, but scarcely anyone would contend that our initiative and enterprise were solely responsible for such a remarkable showing.

Preparations of Rivals

The truth of the matter is that many of our products have been sold without much effort on our part. For a considerable period America has been the only extensive free market, and other nations have come to us to make purchases because their customary commercial relations were interrupted by the war or because the purchasing nation was devoting all of its time and energy to the war. Other neutral nations and Japan were literally forced into foreign trading. Now that we are ourselves heart and hand in the business of fighting we shall probably experience some diminution in the extension of our foreign business. But that is not to say that we are to lose all we have gained or that we are to slump in spirit and initiative. Our energies have simply been turned in another direction for the moment, and our whole situation with respect to readiness to resume peaceful occupations is incomparably better than is that of our allies. As matters stand now they must go through a rather indefinite period during which they will be rebuilding their devastated homes, equipping their industries, reëstablishing their transportation systems and making arrangements for the absorption of their vast military and naval establishments.

The great danger with respect to our future is that we shall not appreciate the character and extent of the preparations which those who are to be our business and trade

rivals are making to regain their lost preëminence in industry, commerce and finance. They are under compulsion to make supreme efforts for they are deep in debt. To pay their debts will be the ambition of all honorable nations. Today all wise, farseeing nations are planning to that end.

Training for Trade

Through all their plans runs the purpose to concentrate their efforts on foreign trade. Only by selling abroad the products of others can they hope to pay their debts. In preparation for this they are drawing into more effective position their financial resources. Banking institutions are combining. Schemes are afoot for establishing trade and merchandise banks to keep in close touch with industrial and commercial enterprises. They are taking stock of their natural resources and studying ways and means of distributing their own raw materials most effectively. Great Britain, France and Germany have determined to get wealth from every possible source both at home and in their dominions and colonies.

Government with Business

The governments of those nations have clasped hands with business. One is to support the other in every way consistent with the public weal. Not only is business to be set free, but it is to have the assistance of the government in taking advantage of that freedom. By every means they can command these nations are spreading among their people an understanding of the situation they face and implanting the idea that to prevail over it every element of productive effort must be brought into harmony with every other. To regain their prosperity they must coöperate fully and intelligently, and foreign trade has become the rallying point for national endeavor.

Aside from a favorable position at the opening of this race for commercial supremacy America has certain other advantages of importance. At the foundation lies a huge gold reserve upon which can be built a structure of credit sufficient not only to finance our own enterprises but also to give aid to those of foreign countries. To guide and assist these credit extensions we have a banking system characterized by some of our rivals as ideal. This system will lend itself to the extension of American financial houses into foreign countries. Already a beginning has been made not only by the setting up of branch banks and foreign offices—establishments which may be termed money and credit depots for the advancing trade army—but also by the organization of merchandise banks, institutions with the usefulness and working of which European nations have long been familiar.

A Nation of Resources

It is because our response to war conditions has shown a ready adaptation to circumstances that we need have no fears as to how this country will avail itself of the quickly expanding opportunities of peace. We are a nation resourceful in ideas, and once we get convincingly before us the fact that we are in for a period of the intensest, most extended, most intelligently directed competition industry and commerce and finance have ever known it is certain that we shall rise to the occasion and be worthy of the struggle.

But we must not come to the end of this war relying solely upon our ready adaptability. This problem is so big, the future is so crowded with opportunities that definite plans must be made now. There is a growing appreciation among our people of the situation, but they are looking for leadership. Surely it is the duty of those trained in practical economics—our business men, our industrial managers, our financiers—to undertake these preparations and to show the way. Just as many of our institutions are now setting aside reserves to meet any possible deflation of values in the future, so should every industrial and financial institution set aside from the problems of the moment a portion of its time for the consideration of the conditions we shall have to meet and of how to meet them.

There ought to be throughout this country the closest attention to efficiency in all our undertakings. We must study to increase production and to improve our methods of distribution. We should take advantage of every device that will give effectiveness to the labor of men or the use of money and credit. We should apply to every available natural resource of this country the fullest measure of intelligent development. And we must learn to coöperate in these things. Otherwise the American trader who has everything else in his favor will be unable to compete in the markets of the world with his rivals. This great contest for commercial preëminence is to be a contest between nations and no individual may hope to survive it if he has to go alone.

Keeping the Engineering Divisions Fitted Up To Strength

The best results are obtained in an organization only when the energies of those comprising it are concentrated along the lines for which they are best suited by natural ability, education and training. It is more important to have the right man in the right place in our army, where lives are at stake, than it is in any business enterprise. The First Replacement Regiment of Engineers was organized at Washington Barracks, Washington, D. C. on Dec. 14, 1917, with the express idea of accomplishing this end. Its specific purpose is to keep all engineering units of the army at full enlistment strength during the period of the war.

The preliminary work of the recruit is first a thorough training in military drill, for the engineer-soldier must be prepared to lay down his shovel and take up his rifle at any time. Infantry drills gradually give way to engineer work and more specific technical training. The engineer-soldiers must know how to tie all the important kinds of knots and lashings to build spar and truss bridges, to construct revetments, dig trenches, place wire entanglements, construct machine-gun emplacements, build pontoon bridges and make roads. They must also know the methods of demolition, sapping and mining. Specialized training in lithography, zincography, surveying, mapping, photography, carpentry, blacksmithing, electricity and machinery are also given to those qualified for further training in these branches.

The Replacement Regiment will be called upon to furnish men for the following organizations: Camouflage regiments, crane-operating and maintenance regiments, depot detachments, electrical and mechanical regiments, forestry (sawmill) battalions, forestry (auxiliary road, camp and bridge) battalions, gas and flame service, general-construction battalions, mining regiments, quarry regiments, sapper regiments, searchlight regiments, supply and shop battalions, surveying, ranging and map-reproduction regiments and water-supply companies.

Engineers are called upon to perform such a wide range of work that practically every man with any technical training or mechanical ability can find a place in this organization. Every male citizen in the United States between the ages of 18 and 21 and 31 and 40 who is physically fit is eligible to join the regiment.

To be assured of assignment to this regiment the applicant for enlistment should write to the commanding officer, First Replacement Regiment Engineers, Room 107, Headquarters Building, Post of Washington Barracks, D. C., for application blank. If the blank shows the man to be eligible an enlistment card is filled out and sent to the recruiting officer nearest to the applicant's place of residence, with instructions to enlist the man for service in this regiment.

Machining Adjusting Collars

By W. G. GROOCOCK
Surrey, England.

A discussion of jig design involving comparison between present-day results and those of the years immediately preceding the advent of high-speed steel, with a few interesting remarks upon the advantage of new ideas, on estimating output, and the possibilities of milling.

IT IS an old but true saying that you never get thanks for advice that is tendered unsought, and from the tone of Mr. Terry's article on the above subject, page 977, Vol. 47, it would appear that suggestions fall under the same truism. While regretting that my suggestion did not fit in with conditions existing in Mr. Terry's shop, I am sufficiently optimistic to believe that the seed sown may yet fall on less barren ground elsewhere.

It is more than probable that a further discussion of the jig in question would not be of general interest were it not for the fact that Mr. Terry has raised other points that are worthy of discussing at any time. These are: (1) Feasibility of design; (2) turning down new ideas; (3) estimates of output; and (4) the possibilities of milling.

Let us discuss these broadly, but with special reference to Mr. Terry's article.

Feasibility of the Design

To be of value any suggested design should be feasible, and there is no better test of feasibility than that of previous use. Mr. Terry would like to know how we "did the job 14 years ago so that a comparison of output could be taken." The design suggested by me (shown in diagram Fig. 3, page 297, Vol. 47) was to all intents and purposes the same as one that was made and used very successfully for doing the same job 14 years ago in a factory where much of this kind of work was produced. The only difference between the one made then and the design suggested by me is that the original had but four work arbors and four wormwheels while the suggested design had two rows of four arbors each. Either would require four cutters. Mr. Terry has conjured up a host of difficulties for this design, but in practice none were encountered. After several years of use there was no appreciable "backlash in the wormwheels" and no "wobble in the screws," as these were supported in two places. Further the jig had no more suspicion of "a swinging pendulum" about it than would be found in the combined action of the knee, table and saddle of a milling machine.

As a comparison of output, Mr. Terry has evidently forgotten that milling practice has developed "some" during the last 14 years—probably more than any other branch of our trade. Apart from this, the period mentioned was before the general introduction of high-speed steel. Comparisons of output might, therefore, under the circumstances be invidious. However, on the basis of the figures given by Mr. Terry the output from the old jig, using carbon-steel cutters, was ahead of present-day practice.

An outstanding feature of this old jig was the ease and rapidity with which the four pieces of work could be indexed. This should settle the question of feasibility of the design. The quick indexing would also provide a little of the "resting time" that Mr. Terry desires for his operator. Personally I have a prejudice against resting time in the shop, and would prefer shorter hours so that the men can rest outside.

All shop men have at some time or other realized that the strongest brake on the chariot of output is the inability of someone higher up to realize the necessity for a change. When a new idea is put forward it is "promptly" turned down. We have all faced such a situation, and Mr. Terry has on several occasions voiced his opinion that such action on the part of one higher up is detrimental to progress. Now referring to the design suggested by me Mr. Terry says, "An identical arrangement was suggested by an assistant while mine was in progress, but was promptly turned down," etc. This would of course prevent the assistant from getting unduly elated, and we may all have to turn down ideas sometimes to keep our assistants from growing bigger than the office. But why turn them down "promptly?" Surely any idea that is put forward is worthy of some consideration, and the prompt turndown that this idea received leads one to believe that consideration was absent.

This phase of tool designing is well illustrated in the book "Ford Methods and the Ford Shops." Take, for instance, these extracts: "It is a proverb among special-tool designers that a man will walk round the best method of doing a job and not see it for a long time, if ever." Again, "It is surely time well spent, before beginning drawings, to consider fully and impartially every plan and method which might possibly serve the occasion, no matter how strange or absurd the plan appears at first sight; and such consideration of seemingly unavailable methods should not be superficial, but most careful and painstaking." This is such thoroughly sound advice that it ought to be posted in every tool office—"lest we forget." We might even send a copy to the one higher up where, if it was acted upon, it might cut out the prompt turndown that is so often the brake used. Possibly too it may even lead to "Ford output," which we badly need in this country.

Estimates of Output

The tool designer usually thinks in terms of output, and with the experience born of previous practice and with the knowledge of the men who will use a fixture he is able to forecast with reasonable accuracy what such a fixture is capable of doing if properly handled. He may be—indeed he should be—an optimist; but in practice his estimates of output are often surprisingly accurate. Mr. Terry throws doubt on the figures I gave, and by arithmetic—which may or may not be correct—tries to show the impossibility of the output I suggested. This reminds me of another Ford story told by Mr. Faurote. A certain manufacturer called into conference with the Ford engineers questioned the estimated hourly output of the machine then under discus-

sion. He asserted that the output given per hour was five times more than what others considered a fair production on such parts for a day. In fact he flatly refused to believe the estimate and told the designer of the machine so. "Well," said the engineer, "if you will go down into the machine shop on the main floor you will find a machine doing it." This, I believe, ended the discussion.

Unfortunately I cannot invite Mr. Terry "down into the machine shop" to see the old jig; but a knowledge of its work coupled with an appreciation of the general advance in milling practice since that time convinces me that I could get the number quoted—or very near it—from one machine in one day of 10 hours.

The Possibilities of Milling

During the past two decades milling practice has been subjected to constant and rapid evolutionary changes. In early practice the machine was leading the cutters. Then cutters were improved and this led to a stronger machine. The high-speed steel cutters came, which again placed the machine at a disadvantage. Today the modern machine is again in the lead, yet Mr. Terry throws doubts on the capability of "some" "illigant divil" of a machine to drive the cutters through mild steel at a feed of 10½ in. per minute.

Machines for doing more than this are now quite common, and as mentioned above the limiting factor is the cutter. A recent cutter experience will serve to illustrate this point. For some time the milling section had complained that cutters of a certain make would not stand up nearly as well as cutters of another brand. As the failures were made by one of the best toolmaking firms and from a brand of steel of world-wide fame, several comparative tests were made using different cutters of each make to check previous results.

The cuts made were about equal to those of Mr. Terry's job. The material was mild steel; peripheral speed of cutter 150 ft. per min., and feed 16 in. per min. In one trial one of the cutters did an aggregate of 1350 in. before it required grinding, while the other cutter failed almost at once. To make sure of the result the trial was repeated several times, always with similar results. On this material the cutter would do as much as the machine would pull. On a similar job, but made from 3 per cent. nickel steel, these cutters are constantly at work at a speed of 120 ft. per min., with an 8½ in. feed per min. On the nickel steel the machine beats the cutters.

The makers of the cutters that failed were frankly unbelieving, but finally sent an expert to investigate. He had the two makes of cutters tried on the same piece of material and at the speed and feed already given. The result was that his cutter fell down in the first two inches while the other finished the job and looked as though it had not been used. This, I think, proves that a feed of 10½ in. per minute is easily within the reach of modern machines and cutters. Naturally for such cutting the fixture as well as the machine must be rigid, but this is only a question of design—not of the principle embodied, but the proportions.

The rigidity of the fixture is closely connected with the accuracy of the work it will produce. Mr. Terry has raised the question of limits of accuracy of these adjusting collars. I hope he has not met with any trouble through his jamming and indexing screw throwing the work out of line with center of cutters.

Having had a good deal of experience with foolishly fine limits I can sympathize with Mr. Terry if he has had fine limits forced upon him for this job. If any reader of the *American Machinist* has this job to do and finds the drawing marked up for fine limits I would advise him to refer the drawing back, and back again, until it is altered. The collar is for taking up wear on the hub and axle of a road wheel. The slots have to embrace the linchpin of the axle, therefore the width of the slots might without detriment vary between the size given and $\frac{1}{32}$ in.

The varying depths of the slots are to take up the longitudinal wear of the wheel hub and axle flange, and since there is quite a considerable difference in the depth of these slots it follows that much slackness must exist before the linchpin can be put into the next slot. This being so then fine limits are a farce also for the depth of the slots. If Mr. Terry has this job again I should advise him—I don't expect any thanks—to have a "go" at the one higher up. Point out to him that such limits hinder production—and we want output now.

I yield to no one in my appreciation of the value of the advertising columns of the *American Machinist* as a hunting ground for ideas. My practice is to cut out all advertisements that show a jig or fixture and file them for use. Now Mr. Terry has found a new use for these pages, as he uses them in conjunction with a misquoted sentence of mine to camouflage the weakness of his defense. String fixtures have their uses, and I have made, and shall still make, many; but stringing a lot of pieces one after another is, to quote my original statement, "frequently not nearly so productive as operating in a different manner." On several occasions I have made string fixtures and have later on changed them—often the suggestion has come from the shop—for two simple fixtures of the reciprocating type. The result has invariably been an increase in production sometimes more than double that obtained from the string type fixture. It's production we want!

The main thing for a tool designer to remember is that an open mind is an asset. You cannot analyze a problem without it. No matter where the idea comes from it should receive careful attention. It may be the prerogative of the man higher up promptly to turn down an idea, but it is undoubtedly bad policy and is more than likely responsible for many inferior productive methods that we see around us. We never needed output more than we need it now!

Ball-Joint Piston Rod for Steam Hammer

By J. C. Larson

On page 389 of the *American Machinist* is an article under the above title by E. L. Robenolt. I desire to warn your readers against trying this experiment, for I have seen the original rod made by the Studebaker Co. of South Bend, and have put a similar rod in the Osborne works of the International Harvester Co. of New Jersey, at Auburn, N. Y., both of which were miserable failures. I refer you to either of the above companies for verification of this statement. Well knowing the trouble with piston rods in steam hammers I have remedied it to a certain extent by enlarging the rods.

Sidelights

EDITED BY E. C. PORTER

New munition companies organized during February had capital of $2,000,000, compared with the same amount a year ago, and aircraft companies had a capital of slightly less than $2,000,000, compared with only $400,000 for similar concerns organized in February, 1917. The amount of capital invested in new munition and airplane companies since the war began is $255,000,000.

* * *

Arthur J. Mason has been authorized to test out on a large scale electric welding as applied to shipbuilding. This work will take the form of constructing part of a hull at the federal shipbuilding plant at Newark, N. J. The material will be assembled and tacked together and rendered watertight by various forms of arc welding. Suitable foundations are being prepared to allow of severe tests by pressure, as well as every agency to develop the merits of the system.

* * *

Books and library service are to be provided for army navy and Red Cross hospitals in America and France, according to the plan of the American Library Association. Women will be employed in these libraries, and it is also announced that two women have recently been appointed as assistants in cantonment libraries which hitherto have been unavailable to women workers. Miss Anna Neuhauser is acting as assistant in the cantonment library at Camp Hancock, Ga., and Mrs. Lois W. Henderson at Camp Bowie, Tex. The American Library Association will direct the hospital library work under the War Department Commission on Training.

* * *

A $1000 bond will buy six cases of operating instruments for a bse hospital, or furnish pistols for a rifle company, or one motor kitchen. One thousand five hundred dollars of Liberty bonds will buy a motor ambulance or a motor car for a machine-gun battalion. Two $1000 bonds will buy a motor truck; three $1000 bonds will buy rifles for a field-artillery battery or supply horses for a field-signal battalion. Four $1000 bonds will buy a tractor; five $1000 bonds will buy Liberty truck or seven Lewis machine guns, or equip a rifle company with rifles. Six $1000 bonds will buy a Liberty motor; seven $1000 bonds one training plane; nine $1000 bonds one observation baloon. Ten thousand dollars of bonds will fully equip three hospital wards of 50 beds each with all linen, clothing and other necessaries, or buy six large wholesale sterilinzing outfits, or six motor ambulances.

* * *

These methods of saving lubricating oils are posted in the machine shops of Germany: Use only closed oil cans with spouts that will deliver drops, or at most only a thin stream. Use all lubricating apparatus strictly according to instructions and put the oil only where it will actually lubricate; if a machine has automatic droppers shut off the supply while machine is standing. Do not use cylinder oil on shafting or elsewhere when cheaper oil will answer. Keep all rubbing surfaces in good condition; rough surfaces and too tight boxes consume more oil; worn and leaky bearings waste oil. Always use drip pans and arrange to filter and cleanse the oil so caught; it is as good as new. Collect all greasy waste and wiping cloths, so that the oil may be recovered; never burn them. Be careful about using lubricating oil for cooling a bearing. Water will often do as well. Be careful about using oil for cleaning and polishing; never clean the hands with oil; a greasy cloth will do as well.

* * *

The girl shipbuilder has made her debut in Seattle in the person of Marguerite Gothe, 19 years old, who hails from Wisconsin. Miss Gothe is holding down a regular job and making good. She wears overalls and is proud of them. She runs the treenail machine and treenail pointer, and also gives a helping hand in running one of the planing machines in the new Elliott Bay Shipbuilding Co. plant. A treenail, pronounced trunnel and often spelled that way, is a wooden nail used for fastening the frame together in a wooden ship. "Like the job?" said Miss Gothe. "That's not the word. I am simply delighted with it. Running the machine is great fun, and then, you see, I get lots of fresh air. Why this beats working in an office or behind a counter 40 different ways. Then there is the satisfaction of knowing that I am doing something really worth while. Anyone who helps build a ship during the war period is helping Uncle Sam."

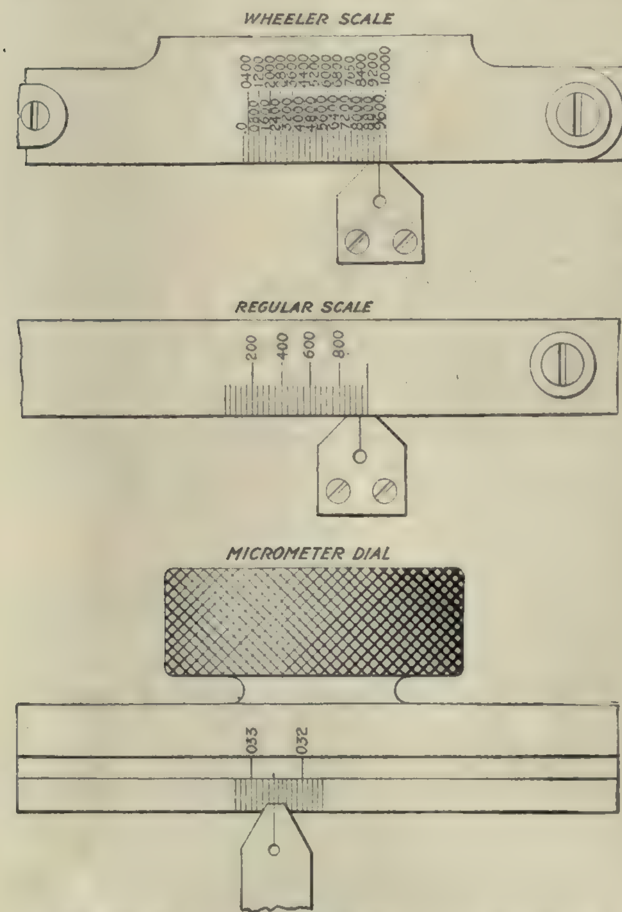
* * *

Women telegraphers who wish to render their country a patriotic service can best do so by accepting employment with a telegraph company, thereby releasing a man for military duty. This is the advice of naval authorities to women seeking to enlist as navy radio operators. Telegraph companies in many cities are maintaining schools in which instructions is even free of charge to women who wish to learn telegraphy, and are employing the women as soon as they become proficient. It is land-wire telegraphy rather than radio, say the navy authorities, that women should study. Women radio operators are not being enlisted in the navy nor enrolled in the Naval Reserve Force for radio-telegraphic duties, according to a statement made by the Naval Communication Service. At the outbreak of the war several women were enlisted as radio operators, but their employment in this capacity was found to be, generally speaking, impracticable. The navy is supplying all merchant ships as well as naval vessels, quarters on both being provided for men only. Instructors in navy radio schools must be radio electricians with actual shore and sea experience, hence women will not be accepted for this duty.

Improved Scale for Measuring Machine

By William C. Betz

As we have a large amount of measuring to do on plugs and standards for the maintenance of accuracy in our product, and realizing through experience that the scale on the measuring machine as it is furnished



IMPROVED SCALE FOR MEASURING MACHINE

by the maker is not productive of speed and economy, our foreman inspector has designed the scale shown in the illustration. For the purpose of comparison the regular scale is also shown. It will be seen that in the regular scale every fifth line is longer that the others and is marked 200, 400, 600, 800, 1000. On the new scale each alternate line is longer, and the lines are marked 0400, 0800, 1200, 1600, 2000, 2400, 2800, etc., up to 10,000. These figures are etched, making it possible to read them quickly and accurately.

To read the regular scale to the setting shown in the sketch, we must take the nearest preceding number, which is 0.800, add to it the three unnumbered spaces (of 0.040 each), and the resultant reading of the vernier equals 0.920. To this must be added the reading of the micrometer disk, which we find to be 0.0326, making the final reading 0.9526.

With the new scale much computation can be eliminated, as it is only necessary to find the line and figure preceding the index and add the difference as shown on the micrometer dial. The nearest preceding line on the scale is marked 0.9200 in., and the dial index points to 0.0326 in. Adding these two we have 0.9526 in., as in the previous example. If, as in our case, a couple of hundred or more measurements a day are taken it means the saving of mental energy.

Hobbing a Large Worm Wheel on a Boring Mill

By E. J. Edwards

The illustrations will show how a worm gear 45⅜ in. in pitch diameter, 190 teeth, with ¾-in. pitch, 14½ deg. angle of pressure, for hurried requirement, was cut

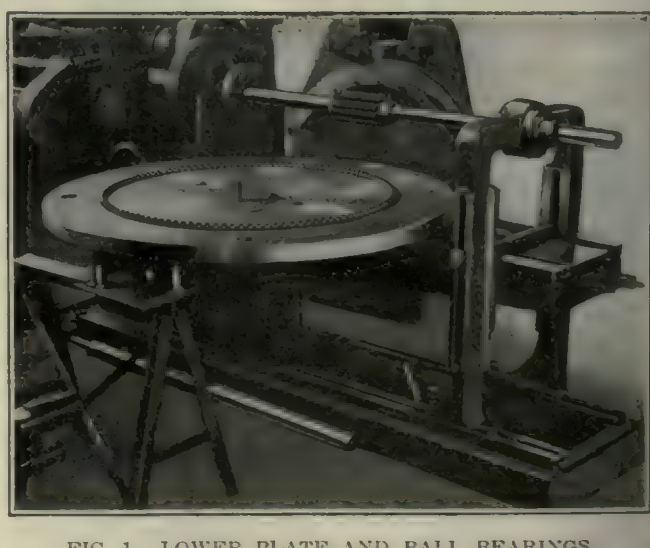


FIG. 1. LOWER PLATE AND BALL BEARINGS

in our own shop. The blank was 46⅛ in. in diameter and too large to put on a milling machine in the regular way, so the next best thing was used—a horizontal boring mill.

On a plate 5 ft. in diameter and 2¼ in. thick, a ball race was cut 43 in. in diameter for 1⅛ in. steel balls.

This plate was leveled by being supported partly on the back side of the mill bed and the overhang jacked up on a horse. Fig. 1 illustrates the arrangement.

A 4-in. pin at the center, surrounded by short pieces of $\frac{1}{4}$-in. drill rod, served as an axis with roller bearings. A second plate placed carefully on the first could now revolve on the ball bearings with very slight friction. The blank was placed centrally on the second plate and bolted securely to it. To get the required angle for the first or gashing cut, for which a fly cutter was used, both plates and the blank were elevated on one side by blocking and jacking, as shown in Fig. 2.

A mark was made on the lower plate, and the upper plate was divided as accurately as possible into 190 equal divisions. A roughing cut was taken with the forming tool, the table moved around to the next mark and another cut taken, this process being repeated until all the teeth were roughed. The overhang of the plates was supported, as shown in Fig. 3, and moved easily on the balls provided. This allowed the feed for depth of cut to be easily taken care of by the cross-feed screw with which the boring mill was already equipped.

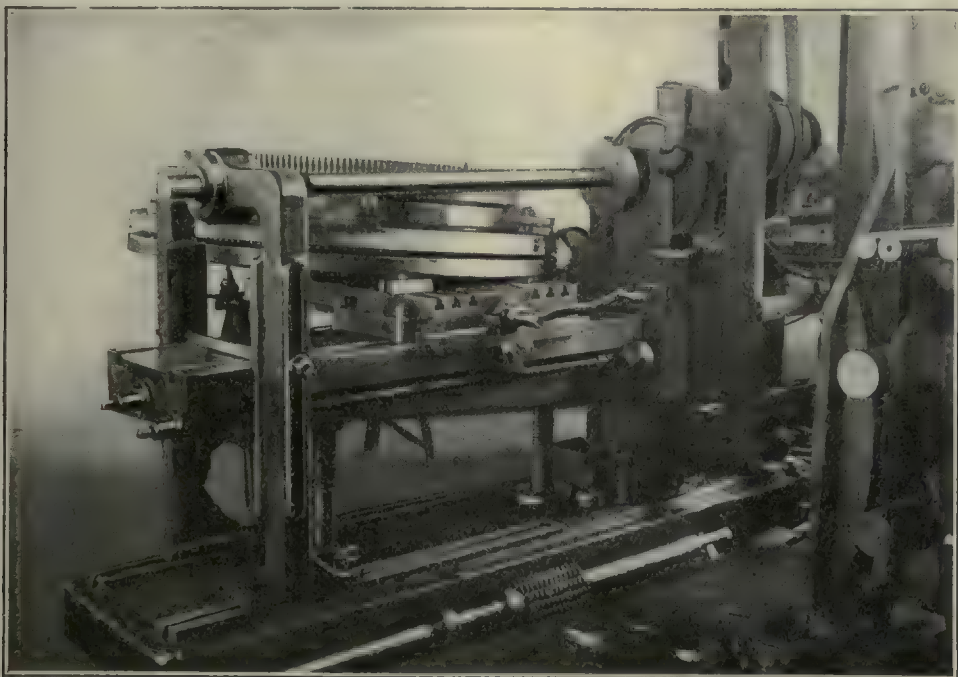


FIG. 2. GASHING THE TEETH WITH A FLY CUTTER

The finishing cut as illustrated in Fig. 4 was taken with a home-made hob cutter.

Any lateral play of the boring bar was prevented by a thrust collar on each side of the upright supporting the free end of the bar. The finished job set in place gave satisfactory results.

A Chambering Tool

BY R. E. GOSS

The writer being recently confronted with the problem of chambering or recessing the $\frac{7}{8}$-in. holes in a number of semi-steel castings as shown at *A* in the accompanying sketch, devised the tool here described, which accomplished the desired object very satisfactorily.

The boring bar *B* with taper shank to fit the drilling machine was turned to fit the $\frac{7}{8}$-in. reamed holes in the work, and about 1 in. at the lower end was reduced to $\frac{3}{4}$ in. in diameter for clearance.

A $\frac{3}{8}$-in. hole was drilled axially in the bar for nearly its full length, a $\frac{1}{4}$-in. square hole passing radially through the bar at the shoulder near the lower end was made to receive the cutting tool *C*, and a radial slot near the upper end extended around $\frac{1}{4}$ of the circumference of the bar plus the width of the slot, which is just over $\frac{3}{16}$ inch.

A $\frac{3}{16}$-in. hole was drilled through the bar opposite the slot, for the purpose of driving out the pin which operates the cam rod, this slot and hole being clearly shown in the section *XX*.

The cam rod *D* is a piece of $\frac{3}{8}$-in. drill rod with a $\frac{3}{16}$-in. hole radially near one end, and a cam formed at the other end by reducing the diameter to $\frac{3}{16}$ in. upon a center which is $\frac{1}{16}$ in. eccentric to the center of the rod. The cutting tool *C* has a slot across its upper surface in which the cam operates when the device is in use.

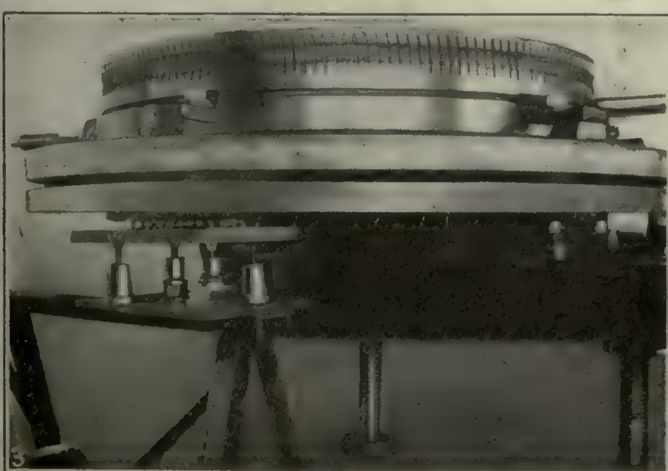


FIG. 3. BALL-BEARING SUPPORT FOR OVERHANG

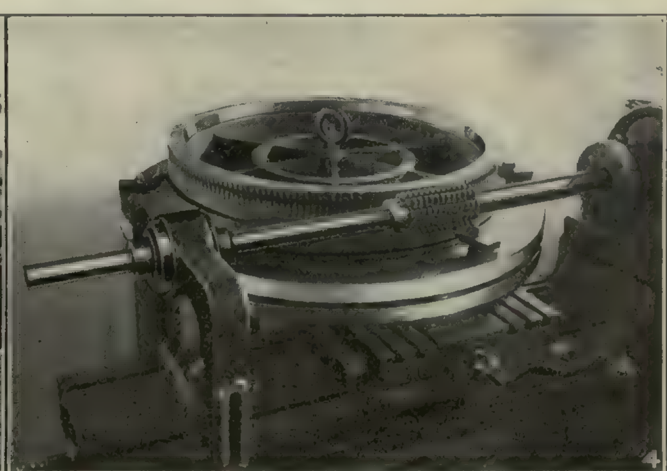
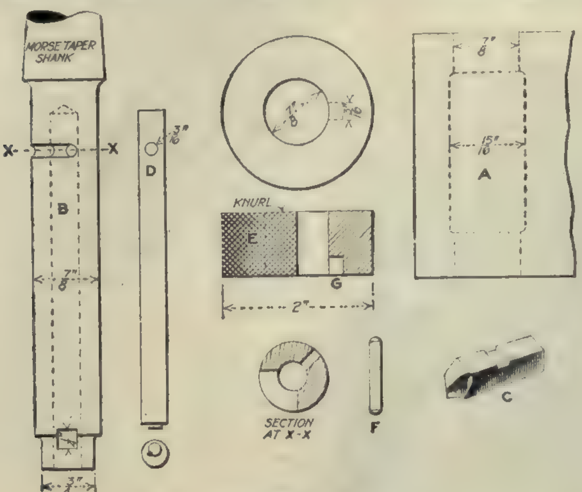


FIG. 4. THE HOBBING OPERATION

In assembling, the cam rod *D* is pushed into the center hole in *B*, the depth of which hole allows the cam rod just to clear the square hole for the cutting tool. The cutting tool *C* is then put in place and the cam rod dropped down into engagement with the slot, whereupon the $\frac{3}{16}$-in. hole in upper end of cam rod coincides with the radial slot in bar *B*. The knurled ring *E* is slipped over the bar to a point above the radial slot, the $\frac{3}{16}$-in. pin *F* is driven through the slot in *A* into the cam rod, and the ring brought down over it, the pin fitting the recess in the ring at *G*.

When the assembled bar is put in place in the work and the cutting tool brought down to the starting point



A CHAMBERING TOOL

of the chamber as determined by lines previously made on the bar, the machine is started and the knurled ring retarded by grasping it with the hand. This causes the cam rod to turn, slowly feeding the cutting tool outward until the pin in the cam rod reaches the end of the radial slot in bar *B* which limits the depth of the chamber. Feed is now applied to the drilling machine and the bar run down to the length of the recess desired; when the machine is stopped, the ring *E* turned back as far as the pin will allow, drawing the cutting tool *B* into the bar, when the bar can be removed from the work.

The cutting tool is shaped as for Acme thread with minimum clearance, so that grinding the face does not materially alter its size. While the tool has the disadvantage of being rather short-lived, the fault is offset by the fact that it is very simple to make, and the entire tool can be disassembled and reassembled in two minutes.

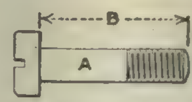
Time Studies on Automatic Screw-Machine Products

By F. A. MacGowan

Having derived considerable benefit from the time-study data published in the *American Machinist*, I am submitting the results of two months' investigation of our automatic department, believing that it may prove of value to others engaged in similar work.

From 133 times studies taken on all classes of work on Cleveland single spindle machines, the sizes of lots varying from 50 to 500 pieces, the following data was gathered:

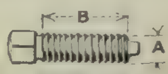
The total actual floor-to-floor time was 514.16 min. The total average record time on these pieces was 707.86 min., the additional 38 per cent. being the delay allow-



B	A-1/4		A-5/16		A-3/8		A-1/2		A-5/8		A-3/4	
	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate
0" to 1 3/8"	8/10	13	1	14 1/2	1 1/10	16	1 2/10	17 1/2	1 4/10	20	1 5/10	22
1 1/2" to 1 7/8"	1	14 1/2	1 1/10	16	1 2/10	17 1/2	1 4/10	20	1 1/2	22	1 6/10	23
2" to 2 3/8"			1 2/10	17 1/2	1 3/10	18	1 5/10	22	1 6/10	23	1 8/10	26
2 1/2" to 2 7/8"			1 3/10	18	1 1/2	22	1 6/10	23	1 8/10	26	2	29
3" to 3 3/8"					1 7/10	25	1 8/10	26	2	29	2 2/10	32
3 1/2" to 3 7/8"					1 9/10	28	2 1/10	30	2 2/10	32	2 4/10	35
4" to 4 1/2"					2 1/10	30	2 3/10	33	2 4/10	35	2 6/10	38

TIME STUDIES ON SLOTTED SCREWS

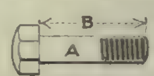
ance necessary for set-ups, stocking up etc. A careful check was kept on the number of machines operated per man. While the operators were allotted three machines



B	A-1/4		A-3/8		A-1/2		A-5/8		A-3/4		A-7/8	
	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate
0 - 1 3/8	8/10	12	1 1/10	16	1 3/10	18	1 4/10	20	1 6/10	23	1 8/10	23
1 1/2 - 1 7/8	9/10	13	1 2/10	17 1/2	1 4/10	20	1 1/2	22	1 7/10	25	1 8/10	26
2 - 2 3/8	1	14 1/2	1 3/10	18	1 1/2	22	1 6/10	23	1 8/10	26	1 9/10	28
2 1/2 - 2 7/8	1 1/10	16	1 1/2	22	1 6/10	23	1 7/10	25	1 9/10	28	2	29
3 - 3 3/8	1 3/10	18	1 6/10	23	1 8/10	26	1 9/10	28	2 1/10	30	2 2/10	32
3 1/2 - 3 7/8	1 4/10	20	1 8/10	26	2	29	2 1/10	30	2 1/4	33	2 4/10	35

TIME STUDIES ON SETSCREWS

each, it was found that owing to two or more jobs running out at the same time, breakdowns, etc., production was maintained on only 2.42 machines per man. From



B	A-3/8		A-1/2		A-5/8		A-3/4		A-7/8			
	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate	Prem.	Piece Rate
0" to 1 3/8"	1 1/10	16	1 3/10	18	1 4/10	20	1 6/10	23				
1 1/2" to 1 7/8"	1 2/10	17 1/2	1 1/2	22	1 6/10	23	1 8/10	26				
2" to 2 3/8"	1 3/10	18	1 7/10	25	1 8/10	26	2 4/10	30	2 1/2	36 1/2		
2 1/2" to 2 7/8"	1 4/10	20	1 8/10	26	2	29	2 3/10	33	2 7/10	39 1/2		
3" to 3 3/8"	1 1/2	22	2	29	2 2/10	32	2 1/2	36 1/2	2 8/10	42 1/2		
3 1/2" to 3 7/8"	1 8/10	26	2 1/10	30	2 4/10	35	2 7/10	39 1/2	3	43 1/2		

TIME STUDIES ON CAPSCREWS

this we have the simple formula: $P = A \times 1.38 + \frac{I}{2.42}$ P = premium time, A = observed or estimated actual time and I = salary increase allowance.

For standard screws on the four-spindle National Acme machine the accompanying tables were made up. The piece rates given are in cents per hundred pieces, and are based on a day rate of 35c. per hour. The premium is figured for a salary increase of 25 per cent.

The National Labor Policy During the War

The need of a definite labor policy has been long apparent. This tells just what principles have been laid down and what plans have been made to have them carried out.

WE ARE at last taking definite and logical steps toward the prevention of labor difficulties, following to a great extent the policy which has proved satisfactory in Great Britain. The national labor program, as outlined at a recent meeting of the National War Labor Board, should be familiar to every manufacturer and worker. It aims to secure justice to both, to the end that production may not be curtailed by reason of labor differences or misunderstandings.

The principles and policies which are to govern the relations between employers and employees in all war industries during the war are as follows:

Right to Organize

1. The right of workers to organize in trade unions and to bargain collectively, through chosen representatives, is recognized and affirmed. This right shall not be denied, abridged or interfered with by the employers in any manner whatsoever.

2. The right of employers to organize in associations of groups and to bargain collectively, through chosen representatives, is recognized and affirmed. This right shall not be denied, abridged or interfered with by the workers in any manner whatsoever.

3. Employers should not discharge workers for membership in trade unions nor for legitimate trade-union activities.

4. The workers, in the exercise of their right to organize, shall not use coercive measures of any kind to induce persons to join their organizations nor to induce employers to bargain or deal therewith.

Existing Conditions

1. In establishments where the union shop exists the same shall continue and the union standards as to wages, hours of labor and other conditions of employment shall be maintained.

2. In establishments where union and nonunion men and women now work together and the employer meets only with employees or representatives engaged in said establishments the continuance of such condition shall not be deemed a grievance. This declaration, however, is not intended in any manner to deny the right, or discharge the practice, of the formation of labor unions or the joining of the same by the workers in said establishments, as guaranteed in the last paragraph, nor to prevent the War Labor Board from urging, or any umpire from granting, under the machinery herein provided, improvement of their situation in the matter of wages, hours of labor or other conditions as shall be found desirable from time to time.

3. Established safeguards and regulations for the protection of the health and safety of workers shall not be relaxed.

Women in Industry

If it shall become necessary to employ women on work ordinarily performed by men they must be allowed equal pay for equal work and must not be allotted tasks disproportionate to their strength.

Hours of Labor

The basic eight-hour day is recognized as applying in all cases in which existing law requires it. In all other cases the question of hours of labor shall be settled with due regard to governmental necessities and the welfare health and proper comfort of the workers.

Maximum Production

The maximum production of all war industries should be maintained and methods of work and operation on the part of employers or workers which operate to delay or limit production or which have a tendency to artificially increase the cost thereof should be discouraged.

Mobilization of Labor

For the purpose of mobilizing the labor supply with a view to its rapid and effective distribution a permanent list of the number of skilled and other workers available in different parts of the nation shall be kept on file by the Department of Labor, the information to be constantly furnished: (1) By the trade unions; (2) by state employment bureaus and federal agencies of like character, and (3) by the managers and operators of industrial establishments throughout the country. These agencies should be given opportunity to aid in the distribution of labor as necessity demands.

Custom of Localities

In fixing wages, hours and conditions of labor regard should always be had to the labor standards, wage scales and other conditions prevailing in the localities affected.

The Living Wage

1. The right of all workers, including common laborers to a living wage is hereby declared.

2. In fixing wages minimum rates of pay shall be established which will insure the subsistence of the worker and his family in health and reasonable comfort.

For the Employers: Loyall A. Osborne, L. F. Loree, W. H. VanDervoort, C. E. Michael, B. L. Worden.

For the Employees: Frank J. Hayes, William L. Hutcheson, Thomas J. Savage, Victor A. Olander, T. A. Rickert.

For the Public: William H. Taft, Frank P. Walsh.

The statement of ex-President William A. Taft, representing the public, is of special interest, and is as follows:

I am profoundly gratified that the conference appointed under the direction of Secretary Wilson has reached an agreement upon the plan for a National Labor Board to maintain maximum production by settling obstructive controversies between employers and workers. It certainly is not too much to say that it was due to the self-restraint, tact and earnest patriotic desire of the representatives of the employers and the workers to reach a conclusion. I can say this with due modesty, because I was not one of such representatives. Mr. Walsh and I were selected as representatives of the public.

Personally it was one of the pleasant experiences of my life. It brought me into contact with leaders of industry and leaders of labor, and my experience gives me a very high respect for both. I am personally indebted to all of the board, but especially to Mr. Walsh, with whom as the only other lawyer on the board, it was necessary for me to confer frequently in the framing of the points which step by step the conference agreed to. Of course the next question is, "Will our plan work?" I hope and think it will if administered in the spirit in which it was formulated and agreed upon.

The other representative of the public, Frank P. Walsh, is also much encouraged at the outcome. He says:

The plan submitted represents the best thought of capital and labor as to what the policy of our Government with respect to industrial relations during the war ought to be. Representing capital were five of the largest employers in the nation, but one of whom had ever dealt with trade unions, advised and counseled by ex-President Taft, one

of the world's proved great administrators and of the very highest American type of manhood. The representatives of the unions upon the board were the national officers of unions engaged in war production and numbering in their ranks considerably over one million men and women.

The principles declared might be called an industrial chart for the government securing to the employer maximum production, and to the worker the strongest guarantee of his right to organization and the healthy growth of the principles of democracy as applied to industry, as well as the highest protection of his economic welfare while the war for human liberty everywhere is being waged. If the plan is adopted by the government I am satisfied that there will be a ready and hearty acquiescence therein by the employers and workers of the country so that the volume of production may flow with the maximum of fruitfulness and speed. This is absolutely essential to an early victory. The industrial army, both planners and workers, which are but other names for employers and employees, is second only in importance and necessity to our forces in the theater of war. Their loyal coöperation and enthusiastic effort will win the war.

Along this line it is gratifying to find these principles being applied by the Shipbuilding Labor Adjustment Board, which is endeavoring to prevent the shifting now going on from yard to yard. One of the means of accomplishing this is the standardizing of wages in practically all of the yards on the north Atlantic coast. Wage increases have been made, though not to the extent asked, and a 60-hour week is placed as the maximum time. The adoption of two and three shifts of eight hours each is recommended as the most efficient.

The Recent Labor Agreement

By Loyall A. Osborne

Vice President of the Westinghouse Electric & Manufacturing Co., and chairman of the executive committee of the National Industrial Conference Board

The significance of the agreement reached by the commission of employers and employees lies in the fact that in the face of a great national emergency two groups whose views have been popularly believed to be irreconcilable have met and by discussion and concession agreed upon a program that fully protects not alone the legal rights of both groups but the cherished principles for which they have most tenaciously contended.

The cardinal principle upon which the commission proceeded in its deliberations was that there must be no interruption to the production of war essentials by acts to prevent which lay within the control of either employer or employee. This meant that for the period of the war there should be no lockouts or strikes.

If labor is to relinquish the principal weapon by which it has heretofore secured compliance with its demands it becomes necessary that there be created a tribunal through which both the worker and the employer should be guaranteed that every just grievance should have a hearing and be settled fairly and in accordance with a body of agreed-upon principles. This, I believe, the program insures.

If the leaders of labor throughout the country are, as I believe them to be, of the same high-minded and patriotic type as their representatives with whom I had the honor and good fortune to sit in conference I am sure there will be no difficulty that the machinery provided cannot compose with impartial justice to all.

Speaking for the employers I am confident that they will wholeheartedly support the program agreed upon by their representatives. I have construed my presence on the commission and my agreement to the program as a pledge of the great national associations of manufacturers represented on the National Industrial Conference Board, which sent me there, that employers will observe the letter and spirit of the understanding.

I cannot express too highly my appreciation of the invaluable services rendered to the commission by the representatives of the public, ex-President Taft and Frank P. Walsh. Their council was of the utmost value to the other members in all of the difficult and complex questions that were the subject of discussion.

Second only to the army of our brave fighting men is our great productive industry, and if we can maintain a condition of industrial peace at home through the medium of the agreement now reached, as I firmly believe we can, no American need doubt the successful outcome of our national effort.

Unnecessary Marking of Tools, Etc.

In these days of strenuous endeavor to keep manufacturers supplied with milling cutters, special reamers and tools of various kinds, anything which delays the production of these tools is felt clear down the line. One of the delays is caused by the unnecessary marking which is called for in many cases.

It is of course very convenient to have the life history of a cutter marked on its side so as to obviate any excuse on the part of the user for his mistakes. But when these markings run into a dissertation which includes symbols and a long pedigree it becomes a serious matter for the cutter maker. This is particularly true of small cutters and similar tools.

The usual method of marking is by stamping before grinding, but it is not always easy to stamp deep enough to allow for grinding after the change in shape due to hardening. Another method is to etch after hardening and grinding. Each method has its good points, but in any case the least put on the better.

Sometimes when the attention of the customer has been called to the drawbacks entailed in elaborate marking much of the lettering can be eliminated. By carefully considering the matter and only asking for such lettering as may be necessary the delivery of tools and cutters can be expedited to a great extent.

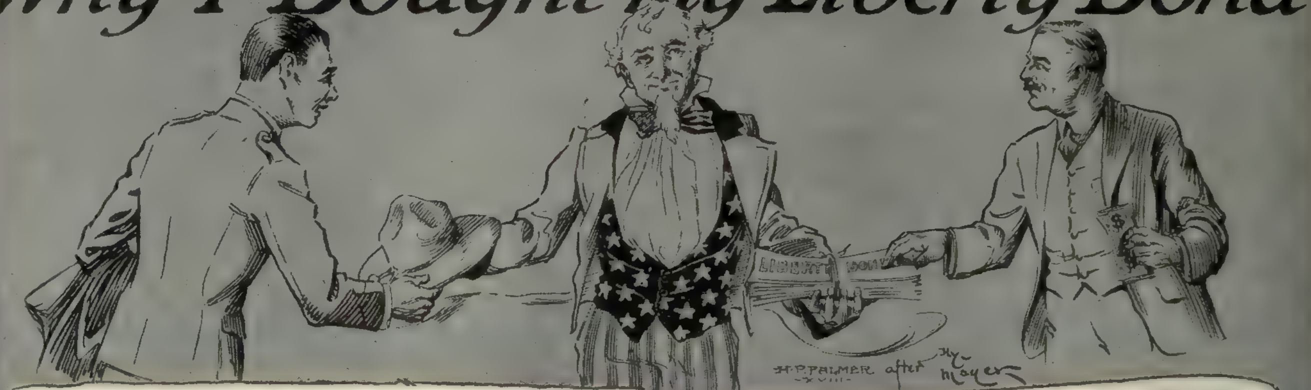
Any suggestions that will assist in overcoming this difficulty will be appreciated by the cutter makers.

Setting a Taper Attachment by Means of a Dial Indicator

By William S. Rowell

Lest someone should follow Mr. Watson's method of setting a taper attachment, or compound rest, as described on page 501 of the *American Machinist*, and regret it the writer would say: The setting must be to the tangent of half the included angle and not to the sine, the radius being the distance between measuring points. It may be said that the difference between sine and tangent is slight in such tapers as the Morse and even Briggs pipe tapers; but it is always best to start right (there will be opportunity enough to go wrong), and in a taper of 3 in. to the foot, there is a difference of almost 0.002 in. for each inch in length.

Why I Bought my Liberty Bond



Why I Buy Liberty Bonds

A composite letter from six Cleveland shop men, one of them a naturalized German.

The country needs the money and I do not consider that I am doing it a favor in buying bonds. I am merely protecting my own interests, for if the Government is not upheld, where are we?

I am willing to lend the money without interest or to give it to the Government to help win the war. I must help the country as I should not feel comfortable unless I was doing my part.

ROB'T B. ALTER, — HENRY LUERS, — A. E. ROBINSON,

THE AMERICAN TOOL WORKS COMPANY.

BUILDERS OF

LATHES - PLANERS - SHAPERS - RADIAL DRILLS.

CABLE ADDRESS "LATHE CINCINNATI"
CODES USED

CINCINNATI, U.S.A
March 19, 1918.

American Machinist,
10th Ave. & 36th St.,
New York City.

Gentlemen:

In your letter of March 12th you ask me to state "Why I Bought Liberty Bonds" - the reasons are so numerous that I hardly know where to begin. Some one has stated that if the American Flag is good enough to live under, it is good enough to fight for, and I might add that it is quite good enough to work for and to buy for, or to do anything that is requested by our country.

Those of us who cannot go to the front and fight and give our blood and our lives, should do every other necessary thing - especially should we buy all of the Liberty Bonds that we can possibly afford, because modern war is perhaps more one of money and resources than it is of guns and bayonets.

The success of every Liberty Loan is an absolute necessity, and every business man who has any thought for the future must now so thoroughly realize this, that he will subscribe to the limit, for should the war be lost to the Allies, our lives, our homes and our business will be worth little.

Sincerely yours,

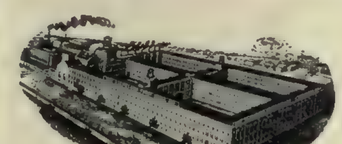
J. B. Doan
PRES'T & GEN'L MANAGER
THE AMERICAN TOOL WORKS CO.

JBD-EB

J. D. COX, President & General Manager
F. F. PRENTISS, 1st Vice President
S. H. COX, 2nd Vice President

ESTABLISHED 1874
INCORPORATED 1904

JACOB D. COX, JR. 3rd Vice President
E. G. BUCKWELL, Secretary
GEO. F. HAST, Treasurer



THE CLEVELAND TWIST DRILL COMPANY.
EAST 49TH STREET AND LAKESIDE AVENUE

NEW YORK SALESROOMS 30 READE ST
CHICAGO SALESROOMS 9 NORTH JEFFERSON ST

TRADE (C) MARK

KINDLY REPLY FOR ATTENTION OF

CLEVELAND, OHIO, U.S.A.
March 23rd, 1918.

Mr. Fred n. Colvin,
American Machinist,
New York City.

Dear Sir:

My reason for buying Liberty Bonds was because I considered the rights and privileges enjoyed in the past by all Americans were threatened by the most ruthless military machine the world has ever produced.

We are sending our sons to the trenches to fight this ruthless military tyrant. These sons must have every kind of equipment necessary to carry on decisive warfare.

To get this vast equipment in the short time needed, requires the expenditure of large sums of money. Uncle Sam is going to furnish this money, and procure this equipment to properly arm our sons to defend our rights, but he can only do this by borrowing from us thru the medium of selling government bonds (or Liberty Bonds). Uncle Sam absolutely guarantees the payment as well as a liberal interest on these bonds.

Everyone enjoying our American privileges should be doing one of three things - he should be in the army; helping to finance the war; or, making something needed by our fighting sons.

Yours very truly,

E. G. Peck
GEN. SUPT.

FHR

THE BLANCHARD MACHINE COMPANY
MECHANICAL ENGINEERS
AND MACHINISTS
64 STATE STREET, CAMBRIDGE, MASS.

March 15, 1918

American Machinist,
10th Ave. & 36th St.,
New York City.

Why I Bought My Liberty Bonds.

Gentlemen: Attention Mr. Colvin.

I wanted to go across with the boys, but was rejected and so am "doing my bit" by buying two Liberty Bonds, because I thought that was the best way that I could help "Win the War."

Yours truly,

Ernest Watt

Editorials

A Machine-Tool Program Needed

The machine-tool situation is far from satisfactory. The machine-tool shops are not all as busy as they should be in view of the tremendous demands that are sure to be made upon them a little later. And all because no definite machine-tool program has been adopted.

When the aircraft program was decided upon the question of machine-tool equipment for the shops was one of the first matters that received attention. Builders of machine tools for making aircraft engines and planes were overwhelmed with orders. The demand for cylinder grinders, for example, was so great that the existing plants could not meet the deliveries demanded and new arrangements were made for manufacturing them elsewhere.

Unfortunately the demands were not well considered in all cases, and there are a number of airplane-engine shops in which weeks after delivery these machines have not yet been unboxed. These delays are doubly unfortunate because they not only mean a longer wait for fighting machines but they also shake the confidence of the machine builders when future demands will be made.

* * *

Similarly the new gun program is full of possibilities for disappointment. The situation in brief is that a large number of heavy-caliber guns are to be made during the next two years. The machinery for making them is not yet in existence except as it may be released by the completion of contracts under way. Up to now hardly any orders have been placed for large lathes and other machines, which will require from six to nine months to build.

* * *

The need of a machine-tool program is apparent, for machines are the basis of all manufacturing. A program should be worked out at once. A conference between those who know the kind of guns to be made and the machine-tool builders or representative engineers who understand the situation would do much to straighten out the difficulty.

* * *

The object should be to establish a machine-tool reserve so that a part of the machines produced would be available when needed. The nonexistence of this reserve has caused the uneconomical rush and confusion which resulted from the pressing demands of the aircraft program already mentioned.

Knowing the gun program in a general way a conference could determine upon an appropriate program for the building of the needed machine tools even before the orders are placed for the guns.

Orders should be placed for lathes, boring mills, milling machines, planing machines and other requisite machines. These could easily go into a general reserve to be drawn on as occasion demanded. They could be held in the city where made until it is known where they are to go and so avoid needless transportation.

Such a reserve of machine tools would facilitate gun and other production, and the placing of orders now would prevent the disorganization of the working forces of the machine-tool shops. It would also prevent the undue shifting of labor, the congesting of railways and promote the stabilization of industry in general.

With such a reserve—the whole being tabulated the same as the machine-tool section of the Council of National Defense now records the available machine-tool supply—any contractor could begin work the moment he is called upon.

* * *

What if the exact size of machine that would ordinarily be used was not available? What if the job could swing on a 9-ft. boring-mill table when there were only 10 or 11 ft. mills in the reserve? A small waste of money perhaps, but not to be compared with the waste of human life and the waste of money caused by delay in suppying the machines.

* * *

The machine-tool program thus delineated will do much toward winning the war. A suitable machine-tool reserve will speed the production of guns and other munitions and even accelerate the building of ships. It will help to stabilize industry, discourage speculation and prevent disorganization and the ills that accompany it.

No time should be lost. Every hour delays our full participation in the war, and our full strength is sorely needed.

The Gisholt Idea

We have long known of the need for trained men in our shops, but few of us have had the vision to see that the first requirement was to have a definite plan for training the men who must instruct them. And yet the trained instructors are an absolute necessity if we are to have the industrial army of skilled men which we need.

* * *

A method of training instruction for shop men, for machine operators, repair men and tool setters, for tool layout men and estimators is outlined in the first article in this issue. The details of the method will follow in a later issue. The first article attempts to show the principles involved, but these are so intangible in many ways, though no less real on that account, as to make them more or less difficult for the man who has not kept pace with modern developments in this line to understand and fully appreciate them.

There is no question as to the need of such training, and we trust that the method outlined may receive the careful study it deserves.

The CHIEF of ORDNANCE and DIVISION HEADS

Shop Equipment News

New Britain Tote-Box Rack

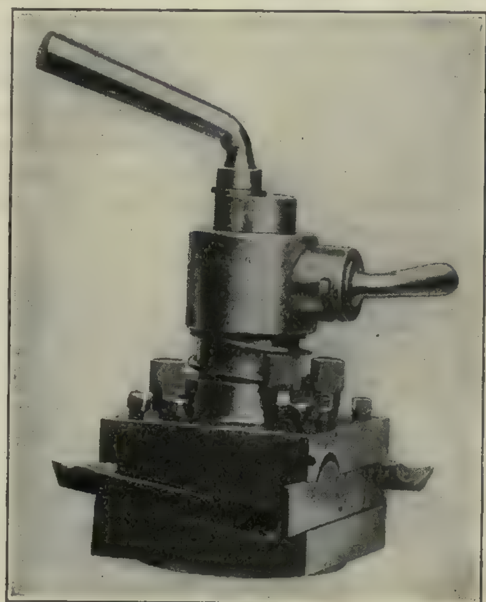
In answer to a demand for a rack to accommodate the tote boxes manufactured by this company the New Britain Machine Co., New Britain, Conn., has placed on the market the tote-box rack here illustrated. It is claimed that the construction is such as to make the rack comparatively light in weight, but to afford ample stiffness to withstand any load that may be placed in it. The front uprights are of flat steel, the rear uprights are angles, while the runners upon which the boxes slide are angles electrically welded to the uprights. These welded members are connected by cross-ties at the front, the back being closed in and stiffened by sheets bolted to the angle uprights. The rack shown is a standard unit, but may be expanded horizontally as desired, and upon special order can be built to accommodate a larger number of boxes in each tier. A particular feature of the rack is that when a box is pulled out and allowed to sag slightly the rear end will come in contact with the front cross-tie, permitting loading or unloading in this exposed position without danger of the box sliding out. The racks are shipped either assembled or knocked down. The rack is built for two sizes of boxes, 16 x 10 x 5 in. and 20 x 12 x 6 in.

NEW BRITAIN TOTE-BOX RACK

Rack for 6 x 10 x 5-in. boxes: Height of 6-box section, 3 ft. 11 in.; width of 6-box section, $11\frac{3}{8}$ in.; depth from front to back, 18 in.; distance from lower box to floor, 4 in.; height of box space, 7 in.; width of box space, $10\frac{7}{8}$ in. Rack for 20 x 12 x 6-in. boxes; height of 6-box section, 4 ft. 5 in.; width of 6-box section, $13\frac{3}{8}$ in.; depth from front to back, $22\frac{3}{4}$ in.; distance from lower box to floor, 4 in.; height of box space, 8 in.; width of box space, $12\frac{7}{8}$ in.

Craig & Coffman Turret Toolpost

The illustration shows a turret toolpost that is now being marketed by Craig & Coffman, 3714 Flora Ave., Kansas City, Mo. The device is made in two standard sizes. but can be had in larger sizes on special order. The larger size, No. $3\frac{1}{2}$, is $3\frac{1}{2}$ in. square and carries three $\frac{3}{8}$-in. square cutters and one $\frac{3}{4}$-in. standard cutting-off plate. The No. $2\frac{1}{2}$ toolpost is for bench lathes and is $2\frac{1}{2}$ in. square, carrying three $\frac{1}{4}$-in. square cutters and one $\frac{1}{2}$-in. cutting-off plate. The object of this tool is to place in a convenient manner the four essential lathe tools—roughing, finishing, threading and cutting off—as well as to make possible the rapid production of duplicate parts. The large parts are steel forgings, the wedging keys are brass, the tool carrier is tempered and ground, the cutting-off block is of nickel-chrome steel and the vertical adjusting screws and indexing pin are of tempered drill rod. Each of the four tools has an independent vertical adjustment of $\frac{5}{16}$ in. and the facing tool can be set at any angle to the faceplate while the toolpost stands square with it. Provision is also made for holding a boring bar. The elevating or locking handle comes to a positive stop in both positions, and it is claimed that the operator cannot injure the locking mechanism. Three taper wedging keys form a positive lock between the inner post and the revolving carrier, the wear on the wedging keys being automatically taken up.



CRAIG & COFFMAN TURRET TOOLPOST

The advantages claimed for the device are as follows: Four tools on the lathe ready for use, only one wrench needed, vertical adjustment secured without tools, cutting tool can be adjusted without stopping the lathe, accuracy and permanency of vertical adjustment, and the additional feature that the tool may be brought close to the chuck without bent or special cutters.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., April 15, 1918—Probably one of the most difficult problems before the various branches of the War Department at present is that of securing a sufficient number of inspectors with enough mechanical experience to handle their work intelligently and avoid unnecessary delay in output.

Every manufacturer knows how hard it is to secure the right kind of men, and this is particularly true when they must be had in large numbers and to inspect work with which they are not familiar. If, however, the men have a fair amount of what may be called mechanical sense, so that they can distinguish between a case that is good enough for its purpose and one that is not, even though the first does not comply exactly with the specifications, the situation is greatly relieved.

If inspectors can be taught that it is their particular job to pass all material which will serve the purpose of the piece required instead of thinking that it is their duty to reject everything possible it will be very much better for all concerned. There are many things on which inspection of every part is entirely unnecessary. If the completed machine, instrument or device will function it is sufficient evidence in many cases that the parts must be satisfactory.

A case in point is the inspection of magnetic compasses, which are very badly needed. Telegrams, long-distance telephone calls and letters, all urge an increase of production, and yet the output is being delayed by unnecessary inspection. When an inspector who evidently never saw the inside of a shop before demands to inspect every piece of material before it is made up, who measures the brass with a micrometer and then *feels* it to see if it can be drawn without cracking, it is something of a joke to the shop man. And, to cap the climax, when he takes from eight to ten times as long as necessary to test the completed article and winds up by sealing a magnetic compass with *iron* wire the comedy is about complete.

Another instance is where special attachments were being made for lathes to go in motor-truck repair shops. The inspector insisted upon measuring every piece with a micrometer, and on holding them to absurd limits—pieces, mark you, that did not affect the operation of the device in the least. It so happened that the lathe on which these attachments go were inspected by a practical man who, knowing that no precision work was expected of them, simply looked them over to see that the head and tail spindles lined up, that the cross-slide was square within reasonable limits and that the lathe ran well under power. The situation became so bad that the makers of these attachments protested at the delay and expense of the needless inspection, with the result that a real inspector is now on the job, and the work is going along very smoothly.

The effect of all this is that many manufacturers are preparing to submit two sets of bids for all future work. One bid will cover inspection of the satisfactory performance of the completed article, and the other the parts inspection which is now demanded and which, together with the many delays occasioned by having the inspector in the way of the workmen, adds considerably more to the cost. It can easily be seen which price will be the lowest.

The Browning Machine Gun

By Edgar Park Valentine

[The author of this description of the new Browning gun is 11 years of age and delivered it to his class in the Horace Mann School. The fact that the action of an automatic rifle can be so clearly described by a boy of this age speaks volumes for the simplicity of the gun as well as reflecting great credit on the mechanical grasp of the author's mind.—Editor.]

"For several years the United States Government has used to some extent the Colt automatic machine gun made by the Colt Firearms Co. and the Marlin Arms Co. These two companies supplied the Colt machine gun to Russia, France, England, United States, etc. It happened that Mr. Browning had invented the Colt gun and was working on two new types which he thought would meet more demands. Lately the United States decided to test his finished models, which was done on Feb. 27, 1918, in Washington, D. C. The test proved the guns more than successful. The heavy type was capable of firing 540 shots a minute, or 9 a second, which excelled all other records. This Browning gun is water cooled. To start the gun firing you pull the trigger which shoots the bullet. When the bullet is fired its gases act upon the piston which is turned to the end of the belt crank lever. The piston receives a sharp impulse from the gases coming through the port, and this in turn is imparted to the lever which is swung downward and backward through a considerable arc. It is this rotary motion which serves to operate a train of levers, rods, spring and a feed wheel, all working in harmony in the functioning of the gun mechanism. When the cartridge wheel turns it draws in the canvas belt that contains the cartridges into what they call the maw of a gun, or the place where the cartridges go in. When the cartridges pass into the gun they are

extracted from the canvas belt by the cartridge extractor. They are then delivered to the carrier, which in turn raises them to the chamber position then the bolt is drawn into place, closing the cartridge chamber, and the gun is ready to fire. Then the piston hammer is thrown forward through the agency of its spring. It hits a pin running through the bolt, which fires the bullet. Ejection of the used cartridge is performed by the ejector which projects on the path of the fired case, and the cycle of operation is renewed.

"The light type of Browning gun is air cooled and has much the same mechanism as the heavy type, only it is smaller and much lighter and fires 10 shots a second. Each magazine contains 20 shots and the gun is raised to the shoulder like a rifle.

"The Browning gun is not used on aircraft. Both the Marlin and Lewis aircraft guns are used for that branch and have proved very successful and effective."

Soldier Guards at Plants

The Secretary of War authorizes publication of the following memorandum prepared for the General Staff concerning the use of armed guards about industrial plants as a protection against incendiarism and alien-enemy activities.

The soldier in training who has offered his life for the defence of country should not sacrifice his effectiveness by performing police duty in the protection of property back of the line. This is the duty of the citizen at home. The theater of operations for armed soldiers is the battlefield of Europe. Each civilian should aid his country by acting as a guard for the detection and prevention of intrigue, deceit and all the familiar stealthy operations of the enemy in our midst. Each soldier unnecessarily detained as a guard in this country aids and abets the enemy in Europe.

What does this country need in the way of plant protection? Many manufacturers do not seem to know. The Government of the United States is making every effort to train the army of the United States and place it on the French front in contact with the enemy. No man among us wants men of the national army withdrawn from training camps for the purpose of guarding factories. Often a guard may be needed for the safety of the factory. When it is, it should be supplied by the owner of the factory, by the municipality or by the state. The man who has been given the opportunity to fight the enemy in France should not be called back nor held in this country for any purpose other than the necessary military training.

Real Danger Is Within the Plant

Recent events have shown that the greatest danger is from within, and it is from within that the movement for protection must come. To surround a plant with a cordon of guards may at first seem proper and desirable. But the soldier in uniform on a fixed beat can be avoided like most other fixed obstacles, and the real danger is the concealed lurker within the plant itself. The man who is really dangerous passes through this cordon of soldiers with the consent, the approval, often at the request, of the owners of the plants. Such a condition renders the guard useless unless augmented by interior watchfulness.

After careful investigation the officers of the Intelligence Department of the army and agents of the Department of Justice are a unit in advising that certain measures of internal protection be adopted by each company. These measures are summarized briefly as follows:

Special Officer Recommended

Each factory should have a superintendent of personnel and plant protection, with these functions:

1. Each day, and if possible more than once a day, he should make or direct to be made a minute examination of the plant from roof to cellar, and especially those seldom visited places where an intruder might lurk or where an accumulation of inflammable material or waste might be thrown. This general inspection is of the greatest importance, and should be supplemented by the floor bosses and sub-bosses, the senior in charge making a detailed inspection of his floor and reporting to the personnel and plant-protection officer at frequent intervals and always at the beginning and end of the day and at noon.

2. A careful scrutiny should be made of the workers as they enter in the morning and leave at night, and particular attention should be paid to those leaving at odd hours. All should be provided with signed identification cards or other device, supplemented by signed cards, alphabetically arranged, the loss of which should cause the man to be discharged.

3. The personnel and plant-protection officer should tabulate or card catalog the employees to an extent sufficient to enable him to know who are the really loyal citizens as distinguished from those who are possible sources of danger.

4. In discovering the would-be mischief maker no help can be so effective as that of the loyal employee. To this end the personnel officer should as quickly as possible enlist the services of the more intelligent and unquestionably loyal, especially those who have sons or other relatives in the army. It should be made clear to them that in guarding the factory in which they work they are rendering to the country a service of equal importance and greater effectiveness than that rendered by sentries on guard.

Protective measures along these lines are within the reach of each plant relying upon its own resources. They do not in the least preclude the employment of such guards as may seem advisable outside of the works, but in the opinion of experts they do to a large extent obviate the necessity for such guards.

It may be objected that such an organization as outlined will add to the legitimate cost of production. But aside from any question of our patriotic duty to keep the output of all materials at its highest pitch and to preserve every resource of the country for the use of ourselves and of the nation associated with us in the war it is clear that the expenditures would probably be less than the increase in fire-insurance rates which will inevitably follow the destruction of plants through carelessness or other causes. The great losses by fire may be laid to preventable fires.

The continuation of this plan upon our return to peace will convert an annual potential loss into a potential gain. These measures apply not only to manufacturing plants but are equally applicable to shipyards, grain elevators and stores of supplies.

Personals

Herbert Longstaff is now manager of the St. Louis office of the Boatman's Bank Building of the Asbestos Metal Co. of Pittsburgh, Penn.

Charles L. Wood has been promoted to assistant general manager of sales in charge of the bureau of bars and hoops of the Carnegie Steel Co.

W. T. Bohn, formerly employment manager of the Alluminum Castings Co. of Cleveland, has been elected secretary of the Founders' Association of Cleveland.

Daniel Bloomfield is now at the head of the Industrial Service Department, Division of General Service, Emergency Fleet Corporation of the United States Shipping Board.

Whiting Williams, who was formerly secretary of the Cleveland Welfare Federation, has been placed in charge of the welfare work of the three Cleveland plants of the Hydraulic Pressed Steel Co.

John W. Higgins, president of the Worcester Pressed Steel Co., Worcester, Mass., was recently elected president of the New England Safety Council at its annual meeting in Boston, Mass., Mar. 21.

Fred H. Cozzens, formerly manager of export sales of the Four Wheel Drive Automobile Co., Summitville, Wis., has resigned to become vice president and general manager of the Topp-Stewart Tractor Co.

William G. Clyde has been promoted to the vice presidency and general manager of sales of the Carnegie Steel Co. Mr. Clyde by the promotion has also become a member of the board of directors of the company.

D. B. Clark, formerly superintendent of the shell department of the American Brake Shoe and Foundry, Co., Erie, Penn. is now general superintendent of the Watervliet Arsenal, Watervliet, N. Y. Mr. Clark has charge of the entire production of the plant.

Robert E. Frame for six years assistant to the president of the Haskell & Barker Car Co., Michigan City, Ind., resigned on Mar. 1 and has been elected vice president of the Hutchins Tar Roofing Co., Detroit, Mich.

A. W. Henn was elected president of the National Acme Co., Cleveland, Ohio, at a recent annual meeting of the directors, succeeding **W. D. B. Alexander,** who was made chairman of the board. **E. C. Henn** was re-elected vice president and **N. S. Rathburn** was elected secretary.

E. E. Adams, formerly consulting engineer, and **F. Fercombe,** formerly assistant controller of the Union Pacific R. R., have been appointed assistants to **R. M. Livett,** director of the division of capital expenditure of the United States Railroad Administration at Washington.

H. T. Bentley, superintendent of motive power and machinery of the Chicago & Northwestern R. R., has been requested to join the staff of the Director General of Railroads at Washington, D. C. Mr. Bentley has obtained leave of absence for an indefinite period.

W. O. Duntley has resigned from the presidency of the Chicago Pneumatic Tool Co., Chicago, after 22 years of service. He will devote his time hereafter to his private affairs, but will continue as a director and member of the executive committee of the company. **Jacob L. Price** succeeds Mr. Duntley as president.

The Marion Machine Foundry and Supply Co. has taken over the entire business, goodwill, patents, patterns and drawings of the Planet Steam Specialty Co. The line of soot blowers for all kinds of water-tube boilers made by the Planet Co. will be still further developed and adapted to all types of boilers.

Col. Henry T. Bope has resigned his position as vice president and general manager of sales with the Carnegie Steel Co. to devote his time to private interests. Colonel Bope became connected with Carnegie Brothers & Co. in 1879 and has remained continuously in the sales work of that company and its successors up to the present time.

J. E. A. Moore, 1900 Euclid Building, Cleveland, Ohio, announces that he will continue the engineering practice now carried on under the partnership of Marain Moore. Mr. Moore will give particular attention to various lines of engineering plants, their operation and equipment, special process of development and design, conveying, elevating and special machinery, steel construction, etc.

A. W. Wheatley for the past two years at the head of the Lima Locomotive Corporation, Lima, Ohio, will retire from active management of that company, but for the present will retain his office as president and member of the board of directors. **W. L. Reid,** Schenectady, N. Y., formerly superintendent of the Baldwin Locomotive Co.'s plant, has become connected with the Lima Locomotive Co. as vice president in charge of manufacture. Mr. Reid and **L. A. Larsen,** secretary and treasurer, and assistant to the president, will have active control of the plant.

Business Items

The Willard Press and Tool Co., 512 Reading Rd., Cincinnati, Ohio, has been formed to manufacture the punch presses and dividing heads formerly built by the Willard Machine Tool Co. **G. Mattman** is president, **Thomas L. Bratten** is secretary and treasurer and **George W. Schaefer** is vice president and general manager.

The E. J. Flather Manufacturing Co., Inc., at a recent stock holders' meeting changed the name of the corporation to the Flather Manufacturing Co. E. J. Flather is retiring from the active management, but will continue with the company as consulting engineer. **H. E. Flather** was elected president and **Edwin Morey** was elected treasurer.

Grants Pass Iron and Steel Works has been moved to Kalmath Falls, Ore., and has been reorganized and reincorporated under the name of Kalmath Iron and Steel Works with a capital stock of $20,000 to do a general foundry and machine business. **H. D. Mortenson** is president, **J. W. Fitzpatrick** secretary and treasurer, and **B. M. Hall** general manager. The company will be in the market for machinery and tools at an early date.

Trade Catalogs

The Good Active Cone Belt Shifter. Nils E. Goodactive, Chicago, Ill. Loose-leaf catalog, ½ x 10 in.; illustrated.

Saving the Overtime. The Adder Machine Co., Wilkes-Barre, Penn. Booklet. Pp. 8; 3½ x 9 in.; describing the Wales adding machine.

I. & C. Gage Standards. Ibsen & Co., 404 Keefe Ave., Milwaukee, Wis. Pamphlet. Pp. 8; 6 x 9 in. This pamphlet illustrates and describes a number of gage standards in sets 1 to 5 and several special sets.

Lighting for Production and Safety. Cooper Hewitt Electric Co., Eighth and Grand Sts., Hoboken, N. J. Booklet, 7 x 10 in. Gives a number of illustrations and shows various lighting plans of a number of large factories.

King Pressure Toggle. R. D. King, Monadnock Block, Chicago, Ill. Four-page leaflet describing and illustrating a permanent attachment for punch presses for metal drawing, bending, forming or any other operations where a spring is used for the operation.

History. Greenfield Tap and Die Corporation, Greenfield, Mass. Booklet, p. 24; 6¾ x 9¼ in.; illustrated. Issued by the corporation on the occasion of the formal opening of the administrative building, Mar. 5, 1918, and gives a historical sketch of the development of the corporation since 1872.

New Publications

Precision Grinding Machines—By Thomas R. Shaw. Two hundred and fifteen pages and one hundred and seventy illustrations; published by Scott, Greenwood & Son, London, England. Price, 10s. 6d.

This book sets forth the importance and advantages of grinding, in a clear and concise manner. In speaking of the genesis of cylindrical grinding machines, credit for the original design is justly given to J. R. Brown of Providence, R. I. The illustrations show a large variety of grinding machines and attachments of both American and English make, and the text fully describes the use of such machines. It also contains some very good instructions as to erection and leveling and the use of abrasive wheels of different grades and grits. It is surprising in a work of this kind that no reference is made to grinding machines for small delicate work such as the Rivett type. While the arrangement of the illustrations in relation to the text might be improved, the book should prove a very valuable one to the works manager as well as to the grinding-machine operator.

Forthcoming Meetings

The American Gear Manufacturers' Association will hold its second annual convention at White Sulphur Springs, W. Va., Apr. 18, 19 and 20, with headquarters at the Green Brier Hotel. The secretary is F. D. Hamlin of the Earle Gear and Machine Co., 4701 Stenton Ave., Philadelphia, Penn.

American Society of Mechanical Engineers. Monthly meeting, second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers. Spring meeting at Worcester, Mass., June 4, 5, 6 and 7, with headquarters at the Hotel Bancroft.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Foreign Trade Council Conference will be held in Cincinnati at the Gibson Hotel, Apr. 18, 19 and 20. Apply for reservations to O. K. Davis, secretary, 1 Hanover Square, New York City. The general chairman is Robert S. Alter.

The National Gas Engine Association will hold its eleventh annual meeting at the Hotel Sherman, Chicago, Ill., June 3 and 4. The headquarters of the association are at Lakemont, N. Y.

The spring convention of the National Machine Tool Builders' Association for 1918 will be held Thursday and Friday, May 16 and 17, at the Marlborough-Blenheim Hotel, Atlantic City, N. J. Charles L. Taylor of Hartford, Conn., is secretary.

The National Metal Trades Association announces the following program of its forthcoming convention, which will be held at the Hotel Astor, New York City: Monday, Apr. 22, 10 a.m., executive committee meeting; 7 p.m., secretaries' dinner. Tuesday, Apr. 23, 10 a.m. to 5 p.m., council meeting; 10 a.m., meeting of local secretaries; 6:45 p.m., alumni dinner. Wednesday, Apr. 24, 9:30 a.m. and 2 p.m., convention; 12:30 p.m., buffet luncheon; 7 p.m., banquet. Thursday, Apr. 25, 9:30 a.m., and 2 p.m., convention and meeting of the incoming administrative council. Homer D. Sayre, People's Gas Building, Chicago, Ill., is the secretary.

A joint convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held at Cleveland, Ohio, May 15-17. Among the important subjects to come up for action will be Government control of fuel, transportation and shipping of materials and price fixing. The coöperation of labor in war activities will also be discussed at length.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

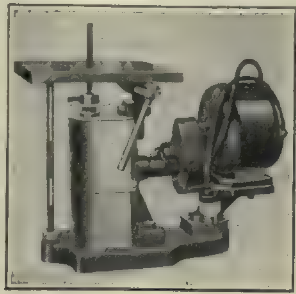
Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Filing Machine, Twentieth Century, No. 1

W. F. Davis Machine Tool Co., 85 Liberty St., New York City

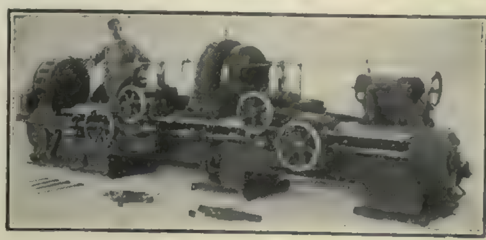


"American Machinist," Mar. 28, 1918

This machine is built for either belt or motor drive. The table may be quickly adjusted and locked at any angle. Weight with belt drive, 65 lb.; height from bench to top of table, 13 in.; size of table, 10 x $8\frac{1}{2}$ in.; hole in table, $\frac{5}{8}$ in., spindle, $\frac{3}{4}$ in. square; hole in spindle, $\frac{3}{8}$ in.; stroke, 0 to 2 in.; strokes per minute, 500.

Lathe, Axle No. 3

Niles-Bement-Pond Co., 111 Broadway, New York City.



"American Machinist," Apr. 4. 1918

Swing over bed shears, $30\frac{1}{2}$ in.; swing over tool slide, 13 in.; diameter of hole in driving head, 13 in.; maximum distance between centers, 9 ft. 3 in.; length of bed, 14 ft.; width of bed at shears, $27\frac{1}{2}$ in.; depth of bed over shears, $19\frac{5}{8}$ in.; diameter of tailstock spindles, 5 in.; traverse of right spindle, 9 in.; bearing of carriages on bed, 30 in.; width of bridge, 12 in.; size of tools, $1\frac{1}{4}$ x $2\frac{1}{2}$ in.; feeds, three, $\frac{1}{16}$, $\frac{3}{32}$ and $\frac{3}{16}$ in. per revolution

Slotting Attachment for Shaping and Planing Machines

Bruno Manufacturing Co., 61 Terrace, Buffalo, N. Y.

"American Machinist," Apr. 4, 1918

A slotting attachment for shaping and planing machines. The tool is bolted to the clapper in place of the toolpost, allowing the use of a very short, stiff cutting tool, as no projecting toolpost is in the way to necessitate the use of a long, slender tool. The device can be turned in any position to make is convenient for the style or type of work that is being done. Made in three sizes: No. 0, taking tools with shanks from $\frac{3}{8}$ to $\frac{1}{2}$ in. in diameter; No. 1, taking tools with shanks from $\frac{1}{2}$ to $\frac{5}{8}$ in. in diameter; and No. 2, taking tools from from $\frac{5}{8}$ to $\frac{3}{4}$ in. in diameter.

Nickel, Pure Sheet

Driver-Harris Co., Harrison, N. J.

"American Machinist," Mar. 28, 1918

This company is now in a position to supply pure sheet nickel for commercial use. The superior qualities of pure solid nickel should not be confused with those of metals frequently sold as nickel but which are merely articles of steel, brass or german silver with a thin nickel-plating that in a short time wears through, rendering the ware unsuitable and unsafe for use. The danger of poisoning by verdigris is eliminated in pure nickel, as it does not rust, oxidize or tarnish, as in the case of some alloys. Corrosion cannot occur even where the surface is injured, and this is an advantage over the plated articles. Acids and other tarnish removers used to clean plated and copper food containers, being poisonous, are sources of danger that are also obviated by the use of pure nickel. It requires no replating and abrasions on its surface only serve to brighten the finish.

Toolholder, Bench Lathe

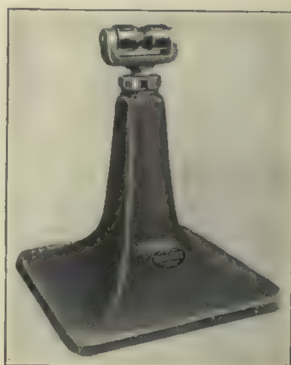
Ready Tool Co., Bridgeport, Conn.

"American Machinist," Mar. 28, 1918

A toolholder especially for bench and watch lathes. It is drop-forged, $\frac{5}{16}$ x $\frac{1}{2}$ x $3\frac{1}{2}$ in. fitted with $\frac{3}{16}$-in. sq. cutter of high-speed steel treated by the Taylor-White process. A wrench is also included as is usual with the larger holders.

Stock Support, Adjustable "Loway"

A. F. Way Co., Inc., Hartford, Conn.

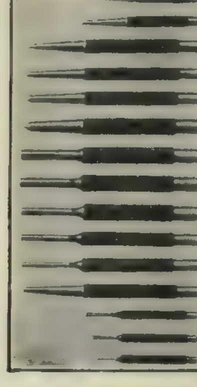


"American Machinist," Apr. 4, 1918

This support is intended for use with hacksaws, screw machines, band and circular sawing machines, bolt cutters, thread-milling machines, pipe-threading machines, rolling mills, etc., and wherever long bar stock, pipe, tubing or other material must be supported. The device is equipped with a base of ample size so that it will not upset, and may be quickly adjusted for height by means of the column screw

Punches, "O. K.", Set No. 15

West Haven Manufacturing Co., New Haven, Conn.



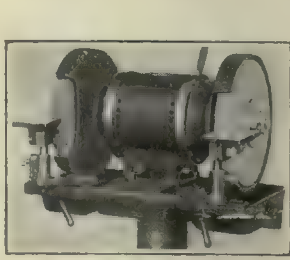
"American Machinist," Apr. 4, 1918

A set of "O. K." brand punches which are being put out in a convenient wood-base case having compartments for each tool. The set contains an assortment of five different sized center punches, eight different sized punches for driving out pins and rivets, one solid drive punch for starting a rivet or pin that starts hard, and one prick punch intended for punching holes through thin metal. Total number of tools in the set, which is known as the company's No. 15, is 15, the largest measuring $\frac{3}{8}$ x 4 in. and the smallest $\frac{3}{16}$ x $2\frac{1}{4}$ in. The punches for driving out pins and rivets vary in size from $\frac{1}{16}$ to $\frac{1}{4}$ in.

Grinding Stand, Motor Driven

Universal Electric Co., 9 Oliver St., Newark, N. J.

"American Machinist," Apr. 4, 1918



This machine is built in both bench and floor types and is equipped with SKF ball bearings. Two 8 x 1-in. wheels are used, which are covered with adjustable guards held by friction produced by spring washers. This enables the operator to turn the guards completely around without loosening screws. The tool rests are adjustable in all directions. The motor is mounted on a baseplate with depressions under each wheel for cooling water. Motors wound for direct current or for two- or three-phase alternating current.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. **Pig** iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Apr. 11, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	$33.00
No. 2 Southern Foundry, Chicago	37.00	33.00	.....
*Bessemer, Pittsburgh	37.25	37.25	38.95
*Basic, Pittsburgh	33.95	33.95	40.00
No. 2X, Philadelphia	33.75	33.75	40.00
*No. 2, Valley	33.95	33.95	38.00
No. 2 Southern Cincinnati	35.90	35.90	35.00
Basic, Eastern Pennsylvania	33.75	33.75	36.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Apr. 11, 1918	One Month Ago	One Year Ago	Apr. 11, 1918	One Year Ago	Apr. 11, 1918	One Year Ago
Structural shapes	$4.195	$4.195	$4.50	$4.20	$4.10	$4.20	$4.50
Soft steel bars	4.095	4.095	4.35	4.20	4.00	4.10	4.25
Soft steel bar shapes	4.095	4.095	4.35	4.20	4.00	4.10	4.25
Plates, ¼ to 1 in. thick	4.445	4.445	6.50	4.20	5.00	4.45	5.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Apr. 11, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.60
Warehouse, New York	4.70	4.25
Warehouse, Cleveland	4.10	4.00
Warehouse, Chicago	4.10	3.90

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Apr. 11, 1918	One Month Ago	One Year Ago	Apr. 11, 1918	One Year Ago	Apr. 11, 1918	One Year Ago
*No. 28 black	5.00	6.445	6.445	7.50	6.385	6.25	6.45	6.25
*No. 26 black	4.90	6.345	6.345	7.40	6.285	6.15	6.35	6.15
*Nos. 22 and 24 black	4.85	6.295	6.295	7.35	6.235	6.10	6.30	6.10
Nos. 18 and 20 black	4.80	6.245	6.245	7.30	6.185	6.05	6.25	6.05
No. 16 blue annealed	4.45	5.645	5.645	6.70	5.585	5.95	5.65	5.95
No. 14 blue annealed	4.35	5.545	5.545	6.60	5.485	5.85	5.55	5.85
No. 10 blue annealed	4.25	5.445	5.445	6.55	5.385	5.80	5.45	5.80
*No. 28 galvanized	6.25	7.695	7.695	6.50	7.635	5.75	7.70	5.75
No. 24 galvanized	5.80	7.245	7.245	9.00	7.335	8.00	7.40	8.00
*No. 26 galvanized	5.95	7.395	7.395	8.70	7.185	7.70	7.40	7.70

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Apr. 11, 1918	One Year Ago
New York	List plus 10%	List plus 25%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Apr. 11, 1918	One Year Ago
New York	$15.00	$9.50
Cleveland	15.00	7.00
Chicago	15.00	8.25

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
⅛ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Apr. 11, 1918	Cleveland Apr. 11, 1918	Chicago Apr. 11, 1918
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel	7.50	8.00	8.25
Spring steel (crucible analysis)	11.00	11.25	11.25
Coppered bessemer rods	7.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel	9.00	8.25	8.25
Floor plates	6.19½	6.00	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Apr. 11, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	34.00
Tin, in 5-ton lots	85.00	85.00	55.00
Lead	7.25	7.25	9.75
Spelter	7.25	7.75	10.75

*Government price.

ST. LOUIS

Lead	7.10	7.10	10.50
Spelter	7.25	7.75	10.75
	7.10	7.10	9.50
	7.12½	7.75	9.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Apr. 11, 1918	One Month Ago	One Year Ago	Apr. 11, 1918	One Year Ago	Apr. 11, 1918	One Year Ago
Copper sheets, base	31.50-33.00	32.00	44.00	35.00	44.00	35.00	43.00
Copper wire (carload lots)	32.00	32.00	39.50	34.00	43.00	34.00	40.00
Brass sheets	30.75	30.75	45.50	30.00	43.00	35.00	43.50
Brass pipe base	36.50	36.50	47.50	41.00	52.00	41.00	47.50
Solder ½ and ½ (case lots)	62.00	62.00	33.88	49.50	33.50	48.00	34.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Apr. 11, 1918	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	35.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Apr. 11, 1918	One Year Ago	Apr. 11, 1918	One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	20.00	23.00	20.50	23.25
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Apr. 11, 1918	One Year Ago
New York	13.00	36.00
Chicago	21.60	37.00
Cleveland	15.75	35.00

The Relining of Guns at the Waterviiet Arsenal

Part One

By E. A. Suverkrop

The average citizen when told that a gun has a life of a given number of rounds imagines that the whole gun is then condemned and becomes scrap after these rounds have been fired. As a matter of fact the tube alone is discarded. Under favorable conditions the body of the gun can be relined again and again without impairment. The methods employed in the relining of guns have heretofore been accessible to the Ordnance Department only. It is with pardonable pride that the "American Machinist" announces that it is the first to place before its readers a full description of this important war economy as practised at the Watervliet arsenal.

After a gun has been fired a number of times the bore becomes so badly eroded that its ballistic qualities are affected, and relining is resorted to for restoring the bore to its original dimensions, thus obtaining again a ballistically new gun. The number of rounds that can be fired before relining is necessary depends on several factors, among which are muzzle velocity, kind of powder used, material of the liner, etc.

An additional effect of the repeated firing of a gun is the appearance of thermal cracks in the bore. If these cracks are allowed to develop unchecked the strength of the gun will be seriously impaired, and this is another reason for relining old guns and for using double tubes in new ones. Attention was called to this aspect of the subject by a board of officers which convened at Watertown arsenal to investigate the cause of rupture of 12-in. gun No. 41, model 1888, MI ½; 10-in. gun No. 55, model 1888, MII, and 8-in. gun, model 1888, No. 1. The board decided that the rupture of the two last-mentioned guns was caused by the presence of thermal cracks in the bore, and recommended that guns disclosing thermal cracks to any extent be relined. It also recommended that in future new guns be constructed with lining tubes for the purpose of limiting the spread of such cracks.

One of the earliest relining operations of which this arsenal has any record is the case of a 10-in. type No. 1 gun, model 1888, which was relined in October, 1905, with a partial liner. This liner was a gun-steel cylinder inserted to a distance of 152 in. from the breech end and terminating at that point in a square abutting shoulder. This liner was inserted under a shrinkage that nearly restored the gun to its original tangential resistance. The liner, for 4 in. at the muzzle end, and the corresponding seat in the gun were knurled to prevent rotation. Four securing spline screws were also inserted at the breech end of the liner. The knurled portion was effective in preventing any rotation of the liner; but after firing the gun there was a visible opening on one side of the securing screws in the breech end of the tube, indicating that the liner had a tendency to rotate. Breech measurements indicated that this liner was off shoulder 0.038 in. when assembled. The relined portion was rifled from the muzzle end, using the grooves and lands of the unlined portion of the bore as guides. The test of this gun was fairly satisfactory except for the contraction of the bore at the point where the forward end of the liner abutted against the gun proper. After firing 84 rounds the diameter of the bore at this point was 0.0115 in. less than the prescribed maximum diameter for the bourrelet of the projectile. This was a dangerous condition, and necessitated reaming out the bore. The contraction was attributed to the longitudinal flow of metal toward the shoulder and indicated the desirability of making such liners as heavy as possible. The conclusion drawn from the test of this partial liner was that it could be considered satisfactory up to 60 rounds.

Relining Work

A 3-in. 15-pounder Driggs-Seabury gun, No. 103, was next relined at this arsenal in October, 1907, with a parallel partial liner extending 57.15 in. from the breech face of the tube. It had a square abutting shoulder at its forward end. The test of this gun with the liner was satisfactory. The breech measurements indicated that this liner was in contact at the shoulder. However, with a 3-in. 15-pounder gun, No. 1, model 1903, which was also relined in October, 1907, with a partial liner extending from the breech end of the tube a distance of 77 in., the contraction at the abutting shoulder was so pronounced that the liner was not considered satisfactory. Measurements indicated that the liner was on its shoulder 0.097 in., that is, it projected from the breech end of the tube 0.097 less than it should had there been shoulder contact.

The first full liner assembled in a gun at Watervliet arsenal was in May, 1908, when 6-in. Vickers-Maxim No. 1031A was relined with a taper liner under shrinkages varying from 0.008 in. at the breech to 0.003 in. at the muzzle end. This liner was successful, and since that time all liners inserted in army guns have been full length with a taper surface. The 6-in. Vickers-Maxim gun was originally constructed with an outer

tube extending the whole length of the gun, into which a tapered liner was driven and held in position by a bushing screwed into the breech end of the gun. This would indicate that the construction was adopted with a view to relining the gun. Although not known positively, it is understood that this liner was inserted first in the tube and the gun built up afterward by wire winding and assembling the necessary hoops. It is understood that other English manufacturers follow this method of construction, which was afterward adopted for army 6-in. guns, model 1908, MI, and 14-in. guns, models 1909 and 1910. The exact taper of the liner in this gun was not known at the arsenal when the work of removing it was begun. The gun was step bored with several reamers, and when the liner had been thinned out it was pulled from its seat by means of the cranes.

The Design of Liners

The principal considerations governing the design of liners are as follows:

1. The amount bored out of the gun for the reception of the liner must be limited so that the remaining part of the tube will not be compressed beyond its limit of elasticity. (Note—In certain cases where no provision was made for relining in the original construction and where the compression of the tube approached closely the elastic limit it has been the practice of the department to permit a compression of 5 per cent. above the prescribed elastic limit in tension.)

2. The part removed from the tube must not leave the gun too weak to withstand ordinary service pressures without the aid of the liner; in other words the curve of resistance of the gun should exceed the service pressure with a cracked liner. Some Navy Department drawings show such a curve.

3. The liner must be thick enough to withstand the longitudinal stresses of elongation and compression. The longitudinal stresses are those caused by: (a) The interior and exterior pressure on the liner; (b) longitudinal component of pressure on the rifling due to the inertia of rotation of the projectile; (c) the friction of the projectile band; (d) recoil of piece; (e) friction of the gases and unconsumed portion of the powder charge; (f) mandrelling effect of the projectile band must be considered, particularly on the section of the forcing slope where the wedging action occurs, and a heavy radial pressure is caused on the bore of the liner over the width of the band while the projectile is moving forward; from calculations this latter effect would appear to be one of the most important. The opposing forces to those just cited are: (a) The elastic tensile resistance of the liner; (b) the friction on the exterior surface of the liner due to pressure from surrounding envelope.

4. The inner fibers of the gun should be placed under approximately the same strain of compression as that given the corresponding fibers in the original gun, thus giving the gun nearly its original tangential resistance. (Note—Where the liner has higher physical properties than the original tube, the original tangential strength, as limited by the liner, is restored by making the sum of the terms $D_o + P_o$ equal to their sum in the original construction, the term D_o being the prescribed elastic limit of the inner member and the term P_o being the radial stress at the bore ($E \times 80$) due to the shrinkage. The tangential strength is obtained from the equation

$$P_o = \frac{3(R_n^2 - R_o^2)}{4R_n^2 + 2R_o^2} \quad (D_o + P_o)$$

As it is desired to keep the P_o constant, an increase in the value of D_o results in a decrease in the value of P_o and therefore a corresponding decrease in the shrinkage to be placed upon the liner. According to reliable information the Vickers-Maxim Co. assembles liners with little or no shrinkage. The United States Navy Department is now using a similar method, the general rule of its designers in this case being to give the liner a shrinkage in thousandths of an inch equal to half the caliber of the bore in inches. A stress considerably beyond the elastic limit is permitted in the liner under the theory that the excessive stress only extends for a small distance into the liner through the interior surface as it decreases rapidly as the distance from the bore increases, and that there is no serious objection to overstressing the interior surface of the liner, which is well supported against actual rupture and which is to be discarded after a limited number of rounds.)

5. Care should be taken to reduce the effect of mandrelling at the forcing cone by keeping the liner as thick as possible at this point. In the early liners this was not understood, and the shoulder was behind the forcing cone. In the tests of these guns the enlargement of the bore at this point was much greater than that anticipated from erosion, and was evidently due to flow of metal muzzleward. In most liners a contraction of the bore due to this cause takes place, the maximum amount being at the muzzle.

6. The number of shoulders on the liner should be reduced to a minimum, as there will be a certain amount of unsupported wall at all shoulders except the contact shoulder. This condition is due to contraction of the liner and the elongation of the gun caused by shrinkage strains.

Ease of Assembling

7. The liner should be constructed with a view to ease in assembling. This is the prime factor in favor of the taper liner adopted by the Ordnance Department, and is a sufficient argument for its adoption in spite of its greater cost. The taper liner does not require nearly so much clearance to assemble as does the cylindrical liner, and as a result less heat is required. For instance, in order to assemble a 12-in. taper liner a heat of 400 to 500 deg. F. is required, whereas to assemble a cylindrical liner in the same gun, under the same shrinkage, a heat of 700 to 800 deg. is required. This is of vital importance in view of the danger incident to a built-up gun heated to high temperatures, for it is well known that the elastic limit of the steel is materially reduced at such heats and parts of the gun under great stress while at rest are liable to collapse under the heat.

Not much difficulty has been encountered in keeping taper liners on their shoulders, while the reverse is the case with cylindrical liners. Built-up guns and liners are particularly susceptible to localized strains when subjected to a change in temperature, which cause bends in the bore and prevent the proper seating of the liner. In this case the liner can be seated only by giving the guns more heat to obtain the proper clearance.

With the taper liner such bends are of minor importance, for contact does not occur until the liner is practically home.

In assembling cylindrical liners at this arsenal the localized gripping caused by such bending has several times necessitated the withdrawal of the liner when it was only a few feet from being home. In these cases a number of burrs are usually raised on the tube, and as these must be removed before making a further attempt to assemble, the operation has to be postponed to a later date, a proceeding which results in the loss of the heat. However, in some of these cases success has been attained by removing the liner and revolving it 90 or 100 deg. and again entering it in the gun. This shows conclusively that the guns bend under the heat, for telltaling and spotting plainly indicate that they were straight before being heated. It is believed that although the liner is cold when inserted it is likewise susceptible to bending on account of the heat of the surrounding gun. In general the bend is a single one, as indicated at the points of rubbing, but in many cases several distinct bends have been noticed. For overcoming this defect a taper liner is most suitable as its exterior diameter gradually reduces and the surfaces do not come in contact soon enough to do any harm.

8. The liner should be constructed with a view to ease of removal when it is worn out. The taper liner has an advantage here, for when once the liner is started from its seat the entire surface is relieved from contact. This arsenal has had considerable experience in removing parts of guns upon which outer hoops and jackets have been shrunk. This has been accomplished by heating the entire gun in the furnace and by suddenly injecting a large amount of cold water into the bore. The resulting contraction of the interior part loosens it enough to allow it to drop from its jackets. This operation, called breaking the shrink, has been used to disassemble parts of guns which were required for use in manufacture; for the removal of hoops which have developed cracks after assembling; for the release of parts of guns, which after having been shrunk together show an overcompression at certain points; for the breaking of the shrinkage when a liner originally assembled has worked away from its shoulder, the intention being in this case to permit the liner to again seat itself in the shoulder; and also in one case for the removal of a liner which became so eroded that a replacing liner was necessary.

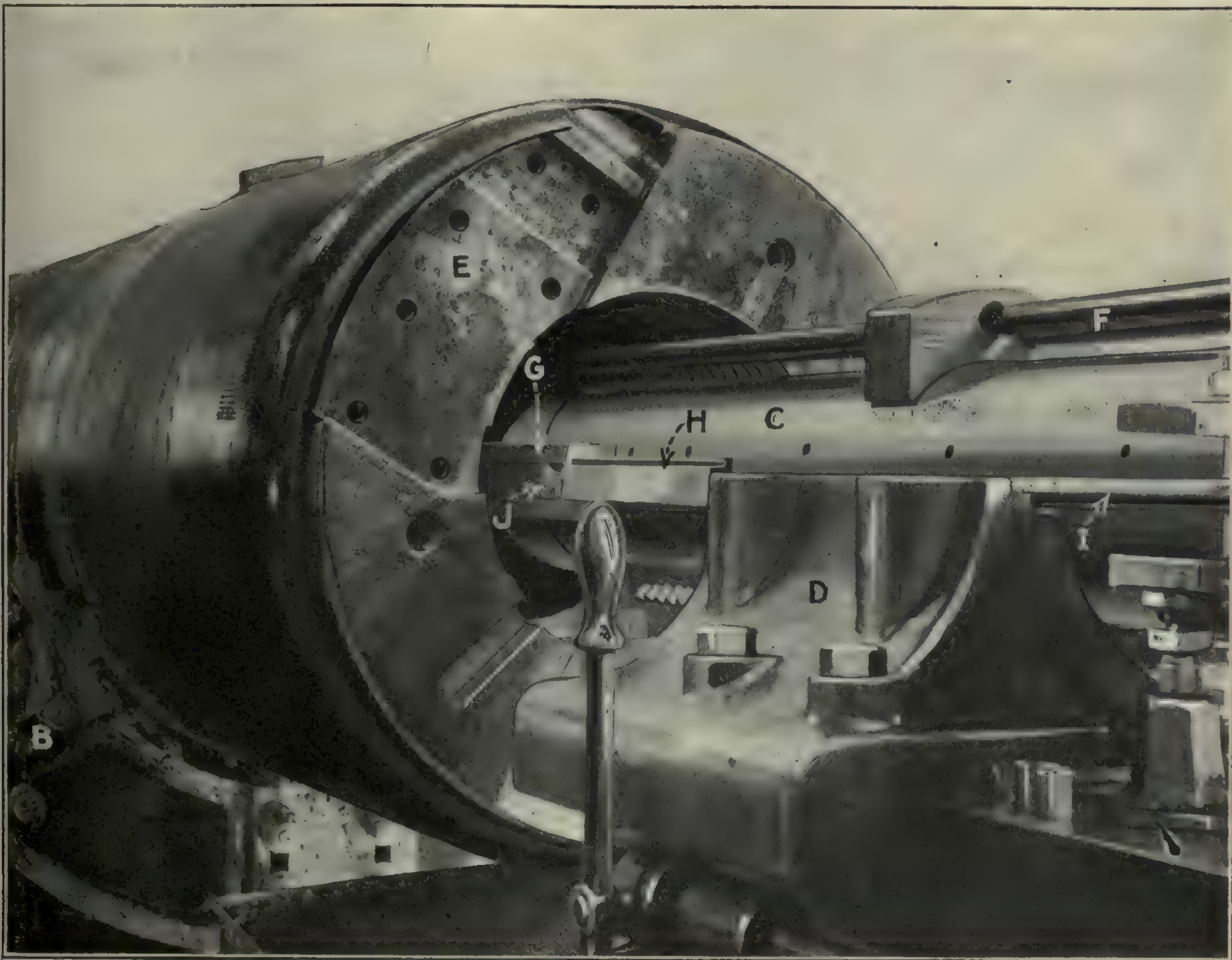


FIG. 1. GUN MOUNTED IN LATHE FOR TAPER BORING

The liner in 6-in. gun No. 1, model 1900, was removed in this manner. A heat of 700 deg. was used, the gun being suspended from the liner so as to obtain the maximum weight pulling downward after the shrinkage was broken. Cold water was injected into the bore, and after 45 sec. the gun separated from the liner with-

out using any force other than the weight of the parts. It is doubted if this method would be successful in cases where the liner was incorporated in the original manufacture of a gun. In such cases the strains caused by superimposing the different hoops in building up the gun usually cause decided bends in the liner, and as pressure is removed in breaking the shrinkage the liner will tend to return to its original shape. This would make it stick in places and would prevent it from dropping from its seat. By the aid of a press the removal might be accomplished, but it has never been tried here. No attempt has ever been made to remove a cylindrical liner by interior cooling, and it is not believed that such a removal could be accomplished. (Note—It is also reported that the Vickers-Maxim Co. is able to drop liners by interior cooling. Its method of assembling, as reported in available literature, is similar to that employed at Watervliet arsenal, that is, the liner is assembled first. In relining, this company uses little or no shrinkage. The Navy Department is now assembling liners as the last shrinkage operation, which eliminates the question of bending or distortion referred to here.)

9. The liner should be made of a material which will resist as far as possible the effects of erosion. While many different theories of erosion have been advanced it is generally conceded that, other things being equal, the metal with the highest melting point is the one least affected by erosion. On account of the high melting point of wrought iron, plans were made to test its suitability for liners. With this end in view work was started relining a 6-in. wire-wound gun with a wrought-iron liner. The liner was constructed by welding together numerous wrought-iron bars of rectangular section. In turning and boring this liner the welding cracks showed up, and in many cases the seams were open, showing a large amount of cinder between the bars. The liner was condemned and the experiments were discontinued. (Note—It does not appear that there are sufficient data to warrant the conclusion that erosion varies inversely as the melting point of the materials used. This may be so over a wide range of melting points, but it does not necessarily hold in the limited range of melting points of the alloy steels used for liners.)

Method of Preparing Seat in Gun for Liner

The following is a description of the method used at the arsenal in taper boring a gun for the reception of a liner:

A 12-in. 40-caliber gun is taken for example. The gun is placed in a large gun lathe with the breech in a lathe chuck, the center and muzzle being supported by steadyrests. It is set up true and counterbored to 13 in. diameter to a depth of about 4 in. from the muzzle. A reamer or packed bit 13 in. in diameter is started and fed through the gun, after which a similar reamer 14.1 in. in diameter is put through in the same manner. The gun is then reversed in the lathe, the muzzle being placed in the lathe chuck while its center and breech are supported in steadyrests, as at *B*, Fig. 1. It is then stepbored, a series of reamers being used; they are fed into the gun from the breech, the first one to a point 30 in. from the muzzle, the next one to a point 60 in. from the muzzle, and so on, leaving cylindrical steps 30 in. in length throughout the bore. The size of these reamers depends on the taper required and the number of shoulders to be used. After this operation the gun is taken from the lathe and a long boring bar *C* slid through. This bar rests on three semi-circular wooden blocks, one in the center and one at each end of the gun. The boring bar is made of steel and is hollow, and for a gun of the above size should be about 11 in. in diameter and at least 15 ft. longer than the gun. This extra length is required to manipulate the bar in removing and inserting the supporting rings.

After the bar is in place the gun is lifted into the lathe, muzzle end to the faceplate. The end of the bar is then locked into a bronze bushing in the faceplate and supported true with the lathe spindle. The gun is then chucked and the front housing *D* of the boring bench brought up close to the breech *E*. This housing

FIG. 2. BRONZE SUPPORTING RING FOR BORING BAR

forms a support for the boring bar *C*, which extends through it and projects about 14 ft. beyond. After the bar is in place the wooden block in the center is removed by bearing down on the projecting end of the bar. The front housing *D* of the boring bench acts as a fulcrum and the pressure on the end of the bar causes it to spring up in the middle enough to allow the block to be removed by means of the long rod *F* which is attached to it.

After the removal of the wooden block two bronze supporting rings are placed in the gun. These rings, which are a close working fit to the gun and bar, are placed at quarter distances between the faceplate bearing and the boring-bench housing. The rings are slid in place by means of pipes which are attached to them. The pipe in the forward ring passes through a hole in the second one. One of the rings is shown in Fig. 2. After the rings are in place the gun is set dead central with the bar at the breech end and the cut can be started.

The taper is attained by means of a former, or taper guide, *G*, which is fastened securely to the bar *C*

throughout the whole length of the gun. This taper guide is made in sections about 5 ft. long, and has the same taper that it is desired to give the gun. Into the guide is fitted a tool holder *H* about 16 in. long. A hollow feed rod *I* 1 in. in diameter is attached to the toolholder *H* and serves the double purpose of supplying oil to the tool *J* and feeding the toolholder *H* along the guide *G*. When it is desired to start the cut a round-nose roughing tool *J* is inserted in the toolholder in the guide and a cut started about 0.02 in. less in diameter than the finished size. The depth of this roughing cut usually averages from about 0.14 in. at one end to about 0.15 in. at the other. A good flow of oil is forced to the tool through the feed rod *I*. The tool is fed up to within 1 in. of the first ring from the breech, and then the tool *J* and holder *H* are withdrawn and laid aside, care being used not to disturb the setting of the tool in the holder. Another holder *H* with a finishing tool is then inserted and fed up to within 1½ in. of the ring, using a much coarser feed but a slower cutting speed than was used with the first tool. This finishes this part of the taper, and it is then necessary to remove the first supporting ring. The ring is removed by manipulating the overhang of the boring bar *C*, after which it is withdrawn by the pipe *F* to which it is attached. A taper ring, which has been turned to fit the bore about 3 in. back from the distance run by the finishing tool, is then put in place. The roughing tool and holder are again inserted in the guide and fed up to the next ring, after which they are removed and the finishing tool and holder are again inserted and fed up to the ring. The second taper ring is then put in place in the same manner as the first. Boring is again continued until the taper bore has been completed. The accuracy of the taper depends of course upon the straightness of the bar *C* and guides *G*. The shoulder, or shoulders, is obtained by varying the length of the tool. A radius tool is used to finish the shoulders.

In the past the guns relined at the arsenal were always taper bored by the above method of using a boring bar; but the present practice is to use this method only in cases where the number of guns of one model to be relined is small. In case enough guns of the same kind are being relined to warrant the expense a special set of reamers, formed in a similar manner to the ordinary packed reamer, is made up to give the desired taper. The two cutting edges extend the whole length of the reamer and are ground to the exact taper desired. The reamer is mounted on the boring bar, which is supported behind the reamer by a taper bushing. Before taper reaming is started the gun has been step bored. The front end of the reamer carries a pilot bushing which fits snugly into the next cylindrical hole in front of the reamer. The reamer is thus supported firmly at both ends and the result is a nearly perfect taper. In boring by this method the operation is stopped when the first reamer has been advanced into the bore the proper distance. This reamer is then withdrawn and a smaller one entered. The second reamer continues the taper forward of where the first one left off. After finishing with second reamer a third one is entered, and so on until the whole of the bore has been covered. It is thus seen that the total length of all the reamers used must be equal to the length of the taper bore. The appearance of the reamers for a 12-in. navy gun can be seen in Fig. 3. In using these reamers the cutting edges are well lubricated by means of perforated oil pipes. The illustration shows two of the taper reamers used for boring the seat for liners.

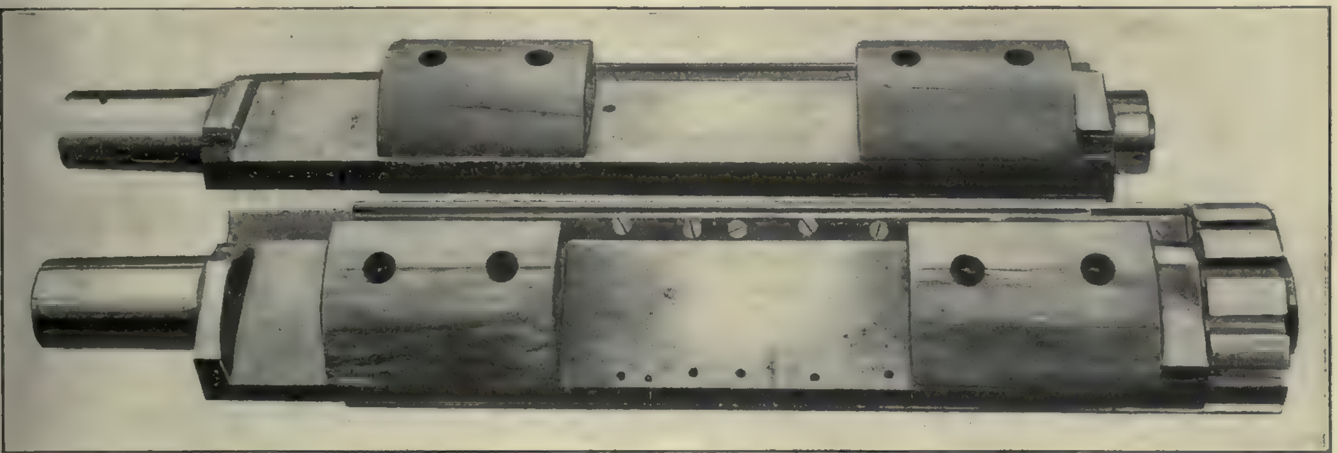


FIG. 3. TAPER REAMERS

The time required of this establishment for taper boring a 12-in. 45-caliber navy gun with the boring bar is 45 working days, or 360 hours, while with the reamers the time is reduced to 22½ days, or 180 hours. The cost of a set of reamers for the 12-in. guns mentioned previously is about $4500. The cost of fitting former guide on to a boring bar for the same job is about $1500, exclusive of the cost of the boring bar. As the reamers give a smoother hole and a more regular taper than can be obtained by the use of a bar the corresponding shrinkage surfaces on the tube are easier to turn and a further saving of time results from the use of these reamers.

Liberty Bonds as a Bonus

The Presto Machine Works, Brooklyn, N. Y., has inaugurated a method of using Liberty bonds as a bonus for patriotic intention and faithful service. Employees can subscribe for a $50 bond and have one dollar a week deducted from their pay for 50 weeks as is usual. Those who remain with the company and complete their payments receive two $50 bonds with interest for nine months. The second bond is a substantial bonus.

Labor Turnover

By PHILIP BRASHER
Employment Manager, the Braden Copper Co.

The question of labor turnover, like many comparatively new ideas, is likely to be misunderstood. This article explains the various phases of labor turnover and is replete with actual experiences obtained in different fields.

IN DISCUSSING the question of labor turnover I find there are two methods that are almost invariably adopted—one is the purely practical, the other the terribly theoretical. I am going to adopt the first because I believe it is the one method of treatment at the present time. There really should be nothing to prevent a discussion of the problem from a combination of these two viewpoints, but apparently there is.

Labor turnover today is in exactly the same position where the discussion of efficiency was 15 years ago. We all realize the tremendous harm that has been done real efficiency because of its being absolutely misunderstood by the average man. That misunderstanding may have been produced in the beginning by those who being interested in discussing efficiency did not emphasize the fact that it is simply codified common sense. I trust that turnover will never have the many trimmings tacked to it which has resulted in so many cases of applied efficiency being simply form instead of substance.

The attitude of the average executive toward turnover reminds me of the attitude of the average Mexiican toward smallpox. The Mexican believes that unless you have had smallpox you are considered to have missed one of the experiences of life, and it is presumed there is something radically wrong with you. I hope in the next ten or fifteen years that executives as a class will appreciate that a turnover of from 50 to 200 per cent. is not any more necessary than having smallpox.

In the first place the subject is of such recent origin that it is not expected that we can know a great deal about it. There has however been a great change in five years, as now everyone interested in the subject of human relations in industry realizes that as "all roads lead to Rome" so does every different phase of human relation bear upon the subject of turnover. I find in very many instances a tendency to place the cart before the horse, to emphasize some particular point that is merely subordinate to the whole.

Realizing What Turnover Is

Why discuss labor turnover at all? Simply and solely because we are beginning to realize the tremendous loss involved in its practice and that we can no longer afford to ignore it.

A week or two ago the New York papers stated "that the shipyards have to employ three temporary men before they can get one permanent worker." This language is very vague, but it can only mean that the shipyards are at present working under a turnover estimated at about 400 per cent. a year. The papers are also full of the subject of housing shipbuilders and the wonderful lack of forethought in realizing that they had to be housed. Then too you will have observed that the question of "the number of rivets that should be driven in a day" is discussed pro and con. Anyone who has had experience with shipbuilding will tell you that a gang of five riveters should drive at least 300 $\frac{3}{4}$-in. rivets, straight riveting, in the course of an eight-hour day. But to show you one of the subsurface effects of labor turnover let me give you an instance.

About ten years ago I had charge of some shipyard work, and as is usual it included a good deal of riveting. I started a gang of riveters at work one morning, and realizing that I was somewhat strange they evidently desired to test me out; when I came back at 12 o'clock they had driven, to be precise, eight rivets. After thinking the matter over and wondering whether to fire them or simply give them a vacation I decided we needed them too badly to permit of their discharge, so I gave them a two-weeks' layoff in which to think about the matter. When they came back they were a chastened crew and I had no more trouble with them. The fact that they wanted to see how far they could go with a new man caused the loss of these five men's services for two weeks at a time when they were particularly needed, and it might have caused their discharge. This shows how turnover causes turnover.

Defining Labor Turnover

The definition of labor turnover as adopted by one association is: "Turnover is the change in personnel brought about by hiring and termination of employment. Many conditions enter into these changes, some of which are beyond the employer's control or influence. Other conditions are largely within the control of the employer, and because of their obvious importance they demand serious consideration. Problems relating to personnel are no less vital than problems relating to markets, materials and machinery. Conditions affecting turnover lie at the heart of all personnel problems. Intelligent consideration cannot be given these conditions without knowledge of the facts, and such knowledge depends upon accurate data. "It is impractical merely to group or express in total percentage all the factors entering into turnover; these factors are irreconcilable. It is of value to know the percentage of exits, but it is of more value to know the causes of those exits; therefore a detailed analysis of reasons underlying termination of employment becomes valuable."

This definition should make it clear that those who are discussing this subject have at least arrived at a common ground and know the problem which they have to face.

A large number of attempts have been made to estimate the cost of turnover. Mr. Loree of the Delaware & Hudson R.R. figured that every time a railroad changes one of its chief executives it costs them $1,000,000. On the other hand Alexander Magnus has estimated that it costs about $8.50 to replace an unskilled laborer and about $73 to replace a skilled worker. I notice recent

estimates that shipyards figure that it costs them today about $40 to replace an ordinary workman.

In 1906 and 1907 I was chief engineer of a company doing work that required a great deal of Italian labor—simply plain shovel men. Roughly we were employing about 1000 of them, and a conservative estimate of the labor turnover in that case would have been about 1200 per cent. However, it did not particularly bother me at that time. Nevertheless, in that particular case Mr. Magnus' estimate of $8.50 would have been very high.

Times change. At present practically every man I hire represents an average investment of about $2500 in cold cash without estimating other losses; labor turnover is very real to me now. Therefore the cost of turnover is one of those intangible things impossible to prove definitely one way or the other. All we can do is to use our common sense and imagination—attempt to visualize the consequences involved in the change of a big man in an organization. The change of a small man can be figured in dollars and cents, but changing a big man costs money, time and loss of product.

I may be wrong, but I firmly believe that a large percentage of concerns that employ more than 100 men would average about 200 per cent. a year turnover if they kept records. There is a munition plant somewhere in this country not over 3000 miles from New York employing about 3700 men, whose turnover has been running about 6700, or almost 200 per cent. a month. This has practically been cut in half recently by introducing a large number of girls on cutting machines, providing them with Victrolas for dancing, a jazz band three times a week, a restaurant supplying good food, and many other features. Instead of a foreman indiscriminately firing a worker, as was done formerly, no man can now be discharged before being sent to the employment bureau and given a choice of work in some other department unless he has been convicted of a very serious offense, in which case the employment bureau then discharges him outright.

Turnover, like the poor, we have always with us and probably always will. It is an individual problem. When you have discovered approximately how much it is costing you and you have reduced your individual labor turnover to what you consider the irreducible minimum, compare it with your neighbor's and concentrate on your local and then on your national situation. Improvement in turnover, like charity, should begin at home.

How To Reduce Labor Turnover

I believe that labor turnover can be reduced to the irreducible minimum—whatever that is—say anywhere between 3 per cent. and 25 per cent. a year by

1. Hiring the best employment manager that can be had.
2. Doing exactly what he wants when he wants it. If he is not the biggest and best man you can get do not hire him. If he has not your entire confidence after six months fire him; for rightly or wrongly he will never be able to accomplish what he ought to for you without it.

If he is on to his job his first efforts will be to keep the good men he already has by considering

a. Wages, bonuses, pensions, delayed premiums and all other methods of compensation.
b. Eliminating indiscriminate firing by the foreman.
c. Hours of labor.
d. Working conditions, safety, health and comfort.
e. Proper food at the proper time (poor food in my opinion is at the bottom of more labor trouble than almost any other one cause).
f. Living conditions, housing, transportation, amusements, etc.
g. Education, both in and out of the plant.
h. Other things involved too numerous to specify.

He will consider these not necessarily to change any one of them, but to see that everything is being done that can be done in fairness to the company and to his employees. All that either of them wants in most cases is a "square deal," but they both do not always know it.

He will try to get more good men by

a. Proper selective methods.
b. Judicious advertising (I mean real press-agent stuff, not merely "men-wanted" column ads.), favorable notice in trade papers of the conditions cited, and running an organization sheet weekly or monthly (if it is well done) are very effective, but the most effective of all is the man-to-man talks by satisfied employees with their friends outside. The secret is in making good men want to get into your organization not onto your pay roll.
c. Getting the proper records, references and available history of all applicants.

The Human Relations

As I said before, the human relation is a potential cause of labor turnover, and the best thing to overcome deficiencies in this respect is to analyze the causes by departments and so find out where the worst conditions exist. One of the most expensive and far-reaching causes is the ineffective and improper method of selection and employment. In the last few years, which have been strenuous ones from the labor-turnover standpoint, the organizations which have come through in the best shape have been those that have had one man in charge of employment work. This man should be the biggest, best educated, most broadminded and most courteous one you can afford to employ. If you cannot afford such a man for your own business a coöperative agreement with neighboring firms can be made to work very satisfactorily. The right man in the right place here will count for more than any other one position in your organization. If he knows his work he will consent to be responsible only to one of the highest officers in your company and he will insist upon the right to consider the conditions I have outlined above and get action upon his decisions within a reasonable time.

In selecting men honesty, industry, intelligence and health are fundamental, yet consideration of them is often neglected. Health is, of course, something that a man should have when he starts the job, and care should be taken to see that it is conserved. Intelligence, like dynamite, should be carefully handled. Never use a razor where a knife will do. I know of a man who for 37 years has pasted little pieces of paper on little pieces of felt. I maintain you could not find a better man for that particular job, for he has just the right combination of health, industry and intelligence. More attention should be paid to dishonesty than is done at present. Like so many other causes of labor turnover, it seems to be considered a necessary evil. I stopped a man coming out of a shipyard once because of the peculiar manner in which he walked, and I found 80-odd pounds of copper sheeting wound about him under his clothes. Another employee used to bring his umbrella rain or shine. One day it rained and he thoughtlessly opened it as he went out of

the gate, and a rifle barrel came clanging down in the street—he did not come back. Rifles are carried out a few parts at a time and assembled and sold outside. A dishonorable employe will spread distrust throughout a whole organization.

The next question is that of wages. I believe it is economical to hire and hold the highest priced man you can afford. I know of a town lying between two other industrial towns and I know that mechanics frequently after leaving A will not even get off the train at B, but will pay the carfare in the longer journey to C. Reason is B has the reputation for paying low wages, so the best mechanics avoid it and go where they can get what they consider their due. In other words, water runs downhill and the best men will naturally gravitate toward the organization, town or city having the most satisfactory general conditions.

In France Before the War

When I was in France in 1913-1914 the French working men were in a similar frame of mind as our own working men today. Good workmen seemed very scarce and there was a great deal of Socialism, syndicalism and sabotage. In and near Paris and in northern France there was great difficulty in holding the men. In the south it was not so bad. Any man who attempted to do more than the local powers had decided upon found his tools broken or mislaid, his machine out of gear, or he could not get his cutting tools sharpened, all this of course being done on the theory that if more than a certain amount were earned during the day by any one man the price would be cut. Unfortunately price-cutting is so frequent that it gives working men a basis for complaint.

I think that that sort of thing on both sides ought to be wiped out. Some simple, safe and sure method ought to be devised whereby when the word of either the employer or employee is given they should be compelled to keep it. How can we expect to make nations keep their word if we cannot compel individuals to do so? I know many will say that this is impractical, if not impossible, but I do not admit it.

One method I have found to work very well, both here and in France, is to specify the minimum amount that an employee can earn. When the French companies I was with at my request told their workmen that they did not wish to retain in their service any man not skilled enough to earn at least 10 fr. a day the men jumped in and earned it without any trouble, though the previous average was less than 8 fr. a day.

In England, in order to avoid the constant shifting from one factory to another, which has been going on during the war, they have adopted the plan of refusing to employ any woman for six weeks unless she brings with her a reference card from her last position stating that she left with their consent. This is worthy of much thought, but it frequently results in injustice and consequently should be modified in some way.

Mental Conditions Must Be Considered

When you speak of conditions you must consider the mental as well as the physical; the personal and pleasant talk between superior and subordinate; the absence of nagging; the presence of occasional encouragement and feeling of man toward man rather than company loyalty. It has been my experience that men want something personal to be loyal to. The foreman typifies the company to the average workman, and the president is the company to the average executive.

As a distinguished speaker at an employment managers' conference not so long ago said: "No matter how fine the company's policy; no matter how good the company's intentions, look to your foreman, for he is your representative in the eyes of the men. Men worked and fought for Jim Hill, not the Northern Pacific Railroad Co., and for Charlie Schwab, not the Bethlehem Steel Co.

At the hotel where I am staying little personal touches are added to show the employees that their work is being appreciated. Service stripes are given; a medal is awarded once every month for the best kept floor, bonuses are paid for certain lengths of service. The owner said to me: "Our reason for doing this is that it works both ways. The employee likes to know that we appreciate his having been with us for years, and the guest who is met by an employee with a number of service stripes on his sleeve realizes from the service which he gets what we are attempting to do."

Another great cause of turnover is the power of indiscriminate discharge by the foreman. This is practically suicidal in almost every case. Once in a while we find a foreman big enough to exercise this power with proper discretion, but usually they are few and far between and it does not pay to rely upon it.

Good Food a Big Factor

It has been my experience that one of the biggest factors in keeping employees satisfied in army camps, lumber camps, mining camps and regular industrial plants is in keeping the employees well fed at a reasonable rate. There is no way in which an industrial organization can spend money to greater advantage than to spend it on the employees' table. Even if it amounts to a financial loss, even if the operation of the proper eating facilities requires a certain outlay beyond the receipts it will be repaid hundreds, possibly thousands, of times in the amount of money saved by retaining contented, well-fed and happy employees. I have in mind a large mail-order business in Buffalo, which feeds all its employees in its own building, and I know of no concern that operates on a more efficient basis and that has a better looking or more healthy lot of employees, and judging from their talk, a more satisfied one.

One of the biggest corporations in the world furnishes daily its executives with a luncheon served in a most democratic manner, but the food is as good as can be obtained at any restaurant in New York.

In the camp of the first training regiment at Plattsburg in 1915 there was no subject more frequently discussed, particularly by those who had been accustomed to camps, than the excellent food served at that time. It was the general opinion not only of myself but of everyone else that it was a big factor in making Plattsburg a happy camp. In my recent work in training camps I endeavored to find out which were satisfied compaines and which were not, and in every instance I found that the happy companies were those in which the cooks and the food were well spoken of. I have mentioned briefly the points I consider most important in

the hope that it will promote discussion of them during the evening.

In closing I would like to call your attention to the difference between army turnover and the average industrial turnover. It is this: The first is unavoidable and the second is not. In trying to explain to officers of high rank the reason the turnover in the army should be considered I pointed out what they admitted to be true, namely, that the army of today is composed of a group of specialists. Each unit is supposed to have a certain number of skilled men of various trades with it at all times or it loses its efficiency. If a division goes into battle and gets shot up it will not do in this day and age to telegraph back, "We have lost so many men; replace them." In order to bring that unit back to its original efficiency the commanding officer must be able to say, "I need five electricians, six machinists and two carpenters to replace casualties sustained." Due to the system installed by the Committee on Classification of Personnel of the Army he can now do this, though six months ago he could not; furthermore he can be sure that the men sent to him will be capable of doing the work.

Effects Being Realized

That even the army—the most conservative of organizations—has at last admitted the necessity of considering turnover is convincing proof that at last its far-reaching effects are beginning to be recognized and considered.

So when you have said labor turnover you have enunciated the greatest problem facing us today in the world of industry, one that embraces practically all others. This is the problem that must be considered first, and on its successful solution depends our future supremacy as a nation.

A Letter to Harry—Not From His Uncle

Dear Harry—Through the kindness of your uncle I had the pleasure of reading your interesting letter on page 68 of the *American Machinist*, and have since thought about it a great deal. The more I think about it the more I wish I might become acquainted with you. However, since that is impossible I will take the liberty of writing you a few lines.

When I heard that you had severed your connection with the company where you were serving your time as an apprentice I was somewhat disappointed, especially after your having completed two-thirds of your course, for I felt that you had let an opportunity slip by. I am sure your wise and experienced uncle would have advised you to remain until your course was completed. But after reading your letter I said to myself: "That boy is a wonder; he's a genius—the machine shop is no place for him." That is what I thought to myself, Harry, and I believe it to be true. A machine shop is no place for a youth like you. No shop superintendent will ever appreciate your ability, for, my boy, you are a literary genius. Your place is on the editorial staff of some first-class newspaper or magazine. Now see if I am not correct in my reasoning.

In my experience with apprentice boys I have never yet discovered one who could produce a paragraph like the following taken from your recent letter—not even the high-school graduates: "The human environment is very interesting. I have heard my elders speak of the shop as a world in miniature, containing men of the most diverse types; but in the scene of my previous labors there was but a dull monotony—just a lot of young fellows trying more or less strenuously, according to their several dispositions, to acquire a knowledge of the trade; and instructors, who often seemed to me as uniform and indifferentiated as if cast from the same pattern."

How often have you found young fellows of your age who could turn a literary production equal to the above? Never, I believe. Here's what you would get from the average apprentice boy: "Gee, this shop's interesting. There's a lot of funny things around here. My old man told me once that there's about as many different guys in a shop as there are in this world; but the old shack where I used to work was dead—just a lot of young guys all trying to get a boss's job because a boss gets good pay and don't have to work; and some school teachers who wear good clothes and l e a r n us nothing."

Then there were some other parts of your letter that impressed me as remarkable. I'll call your attention to a few more. "Another neighbor, a Russian, is his equal in linguistic acquirements, and surpasses him in one respect, as his English is far better than mine." [The Russian also should never have entered a shop.]

"Never again can I share the insular, parochial belief so common among us, that we, and other English-speaking tribes, have a monopoly of desirable qualities."

"What a melting pot this country is, if one may judge from the lesser world, this microcosm, the shop!"

These are only a few examples of the excellent command of the English language you displayed in your letter.

Now, just a word in closing. With your literary ability and excellent vocabulary and command of the English language I would advise you to look for a vacant chair in some technical-journal office or in the advertising department of some large industrial concern, where your ability will be appreciated to the fullest extent and where your machine-shop experience will also be of value to you. There's a future ahead of you in this work, and you'll never have to go on a strike for an increase in salary. And there's no fear of being "junked" in middle age, if you live so long.

Bending and Drilling Tubes, Angles and Flat Sections

BY FRANK A. STANLEY

This line of work includes the bending and forming of brass and steel tubing, the punching and shaping of angles and flat sections, the bending of wire tie rods and the drilling of long tubes with multi-spindle machines. A large amount of material is worked up in the factory from which these data were obtained, and this article describes some of the special apparatus used in performing the various operations.

RECENTLY, while in the city of New Orleans, I spent a little time looking into the methods of some of the local factories for machining, bending and otherwise manipulating brass and steel tubing. There are more uses to which such materials are put than one would suppose to be the case unless special consideration had been given to the subject.

A few articles may be mentioned which are not ordinarily thought of as belonging to this output, such as curtain and drapery rods, door and window attachments, lighting-fixture parts, bathroom equipment and metal beds.

Among the New Orleans establishments handling a large amount of tubing in the manufacture of their regular products is that of the Crescent Bed Co., Ltd. Fig. 1 is a reproduction of a view taken in the department of that plant, where tubing of various sizes and weights is drilled prior to assembling operations. The brass and steel tubing ranges in diameter up to about 3 in. or more, and the number and sizes of holes drilled in the various members of the head and foot of a tubular bed frame will vary with the general design; in any event there are several holes to be drilled in every piece of tubing that enters into the construction of these more or less elaborate frames.

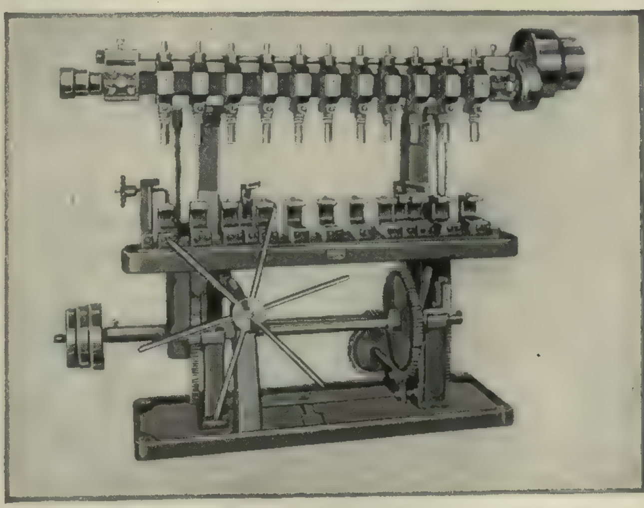


FIG. 2. FRONT VIEW OF HEAVY DRILLING MACHINE WITH WORK REMOVED FROM FIXTURES

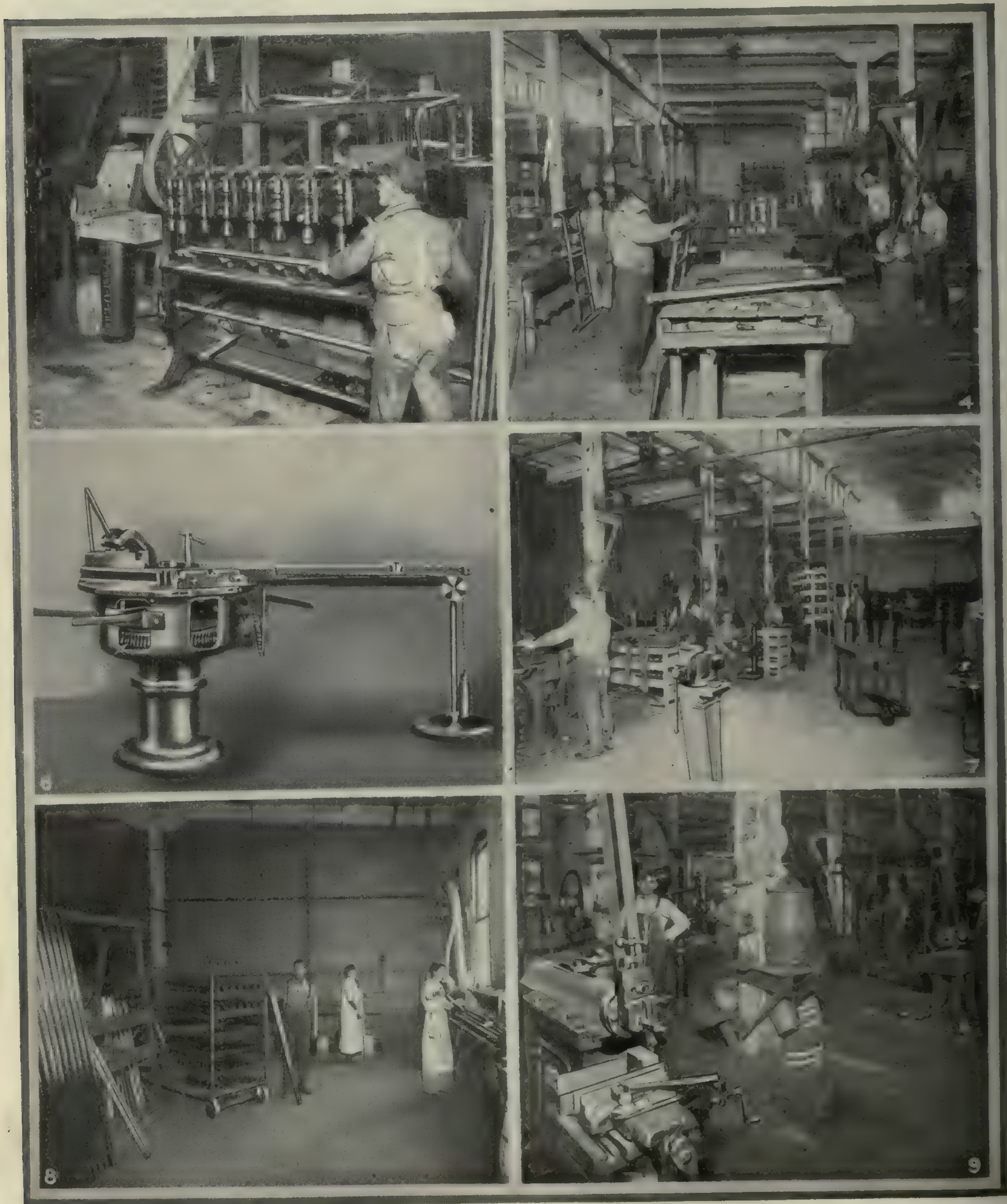
Drilling machines for bent as well as straight lengths of tubing are used here, as this type of machine allows the work to be drilled after it has been bent to any desired radius, thus obviating any difficulties that might arise if it were undertaken to shape up the tubes to the necessary degree of curvature after the holes had been drilled. The multiple-spindle drilling machine illustrated in Fig. 1 as adapted for the operations on work of this character embodies some interesting features, a number of which are best seen in the front view, Fig. 2, which represents distinctly the machine with the work removed to show the holding apparatus and certain other details.

Any number of heads can be used on this machine, and the spacing between spindles is readily regulated to provide various combinations of center distances. The distance between outer heads will give a maximum length between holes of nearly 4½ ft. Whatever the length of work, it is well supported immediately under each spindle by a special type of V-block, so that the

table with its attachments constitutes a fixture adjustable for any diameter of tube. Guide bushings may be used in the tops of the V-supports as indicated in the engravings.

The spindles are driven by spiral gears and the table has a power feed to carry the work upward against the drills. It must not be thought because the machine is adapted especially in this case for drilling light tubing that it is a light-weight tool, as it weighs something like $2\frac{1}{2}$ tons and is capable of drilling simultaneously a series of holes up to a 2-in. diameter.

In the work under operation in the view, Fig. 3, the drills are shown in use without guide bushings, but these may be applied wherever considered advisable.



FIGS. 3, 4, 6, 7, 8 AND 9. SOME OF THE OPERATIONS AND MACHINES USED

Fig. 3—Another drilling operation in a machine designed especially for bent tubing. Fig. 4—Assembling bed frames from drilled tubes. Fig. 6—Side view of tube-bending machine. Fig. 7—Operations on light bends and preparation for assembling. Fig. 8. Use of special trucks and racks for preserving finish on tubes. Fig. 9—Corner of machine shop where many big dies are shaped up for the long gang presses

The machines of this type are operated very rapidly and they may of course be fitted with almost any desired type of drilling or boring tool, and on certain kinds of materials a straight fluted drill may be used in place of the regular twist drill to avoid possibility of hooking under the inner surface of the work when the lips are breaking through the metal.

The two machines shown at work are only part of a number of similar tools which are found of the greatest service in operations of the character indicated.

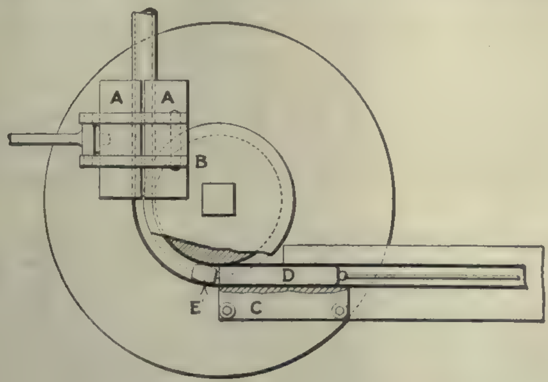


FIG. 5. GENERAL PLAN OF TUBE-BENDING APPARATUS

In Figs. 1 and 3 a great number of straight tubes and many bent sections will be noticed ready for passing to the assembling benches, of which several are shown in the department view in Fig. 4. The reproduction shows distinctly the method of fitting together the straight cross members of a bed and the assembling of the smaller spindles or vertical tubes which serve as ties between the cross tubes. Small interior bolts or rods are used for securing all parts firmly together before the work is passed along to subsequent processes.

The bending operations on steel and brass tubing as conducted at the plant herein described are accomplished with the metal cold, and without filling the tube with sand, resin or any other substance, yet the tubes come out of the apparatus without wrinkles or deformities of any kind.

Details of Bending

The principle of the bending process is represented in Fig. 5, and one of the machines used in the operation is shown in Fig. 6. There are a number of different bending outfits in the department, but the illustrations referred to will suffice to show the general principle of operation.

In the illustration, Fig. 6, there will be noticed a worm-driving gear *A*. This gear is mounted upon a vertical spindle which is squared at its upper end to receive the bending dies or forms, so that these members can readily be changed for different work by lifting them off the spindle and replacing them with the ones required.

The pair of concave jaws at the left in the illustration and which are shown resting upon the round table are utilized to grip the tubing and bend it around the dies. The upper jaw of the pair is suspended from the inner end of an operating lever which is pivoted to the front end of a link, attached by its rear end to the main jaw, as clearly indicated in the view. When the machine is set in operation, the work is first clamped between these jaws by the attendant pulling down the clamping lever; the clutch then being thrown in, the jaws are carried around to the rear and bend the tube about the die which is at the center.

Referring to Fig. 5 the clamping jaws are seen at *A*, and the dies at *B*. Before the machine is set in motion the clamping jaws stand at 90 deg. to the right of their present position, or with their ends against the left-hand end of guide jaw *C*. Rotation of the apparatus to the left brings the jaws *A* to their right-angle position relative to the front of the machine and causes the tubing to be drawn around into the curve required.

Preventing Wrinkling

Of course where a 90-deg. bend is not required, the operation can be stopped at any desired point automatically, the process being the same whether right-angle work or bends greater or less than a right angle are desired. In all cases the inside of the work is reinforced against collapsing or wrinkling by a closely fitting arbor *D* which follows the tube up to the very point of bending; in fact it does more than that, for it has a short section at *E* which is connected to the main arbor by a ball joint so that it floats freely and thus is enabled to support the interior of the tube for a short distance after the start of the bend. This feature is brought out by the illustration, and it will be understood from the foregoing description that as the tube is drawn ahead by the swinging around of the clamping jaws *A*, it must also draw along over the arbor, and every point in the bend must be controlled in the process by the floating section *E*, combined of course with the concaved guiding faces of the dies.

Another feature that should be noted is that the arbor is not secured positively for endwise position;

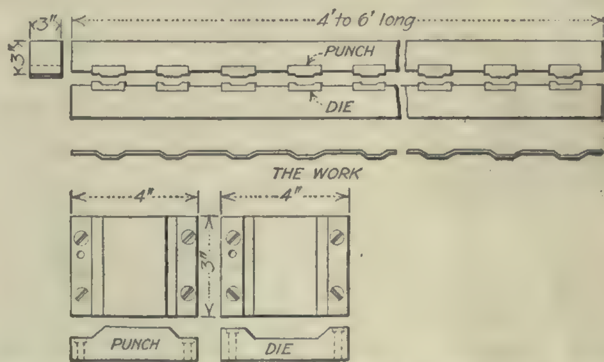


FIG. 11. A SET OF SECTIONAL TOOLS FOR BENDING WIRE RODS IN THE BIG PRESS

instead, it is attached to a small wire cable which leads back to the left and down over a sheave wheel, a weight being attached to the end of cable. In operation, the action of the tube in being drawn ahead around the dies and over the arbor tends to pull the arbor forward within limits by frictional contact in the bore; thus the arbor naturally finds a position in the work as far forward as possible, the position being dependent upon the character and radius of the bend; and it assumes at all times a position best suited for keeping out wrinkles or other irregularities in the surface of the material.

Brass tubing as large as 3 in. in diameter, and steel

tubing up to 2 in. in diameter, can be handled in this machine. There is much material to be shaped and bent which is so small as to admit of advantageous working by other processes, and some parts made of such light material will be noticed in Fig. 7 where bent frames and rods are being drilled or otherwise machined preparatory to assembling.

A great deal of such work can be handled with press tools of one kind or another, though where there is a large variety of comparatively light material to be bent a hand-bending rig is available.

I wish to call attention to one or two points in the system of handling tubes and other parts in the various departments in a manner to prevent unnecessary bruising of surfaces and to facilitate in general the movement of the work through the factory. The illustration, Fig. 8, which represents a portion of the lacquering department, is selected to show a typical truck for tubes, rods and other parts, and racks for both long and short work.

The truck is of steel angles with a series of shelves for small parts and sets of hooks on the shelf-ends for hanging up finished tube lengths. The tubes are thus suspended from the inside so that no portion of the exterior comes in contact with objects likely to injure them. The long tubes shown to the left in the illustration are kept in a sloping rack which has separate compartments for each tube, and the short parts on the truck are kept in trays which are drilled to provide a separate chamber for each piece.

The work of the machine shop connected with the plant consists of repair work, making of special punches and dies and other tools, and the construction of a special machine now and then. The equipment of this department is not elaborate, but some of its operations are quite unusual, particularly in connection with the making of press tools and similar devices peculiar to the necessities of the factory.

A corner of the shop is shown in Fig. 9 which represents in the foreground a shaping machine at work on a die block. The vise on this machine is kept fitted up with special jaws which are longer and deeper than customary, in order to hold long lengths of stock while being finished for use in the punch presses, as much of the press work in a plant of this character is on long strips of metal, angles, flat sections, etc., where the whole piece is placed in the dies and a long series of holes punched simultaneously, or a lot of openings of various shapes cut out at once. The dies for such operations are customarily made up by inserting individual die blocks into a long holder or into a special form of bolster, and similar disposition is made of the punches.

An interesting type of press for handling work of the character indicated above is illustrated in Fig. 10. This is shown with the work removed in order that the punches and dies may be more clearly seen. It is of a design quite generally employed in the plant for punching flat stock and angles and for riveting work of this kind, the capacity of the machine being sufficient to give $4\frac{1}{2}$ ft. between outside punches.

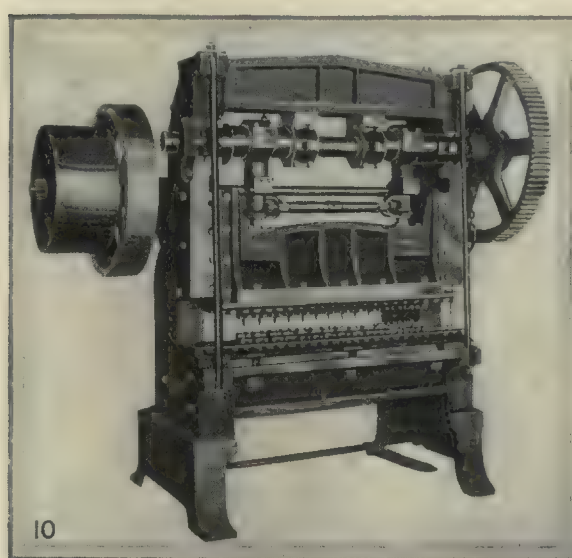


FIG. 10. A MULTIPLE PUNCH PRESS HANDLING WORK UP TO $4\frac{1}{2}$ FT. LONG

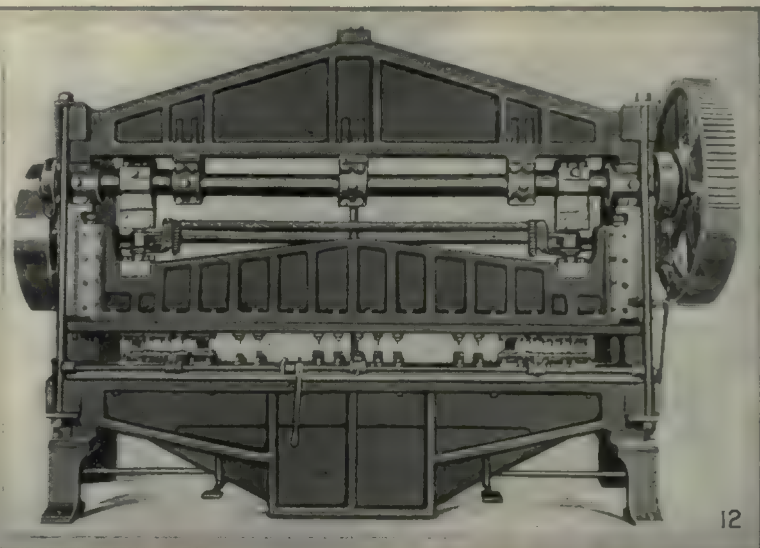


FIG. 12. A 17-TON PRESS TAKING 10 FT. BETWEEN HOUSINGS AND PUNCHING 40 HOLES AT ONCE

The arrangement of the punches and dies is shown in the illustration, and it will be observed that they admit of adjustment to give any desired spacing between holes, both punch holder and die base having a longitudinal guide for the separate tools in which the individual members are secured by the clamping screws.

As for the press itself it has a back-geared drive and two pitmans for operating the ram or crosshead, which slides in V-guides. The adjustment between pitman and ram is effected by a cross-shaft and bevel gears, so that both ends are adjusted uniformly.

One set of tools of this nature is illustrated by the sketch, Fig. 11, which shows the outfit for shaping up a lot of small wire tie rods made from $\frac{1}{8}$-in. material.

The bodies of punch and die members are made up of 3-in. square steel, 4 ft. 6 in. long, trued up parallel on opposite sides and then put into the shaping machine vise in Fig. 9, where a series of seats are cut out crosswise to a depth of about $\frac{1}{4}$ in. to receive the punches and dies proper. The distance between successive die openings is determined by feeding the table carefully for each setting before starting cuts, and when the

side movement is exhausted, resetting the bar of material in the vise and calipering over a test cut made to establish the shoulder of the next opening. Obviously there is no especially close degree of accuracy required in the bending up of the offsets in the wire shown on Fig. 11, but in order to secure alignment of punches and dies and a correspondingly satisfactory operation between them, it is necessary to space the openings in the long bars or holders quite closely.

The dies and punches themselves are of regular tool steel handled and treated in the usual fashion, and after hardening they are secured in place by fillister-head screws and dowel pins.

Life of the Dies

The life of such dies is naturally indefinite owing to the simple character of their working surfaces and the fairly easy service in which they are employed. They are, however, easily replaced when for any reason one of them becomes injured or unduly worn down.

Dies of longer dimensions than given for the tools in Fig. 11 are generally made up in two lengths, as a more satisfactory construction is thus possible. For handling this extra long work there is a press which is well worth illustrating, as it shows some of the heavy equipment which is made use of in machining what might be considered light work, but which because of its length and the number of holes required makes it necessary to resort to big, powerful tools.

Thus Fig. 12 illustrates a press that will take in 10 ft. between housings, and is adapted to the operations of punching long angles and flat bars. This machine weighs nearly 17 tons and will punch as many as 40 holes $\frac{17}{64}$ in. through $\frac{1}{8}$ in. hard angle, and at the same time cope the ends.

The arrangement of dies and punches will be understood, and almost any kind of a long job is possible with slight modification in the tools, although the equipment is specially adapted for punching long angles and bars for couches and davenports.

In general design, the slide, pitmans, adjustment gearing, drive, etc., are similar to the corresponding parts of the smaller press, shown in Fig. 10.

Beating the Gear Cutter

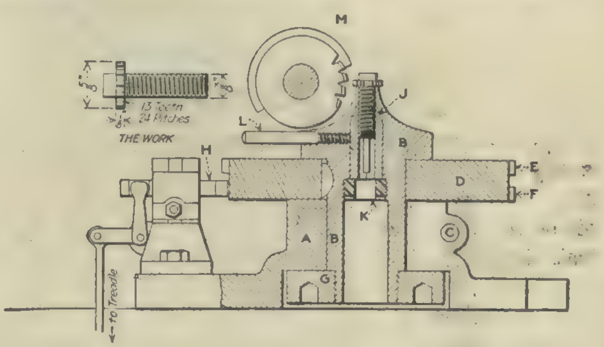
By Donald A. Hampson

We had a number of small pinions to cut at a lower price than we could do it on the gear cutter. It was a hard piece to hold satisfactorily, and much time was spent in running up the work and indexing. The cost ran from 3 to 3½c. for each piece, which was too much. A study of the matter developed the fixture shown, which proved to be satisfactory. The fact that the teeth did not have to be perfectly shaped as long as they were correctly spaced was a factor in deciding on the design used.

A cast-iron base *A* is bored to receive the steel spindle *B*, which is made a nice turning fit. The base is split, as shown, at the right of the cut and adjustment provided by a binding bolt *C*. The steel ring *D*, on the periphery of which is turned two index rings *E* and *F*, is made a press fit on *B*, and is further held by a Woodruff key. The ring *D* bears upon the top surface of *A* and is held to a bearing by the ring nut *G* let into the bottom of the base. The lower index ring *F*, which is the one used for this job, is cut for 13 divisions corresponding to the number of teeth in the gear, the notches being of 10-deg. included angle.

The index pin *H* is shown at the left, its action being obvious. The upper end of the spindle *B* is bored to receive the piece to be cut, and the split bushing shown at *J* keeps the work from turning through pressure applied to the tightening bolt *L*. The bushing *J* is held in place by a small annular nut *K*.

The shoulder of the piece to be cut comes on the arbor center line and is never changed. This produces a slightly concave tooth face, but this concavity on so narrow a surface is hardly distinguished and is not detrimental. By so locating the cut and feeding straight



DETAILS OF THE GEAR-CUTTING FIXTURE

in, the actual cutting takes but a fourth of the time consumed by the regular method. The cut is downward against a rigid support, permitting a coarse feed and high cutting speed.

The arrangement is such that chips take care of themselves and the operator has nothing to do after a cut but to turn the screw *L*, pull out one piece, insert another and tighten up again. A cutter guard shown in part at *M* makes it safe to work close to the cutter while it is running. A foot treadle operates the index pin through the rod and bell crank. The actual turning of the ring is done by hand, the large diameter making this easy and also securing accuracy of spacing at the cut.

In use the fixture was set up on a hand-milling machine. The table of this machine has a screw feed, which is preferable to lever feed because of the more even pressure applied to the cutter. Stops on the table limit the travel to the minimum amount for loading clearance and the operator is thereby prevented from consuming time in unnecessary movements. The index pin is drawn by a touch of the foot on the treadle and is returned by a spring not shown. After an hour's practice this became almost automatic and the boy makes the move unconsciously. One hand feeds the table in and out and the other turns the ring carrying the spindle and gear.

Based on the shop charge of 60c. an hour for the boy's time, the gears cost less than 1c. per piece. An average of 70 to 80 pieces per hour are turned out, though it is a common performance to cut 100 an hour for long periods. In fact the cost of the fixture was earned on the first 10,000. Out of this number over 1 per minute that were turned out.

WE HAVE GOT TO WIN THIS WAR

BY FRANK C. HUDSON

GO visit the yards that are building ships;
See the keels and the ribs in the many slips;
Watch well the riveters, all aglow,
The building of engines to make them go
To carry our boys, with food and guns,
Who are fighting *our* fight against the Huns.

THEN go to the shop where the guns are made,
The guns for our army, unafraid,
Where the guns are forged and bored and turned
For the army the German kaiser spurned.
Go see the shells, by tons and tons,
To carry our message to the Huns.

THINK not that ships, and guns, and shells,
That the many tools of the war-time hells
Can be made without money to pay the men
Who must mine, and forge, and mine again.
Bond after bond, as we've begun,
Will long be needed to beat the Hun.

BUT we who are safe in the "over here"
Must furnish the ships, the guns, the cheer
For the boys we can ill afford to spare,
Who are fighting *our* fight, in the "over there."
Our money and work must supply the guns
For our boys who are saving us from the Huns.

Series for Draftsmen and Designers

A Psychological Study of Draftsmen

BY FRANK H. SOMMERS

Within the last few months a considerable amount of matter has been printed in technical journals relative to the faults of the men in the drafting room in the designing and drawing of various machine and fixture parts, and the mistakes and shortsightedness of some of the boys out in the shop in executing the machine work from said drawings.

ANYONE who would constitute himself a judge and render a verdict on who is to blame for some of the mistakes made in our drafting rooms and factories would indeed find himself in a difficult position. Anyone who has had the care and responsibilities of a drafting room and machine shop upon his shoulders and has been called on to straighten out a tangle somewhere between said drafting room and machine shop will know what an amount of velvet diplomacy and saintly patience must sometimes be brought forward in order to smooth over the faultfinding of the machine shop and the "better than thou" attitude of the drafting room.

The writer has served his time both in the shop and at the drafting board and has during his spare moments, as a sort of an "indoor sport," tried to analyze certain psychological facts which have proved to be interesting and sometimes very aggravating. The writer does not wish to compound a rule or sweep away with a wave of the hand the experience of more well-informed men, but in analyzing that unseen but ever-present thing called "atmosphere" the writer, if pressed for a statement, could truthfully say, and no doubt many will agree with him, that the atmosphere of the machine shop, all things considered, is far better than that of the drafting room. (Draftsmen, kindly keep your seats!)

The writer does not wish to bring forward any points of a technical nature, but will try to deal solely with the psychological aspect of the case. It has been his experience that whenever the question was argued from the technical standpoint the geniuses of the drafting board ultimately, one and all, would try to impress upon their hearers their superior technical knowledge and training. This you will admit left very little room for further argument. Let us therefore refrain from all technics and make our investigation one of psychics.

The movements of those that labor, the tone of their voices, the hum of energy finding application, the respect one man finds for his fellow worker's skill, their relative importance one to another, discipline, method, practice—all these create the factor called "atmosphere." The machine shop is organized along direct lines where the ultimate outcome of expending energy on certain tasks is foreseen sometimes long before these tasks are completed. Very little time is wasted (in comparison to the drafting room) in sifting and scrutinizing the relative merits of applying certain operations to the allotted tasks, as experience has standardized most methods and practices. Ten skilled toolmakers given the same kind of work will probably all do it the same way. Experience has proved to them the best method of doing this work, and as machines and tools are standardized the operations on many pieces also tend to become standardized.

Although there are certain standards in the drafting room which must be complied with it is impossible to standardize brains or human beings. Ten designers given a problem of designing a certain motion for an automatic machine will probably submit ten wholly different designs. We surely would not blame these ten men for submitting ten different layouts of the same motion, as it is possible that every one of these ten designs has some merit all its own. It is improbable that ten men would be given the same piece of work, but the writer has seen five men given the same problem to work out on a rush job and five entirely different designs were submitted. The writer would like to mention here for the benefit of those who would be tempted to try it that the drawing took a considerable period to reach the shop because of the time wasted in the drafting room arguing the relative merits of the five different designs. At last when the drawing was finished and sent out in the shop we had five peevish and somewhat impolite draftsmen on our hands.

If I remember right the "atmosphere" of the drafting room was not very clear for at least a week. The chief draftsman made a big blunder on that occasion and he did not realize that it was only human for each of these five men to protect the child of his own brain. I doubt if this could have happened in the shop.

I believe it is essential that the head of the drafting room should possess greater knowledge of his art than the men under him. His stock of diplomatic phrases must likewise be great; he must be a second Disraeli. A cocksure, domineering chief draftsman can work more harm to an organization than is sometimes realized. He will try to force his own ideas on the men under him to the exclusion of all others, and he will not give them credit for originality, thus tending to destroy their initiative and ambition. Originality, initiative and ambition are absolutely essential to competitive business. These three requisites should find their greatest power in the drafting room, which is the incubator of all the new ideas that later go through the shop and afterward find their place in the open market, and it is regrettable to find so very little originality, initiative and ambition in so many of our drafting rooms.

Let me tell a little story of a man who did not fit the place. A short time before the war a certain department at Washington submitted a set of very elaborate drawings and specifications to the firm the writer was connected with, and asked for prices and delivery. The apparatus was to be used for research work and for compiling certain scientific data for a branch of the Agricultural Department. The drawings must have taken the draftsman a long time to make. After much study we concluded that certain parts of the apparatus were impossible to manufacture and that the design as a whole was impractical.

One of our representatives left for Washington and laid the matter before the head of the department, explaining in detail the findings of his firm, who had manufactured similar apparatus for the past 25 years and whose experience and knowledge was known throughout the world. After much discussion and study and after several interviews the representative was told, "Well, do not figure on what we asked for, but give us a price on something that you think we ought to have."

Fate of the Drawings

On his return we relegated the drawings and 20 pages of specifications to the waste basket. It later developed that the draftsman who drew the work knew that it was wrong, but had to obey the orders of his chief, whose knowledge of anything mechanical was very meager, but whose ideas had to be put on paper and whose word was final. Conditions of this kind in Washington have recently been greatly changed.

Another phase of this question, which has often been elaborated on, is the tendency of the drafting room to be secretive about certain new designs, keeping the machine shop entirely out of its confidence until all drawings and patterns are made and then handing the shop man a set of drawings with the expectation of getting efficient production only to find that certain operations cannot be tooled the way they should because of incorrect and poor designing. If better production is wanted the shopman should at least be given an opportunity of knowing what is taking place, and no doubt much of the peevishness existing among machine-shop men is because they are so seldom consulted by the drafting room regarding designs of jigs, difficult machining operations and other details that seem minor to the draftsman but are often important to the man in the shop who knows his surroundings, his machines, his tools, his men and what they can do best. This aloofness of the drafting room has cost many an organization a pretty penny, and is another cause of so much faultfinding among shop men with almost every drawing that leaves the drafting room. Mistakes in the drafting room will happen no matter how much care is taken, as the human element entering into the fabrication of a drawing is greater than any other. I find that on such occasions the criticism of the shop man is not by any means a constructive criticism; neither is it destructive. It is more of a pleasurable criticism that finds immense joy in pointing out the mistakes of the "wise guys" in the drafting room. These incorrect blueprints are always passed from man to man, and no one misses the opportunity to chuckle gleefully over the mistakes of one who signs his name " J. B. C.," a drafting-room genius, who, according to the men in the shop, pretends to know all about everything and uses a slide rule for all calculations (?).

The Slide Rule

Regarding the slide rule—that wonderful magical instrument that is waved in front of the poor devils in the shop who are supposed to be entirely ignorant of all its magic—I have always been itching for an opportunity to see in print certain psychological studies I have made on the slide rule.

Before I go any further let me restate what I said at the beginning of this article—that I intended to analyze only certain psychological facts and I did not wish to argue anything of a technical nature whatsoever. I also trust that the reader will not take my observations on the slide rule humorously, as I have tried to make them just as serious as possible. They extend over a long period and are guaranteed to be psychologically correct. Every bum machinist should recognize the earmarks.

1. Every draftsman should have a slide rule.

2. He should refer to it not as a slide rule but as a "Mannheim."

3. Every draftsman should carry his "Mannheim" where it will be visible to everyone. The upper vest pocket or the hip pocket is preferable.

4. All circumferences, areas, roots, triangles, etc., should be figured on the slide rule.

5. After calculating same on the slide rule they should be proved by paper and pencil by well-known formulas.

6. After proving with paper and pencil they should be further proved by referring to tables in the "American Machinist Hand Book," which should be on every draftsman's desk.

7. The possession of a "Mannheim" brings with it a certain amount of superiority. It should therefore be in full view of everyone at all hours of the day.

8. When discussions and arguments are in progress with the boobs out in the shop over certain calculations the little "Mannheim" should be brought forward. It will settle the argument, but not in favor of aforesaid boobs.

9. The slide on a "Mannheim" should be lubricated with a good castor oil as often as possible. Calculations can then be swiftly and easily made.

10. A "Mannheim" should be worn—not used.

MANUFACTURE of the 75-MM. HIGH-EXPLOSIVE SHELL

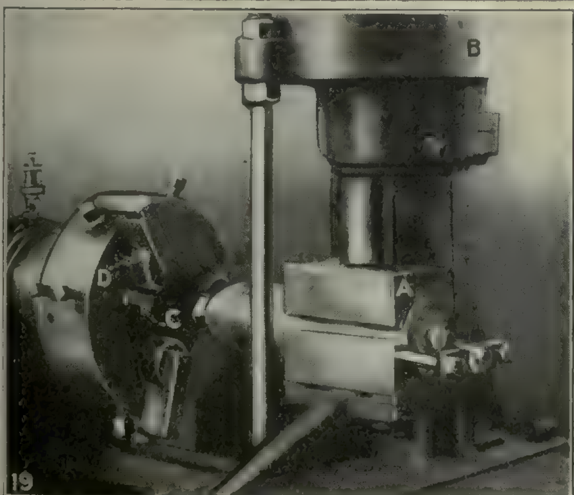
Part Three

This final installment describes the operations from the time the shells have passed through the heat-treating process until they are ready for shipment to the arsenal for loading, at which place the adapters, booster casings, fuse sockets and fuse-socket holders are assembled.

By S. A. Hand

FOLLOWING the heat treatment the shells are sandblasted on the interior to remove any scale that may have been formed during either the closing-in or the heat-treating operations. Next the center plugs are screwed in. This is done by hand while the shells are held in the air-operated bench vises. The shells are next mounted on centers and tested for concentricity by means of an indicator, and after passing this test they are finish turned from the base to the beginning of the bourrelet. The turning is done on centers and the shells are driven by the flat on the center plug, the driver being a fixture on the faceplate of the lathe. As there is nothing unusual in this operation, no further description is necessary.

The next operation is grinding the bourrelet. This is done on a Landis grinding machine by the usual method of traversing the grinding wheel over the part to be ground. After this the exterior of the nose is profiled or hollow milled to shape, Fig. 19. The shell is held in a stationary chuck, or vise, *A* that is securely mounted on the lathe carriage. The vise is operated by air and the air cylinder may be seen at *B*. The revolving head carries a single cutter *C* which has a cutting edge of the same contour as the exterior of the shell nose. During this operation the rollers *D* bear on the bourrelet which has just been ground, which tends to keep the nose concentric with the body. Next the nose is ground, Fig. 20; a Landis grinding machine is used for this purpose and the grinding is done with a formed wheel which does not traverse the work, but is fed in



FGIG. 19. PROFILE TURNING THE NOSE

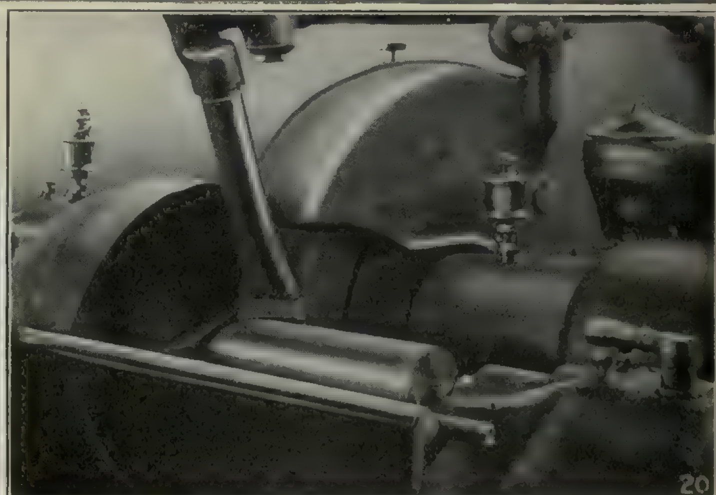
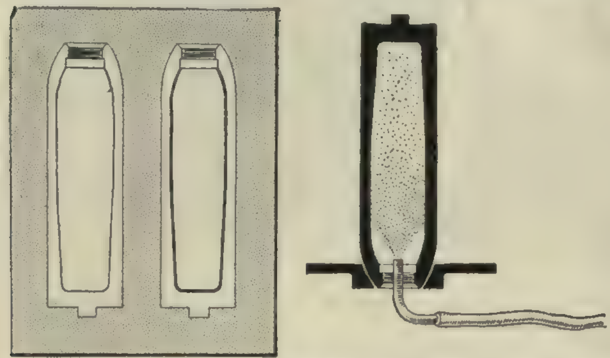


FIG. 20. PROFILE GRINDING THE NOSE

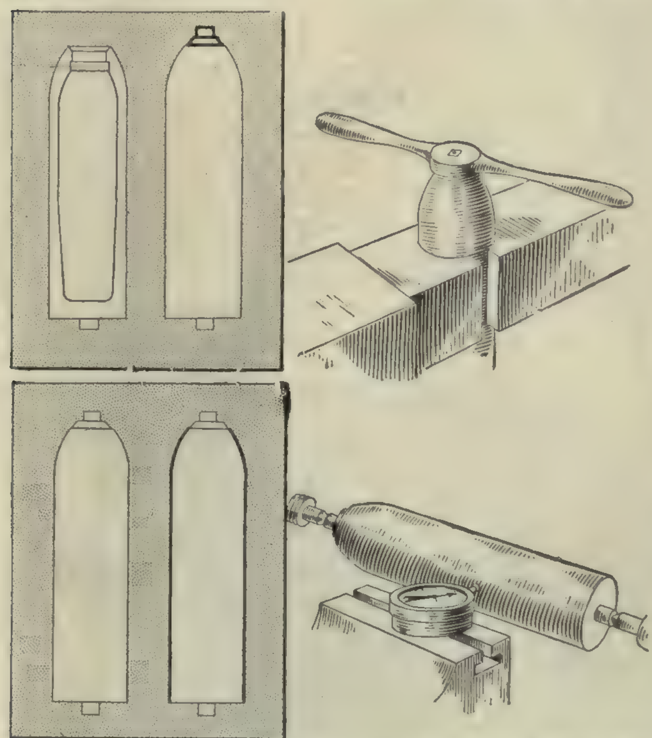
bodily. The wheel generally needs truing after every fifth shell has been ground. Sometimes a diamond is used for this purpose, but if only a very slight correction of shape is necessary an emery wheel dresser or even a stick of abrasive material will suffice.

After the nose grinding the next operation is the grooving for the copper band and the forming of the base. This is a lathe operation, and the work is done with a gang of three tools rigidly held in a heavy tool block. The tool on the left cuts the groove for the copper band; the next tool to the right chamfers the rear



TRANSFORMATION FOR OPERATION 12—SAND-BLAST INTERIOR

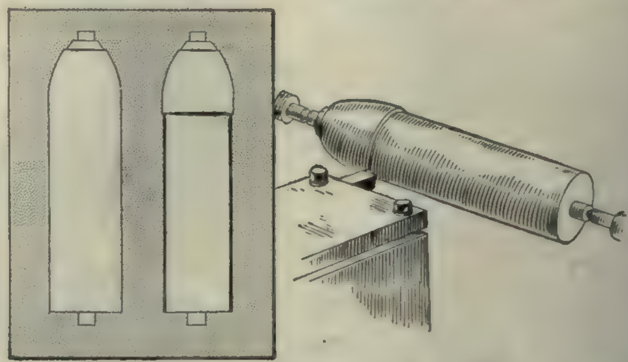
Machine used, Pangborn sand-blasting machine; production, 40 per hour.



TRANSFORMATION FOR OPERATION 13—SCREW IN PLUG AND TEST FOR CONCENTRICITY

Machine used, air-operated vise on bench; bench centers or lathe; gages, dial indicator.

edge of the groove, and the tool at the extreme right chamfers the shell at its base. These tools are positioned by a roller stop held in the tool block, which contacts with the shell base. After this operation the center plug is removed and the shell is tested for concentricity by the apparatus, Fig. 21, which shows a shell resting by its interior on two rollers *A* and the contact point of a dial gage touching the bourrelet *B*. The shell is revolved by hand and the dial gage indicates any deviation from concentricity. The dial gage is supported by the rod *C*, along which it may be moved in order to make the test at any desired point or points on the shell body. The rod *C* can easily be partially revolved by the fingers to get the contact point of the dial gage out of the way when putting shells on or removing them from the apparatus, after which the rod may again be positioned by turning the rod until the



TRANSFORMATION FOR OPERATION 14—FINISH TURN

Machine used, American, LeBlond or Monarch lathe; special fixtures, none; gages, snap and machine stops; cutting tool, Stellite; production, 24 per hour.

spring plunger *D* snaps into the countersunk spot *E* in the collar.

After this test the bottom of the copper-band groove is knurled. The knurling is to keep the band from turning when the rifling of the gun engages the copper band, and answers the same purpose as the sinusoidal waves formed in the band groove of various other types of shells.

The knurling, Fig. 22, is done in a lathe and the shell is held in an air chuck of the same general type as has been previously described. The knurls, one of which may be seen at *A* in the illustration, are held in a heavy block and are fed up to the work by means of a lever connected to an eccentric shaft. The pitch of the knurls is approximately 12 per inch and the knurling is 0.023 in. deep.

The next operation is cutting off the center tit. This is done in a special press. The shell is put into a guide hole, as may be seen at *A*, Fig. 23, and the cutting off is done by shear blades. In fact the whole apparatus is very similar to a sprue cutter except that it is much larger and more powerful.

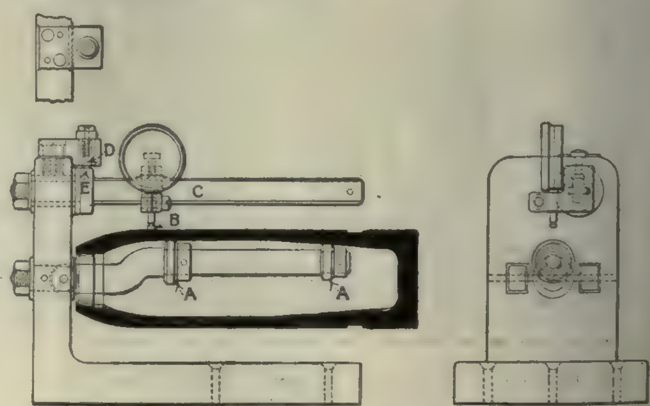
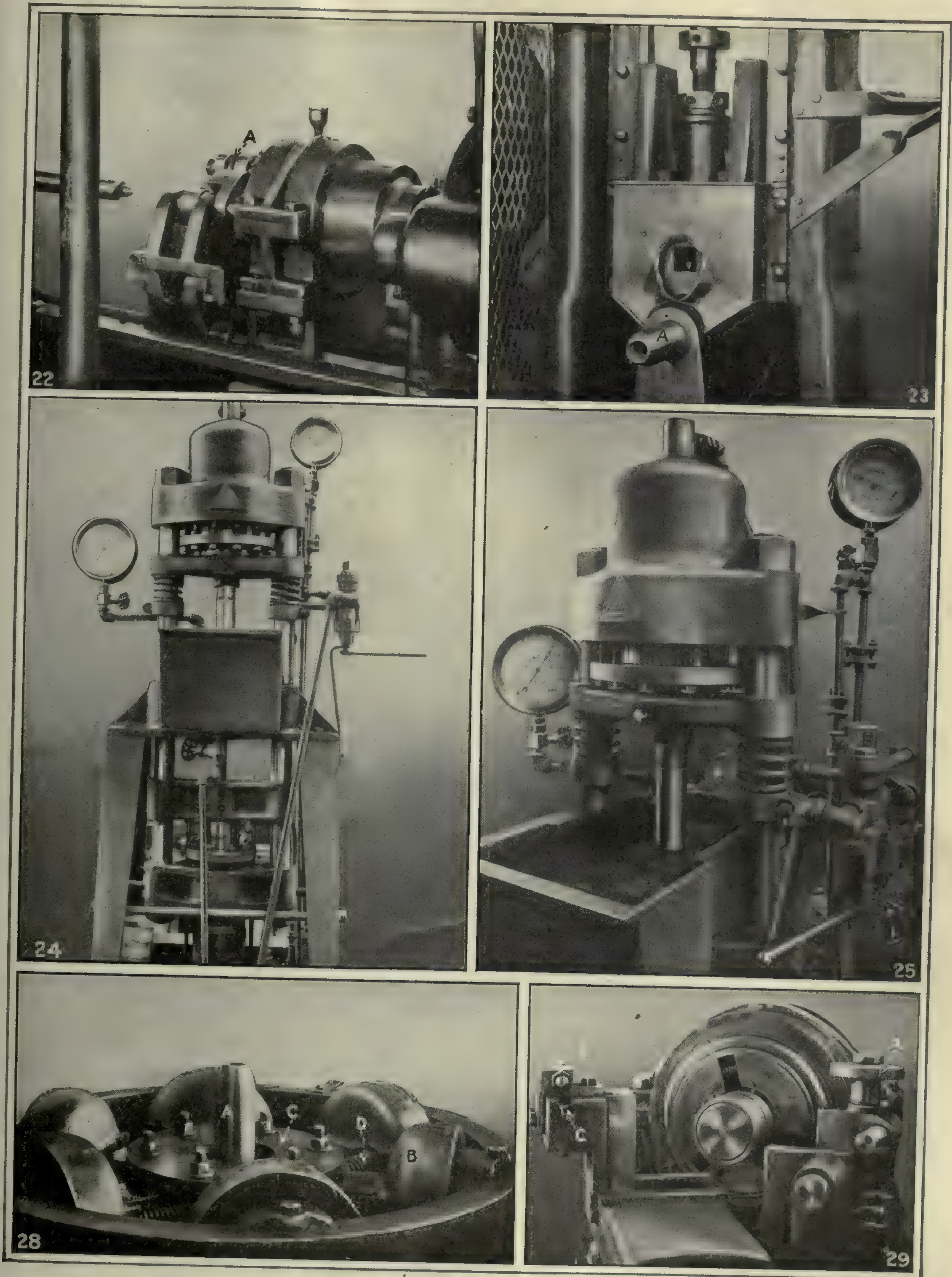


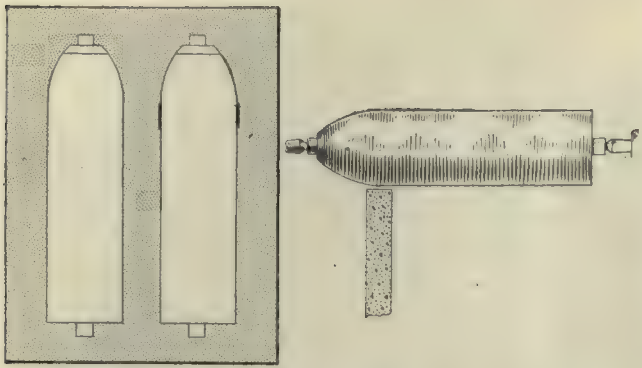
FIG. 21. APPARATUS FOR CONCENTRICITY TEST

After the center tit has been cut off, the base of the shell is ground on a Gardner disk grinding machine to smooth it up. The shell is next washed in hot soda water and is then ready for the first Government in-



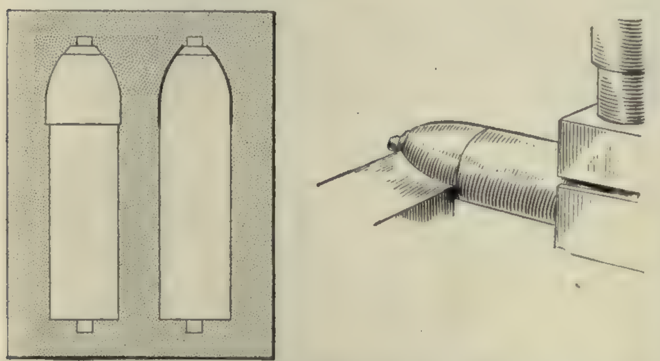
FIGS. 22, 23, 24, 25, 28 AND 29. A NUMBER OF THE OPERATIONS INVOLVED

Fig. 22—Knurling the band groove. Fig. 23—Shearing off center tit. Fig. 24—Hydraulic testing press. Fig. 25—The hydraulic test. Fig. 28—Pressing on copper band. Fig. 29—Turning gas check groove (gage and tool turned up)



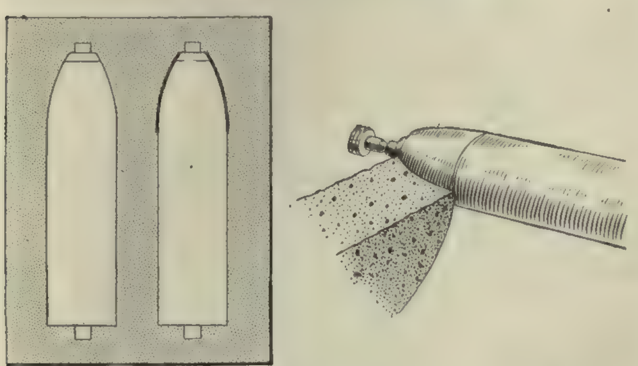
TRANSFORMATION FOR OPERATION 15—GRIND BOURRELET

Machine used, Landis grinding machine; special fixtures, none; gages, snap; production, 40 per hour.



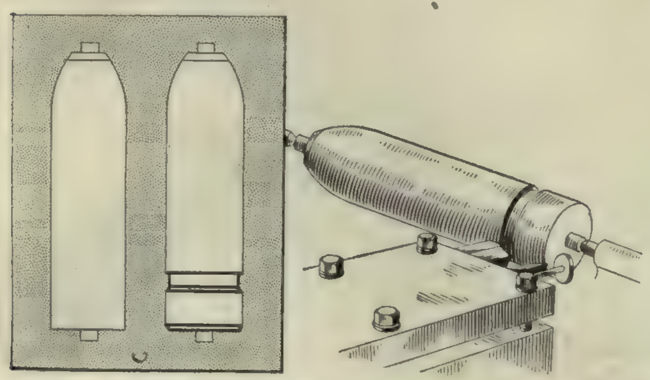
TRANSFORMATION FOR OPERATION 9A—PROFILE NOSE

Machine used, American or LeBlond lathes; special fixtures, air-operated vise on lathe carriage, special revolving head with single profile cutter and three rollers to bear on bourrelet; gages, profile and machine stop; production, 40 per hour.



TRANSFORMATION FOR OPERATION 15A—FORM GRIND NOSE

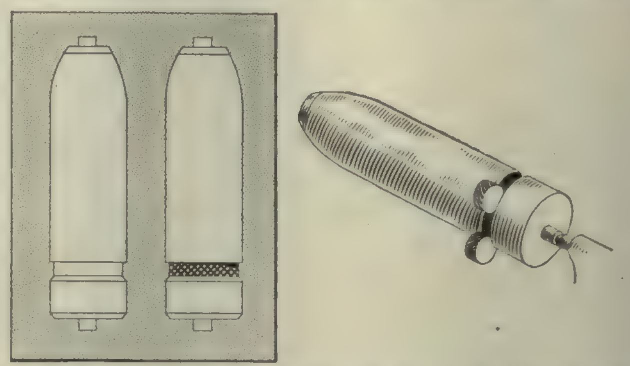
Machine used, Landis grinding machine with formed grinding wheel; special fixtures, none; gages, profile.



TRANSFORMATION FOR OPERATION 16—GROOVE FOR BAND AND FORM BASE

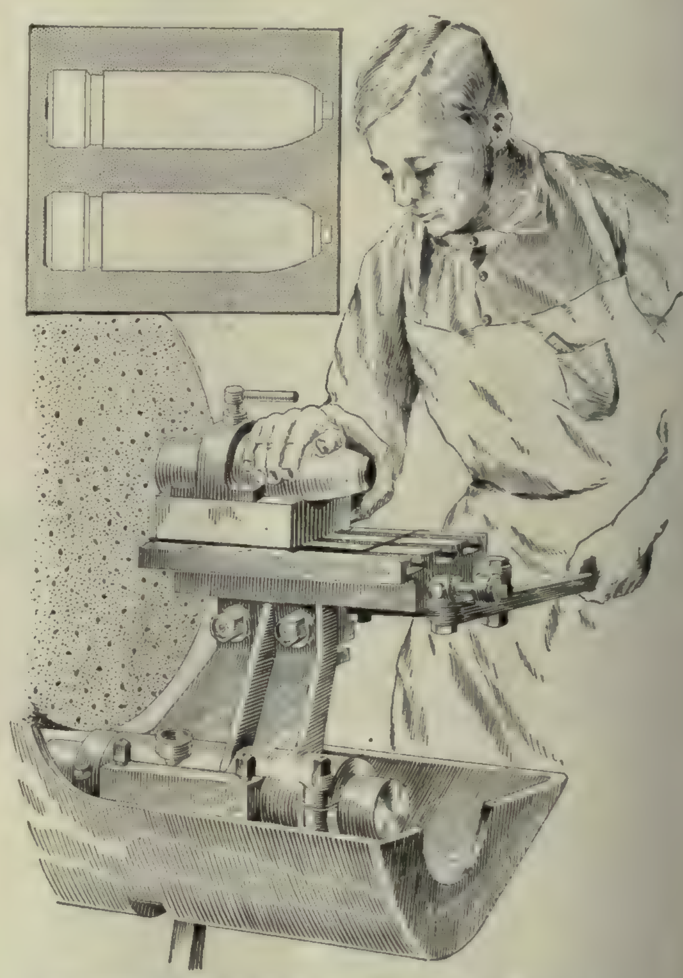
Machine used, LeBlond lathe; special fixtures, three tools in gang; gages, snap and roller gage on tool block; production, 44 per hour.

spection. This inspection merely covers the width, depth and knurling of the band groove and the shell is then ready for the hydraulic test. The specifications for this test are that the shell shall sustain an internal hydraulic pressure of 10,000 lb. per square inch for a period of 15 sec. and must show no leakage in base



TRANSFORMATION FOR OPERATION 18—KNURL BAND GROOVE

Machine used, LeBlond lathe; special fixtures, two knurls set in block and fed to work by lever; gages, stop on cross-slide; production, 45 per hour.



TRANSFORMATION FOR OPERATION 20—GRIND BASE

Machine used, Gardner disk grinding machine; special fixture, V-block and clamp; gages, none; production, 120 per hour.

or body, and any permanent enlargement that may be caused by the internal pressure must not exceed 0.001 in. per inch of diameter when measured at a point approximately ½ in. to the rear of the bourrelet. This test is to be applied after complete machining, but before banding, 10 per cent. of the daily output shall be put through this test.

For the hydraulic test a Metalwood press is used. Fig. 24 is a general view of the press. Fig. 25 is a close-up view and distinctly shows the shell in testing position; also the water tank in which the shell is filled by immersion and which catches the water from the shell when it is emptied. This dispenses with the annoyance due to wetting both the floor and the operator, which is invariably the case when the shells are filled and emptied outside of the machine.

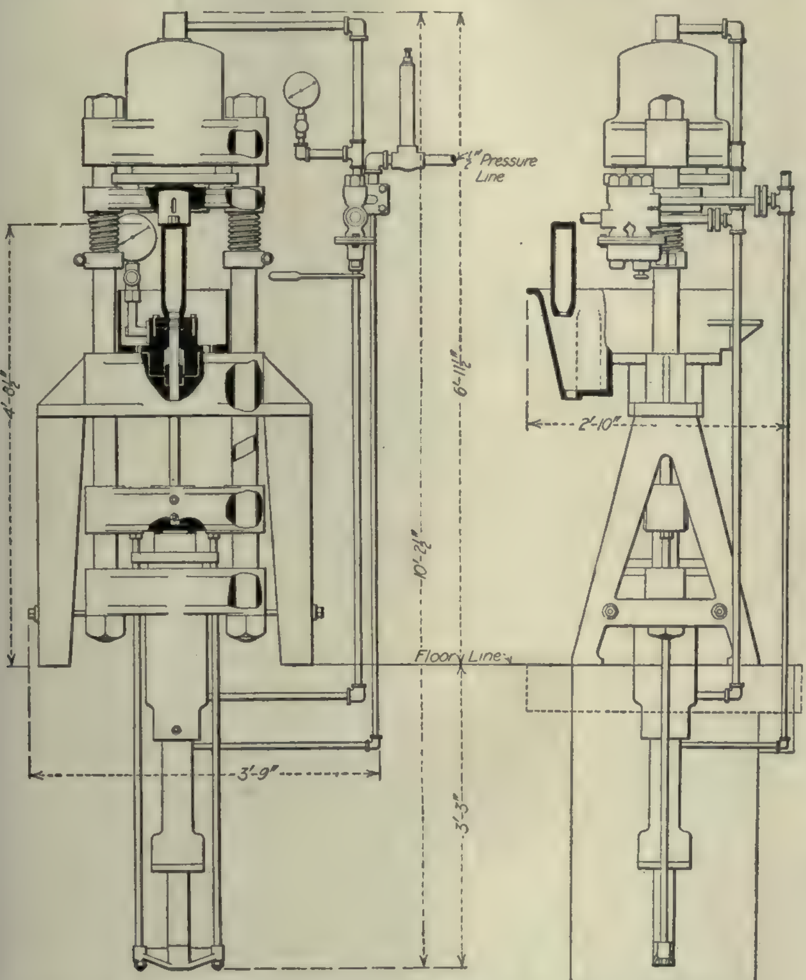


FIG. 26. OUTLINE AND PARTIAL SECTION OF HYDRAULIC PRESS

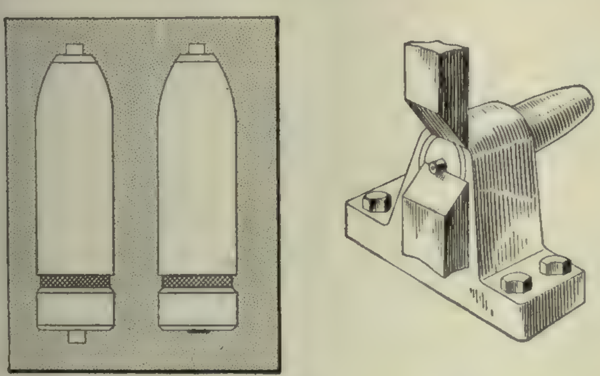
When filled, the shell is placed in position with the nose under water, and as all parts of the high-pressure head are at all times below the water level the objectionable trapping of air within the shell cavity is avoided. Absolute fluid-pressure reading can only be assured by exclusion of all air products from within both the shell and the gage ducts. With the shell placed nose downward there can be no mistaking the difference between leakage at the seal or leakage through the shell. The clamping pressure of this press has been worked out so as to avoid undue column stress on the shell structure.

Fig. 26 is an outline elevation of the front and one side of the press and gives a very good idea of its size and general arrangement.

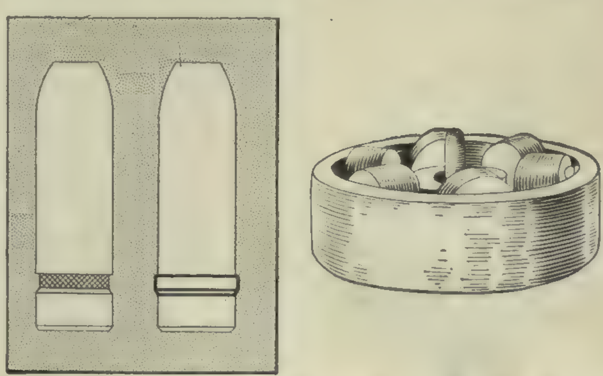
Fig. 27 shows the method of making the seal between the shell nose and the press. *A* is a hardened tool-steel member having a V-shaped annular bead against which the shell is clamped. *B* is a copper gasket which cuts off all pressure past the seal ring joint. *C* is the high-pressure head and holding member of the sealing parts. *D* is the registering member and centralizes the shell nose on the seat. After completion of the above test the copper bands are put on and pressed tightly into the band groove.

The copper bands for some shells are cut from a tube of the proper diameter and thickness, but for the shells under consideration the bands are dropforgings of copper. The band is slipped over the base of the shell, and when in the proper position is struck one or two blows with a mallet. This bends the band and causes it to hug the shell closely at the groove, holding it in its proper position until the crimping heads of the machine begin their work.

Fig. 28 shows the upper part of the hydraulic banding press, and at *A* is a shell ready for the pressing on of the band. The press has six radially disposed cylinders *B*. These cylinders are the movable members, while the rams or pistons are stationary. Each cylinder is provided with a projection which extends through and is guided in the annular boss *C*, and the inner end of

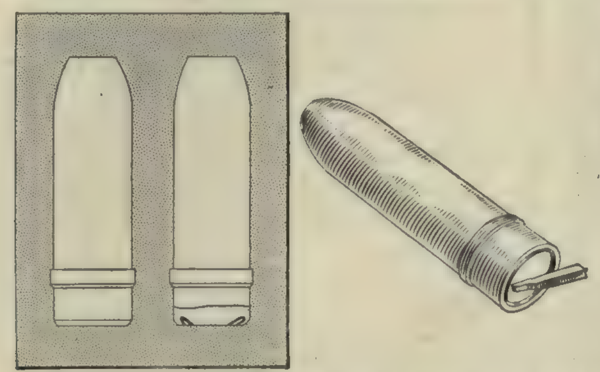


TRANSPORMATION FOR OPERATION 19—SHEAR-OFF TIT
Machine used, special punching machine; special fixtures, block with hole for guiding shell; gages, machine stop; production, 40 per hour.



TRANSFORMATION FOR OPERATION 24—PRESS ON COPPER BAND
Machine used, Southwark; special fixtures, none; gages, pressure gage on press; production, 60 per hour.

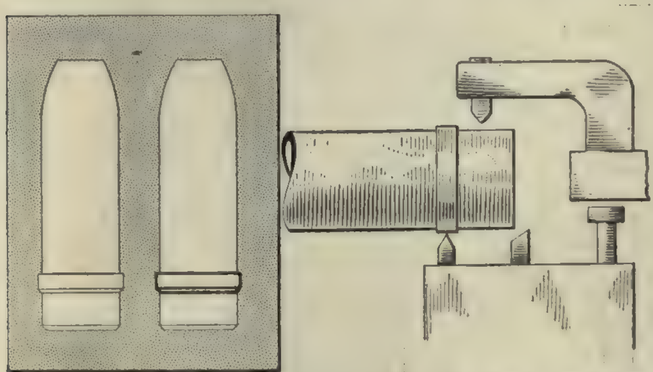
this extension forms the crimping or pressing head. When pressure is released the springs *D* force the cylinders outward and pull the crimping heads away from the shell, releasing it so that it can be removed from the press and a new shell inserted. In action the pressure is applied and released eight or ten times for banding each shell, and before each application of the pressure the shell is partly rotated so as to insure equal pressure at all points of the band. The pressure for banding is from 900 to 1000 lb., but is to be reduced from 850 to 900 lb. In a shell of the type under consideration it is impossible to use an internal mandrel to prevent squeezing the shell out of shape during the banding operation, so that it is very necessary that the work shall be done with the least allowable pressure.



TRANSFORMATION FOR OPERATION 25—GROOVE BASE FOR GAS CHECK

Machine used, LeBlond lathe; special fixtures, tool set in swinging block; gages, special on swinging blocks; production, 60 per hour.

After completion of the banding operation the shell is transferred to a lathe for the cutting of the gas-check groove. This groove is cut in the base of the shell, and as it is undercut at an angle of 30 deg. the compound rest set at that angle is used for the purpose.



TRANSFORMATION FOR OPERATION 26—TURN COPPER BAND

Machine used, American lathe; special fixtures, roughing tool in holder on tailstock spindle, finishing and chamfering tools in gang in tool block; gages, roller gage and machine stop; production, 60 per hour.

Figs. 29, 30 and 31 illustrate a very ingenious method of positioning the tools for this operation. Two stops are used. One is a roller stop *A*, Fig. 29, and the other is a contact stop of round steel *B* having a hemispherical end. The stop *B* is mounted in the same block as the cutting tool, the rear end of which is shown at *C*. Both of the blocks carrying the stops are hinged to their supports, as is clearly shown in the illustration, where they are shown turned up and out of the way so that a shell may be easily inserted or removed.

After chucking the shell the wheel stop *A*, Fig. 29, is turned down, as shown in Fig. 30, and while in this position the carriage is moved along until the wheel stop comes in contact with the shell base. The carriage is now locked in position and the wheel stop turned up out of the way and the tool block turned down in position for making the cut, as shown in Fig. 31. In cutting the gas-check groove the compound rest only is

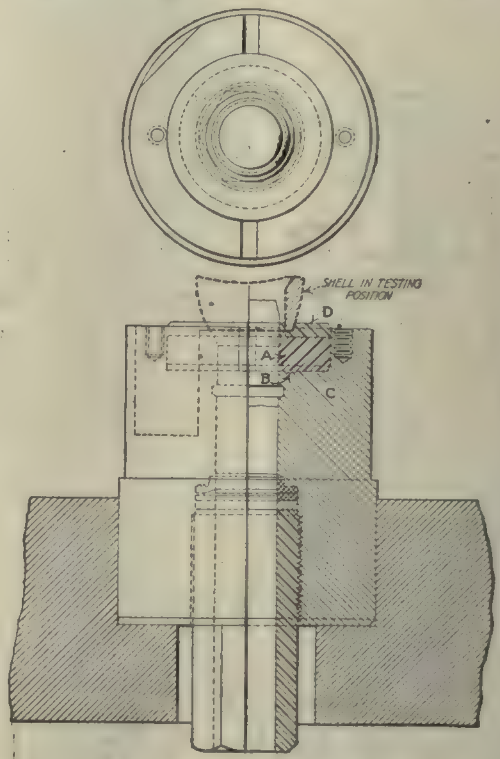
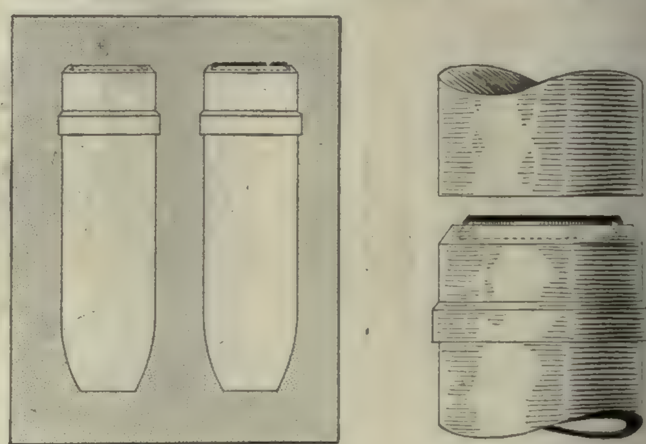


FIG. 27. DETAIL OF SEAL

used and the feeding is done by hand. The depth of the cut is limited by the stop *B*, Fig. 29, coming in contact with the base of the shell.

After grooving for the gas check the next operation is that of turning the copper band, for which the shell is again put in a lathe and held by an air chuck of the type before described. Three cutting tools are



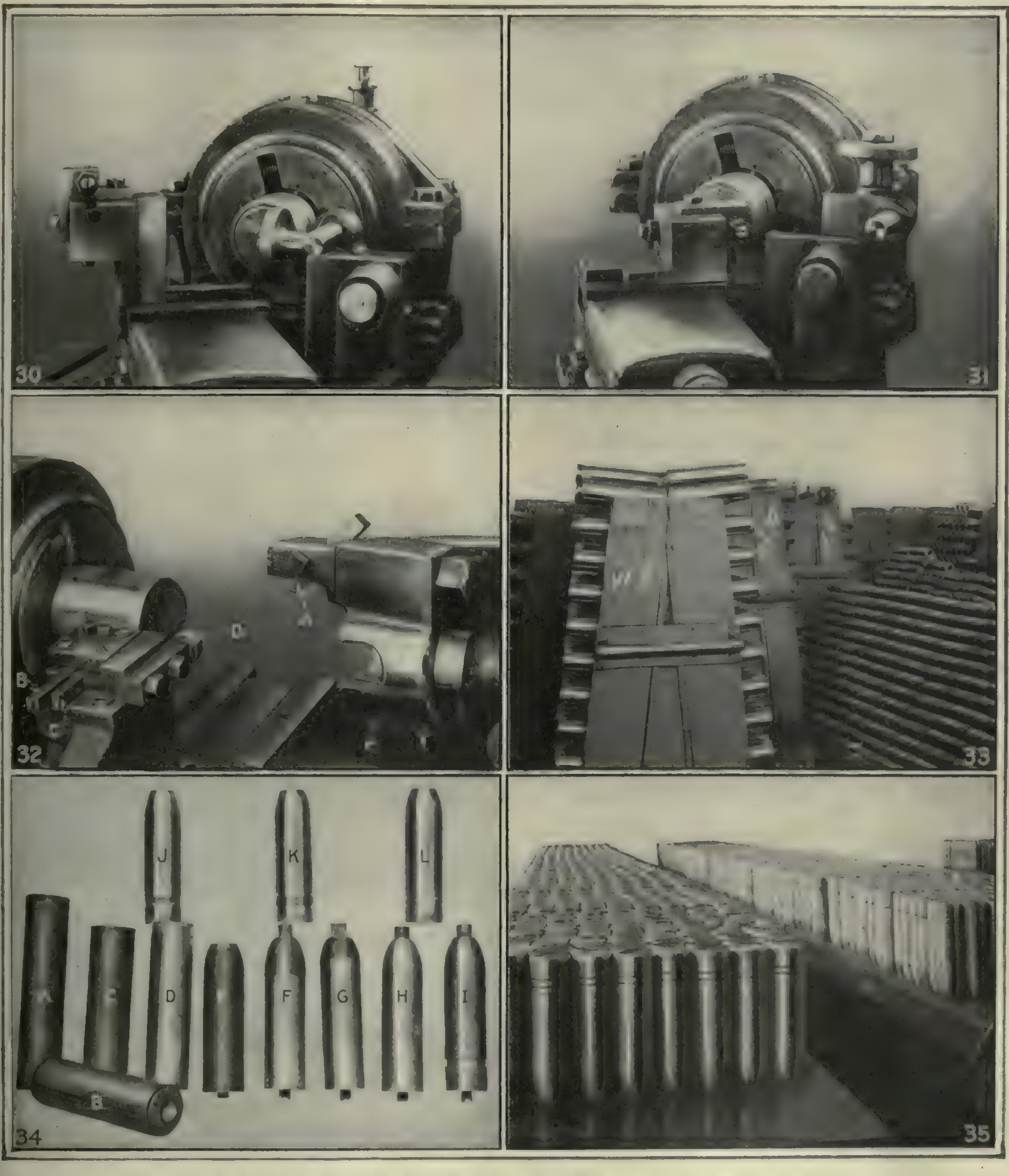
TRANSFORMATION FOR OPERATION 27—ASSEMBLE GAS CHECK AND WASHER

Machine used, Hamilton pneumatic press; special fixtures, none; gages, pressure gage on press; pressure, 110 lb.; production, 60 per hour.

used: a roughing tool *A*, Fig. 32, which is held in a special fixture fastened to the tailstock spindle; a turning tool *B* and a chamfering tool *C*, both of which are held in the same tool block.

The roughing tool *A* is fed to the cut by a hand lever attached to the rear end of the tailstock spindle, but is not visible in the illustration. The finishing cut is made with tool *B*, which is traversed across the band. The motion of the carriage is then continued until the wheel stop *D* strikes the base of the shell when the chamfering tool *C* is fed inward to a stop. This puts a slight chamfer on the rear part of the band. The band is now touched on the sides with a hand tool to remove the burrs formed in turning and the outside is smoothed with a file.

The washer and gas check are next assembed on the shell, and for this purpose a small press operated by compressed air at a pressure of 110 lb. is used. The washer, which goes next to the shell base, is made of lead and is flat, while the gas check, which goes on the outside, is brass and has the outer edge turned up at an angle so that it will enter the groove made to re-



FIGS. 30 TO 35. THE SHELLS IN VARIOUS STAGES OF COMPLETION

Fig. 30—Turning gas-check groove (gage turned down). Fig. 31—Turning gas-check groove (tool in position). Fig. 32—Turning the copper band. Fig. 33—Trucking shells. Fig. 34—Shells in various stages. Fig. 35—Group of banded shells.

ceive it. When the pressure is applied, the upturned edge of the gas check is forced into the groove and the body flattened. This flattening process forces the outer edge of the gas check in an outward direction and attaches it and the washer under it firmly to the base.

The gas check is a very important part of the shell, as it seals up any cracks or flaws that may not have been discovered. Undoubtedly the hydraulic test would expose any such cracks or flaws, but it must be borne in mind that only 10 per cent. of the shells undergo this test. Should any cracks or flaws exist in the base of a shell, unless sealed up there would be great danger that when the gun is fired the flash from the gun charge would ignite the explosive contained in the shell. Thus

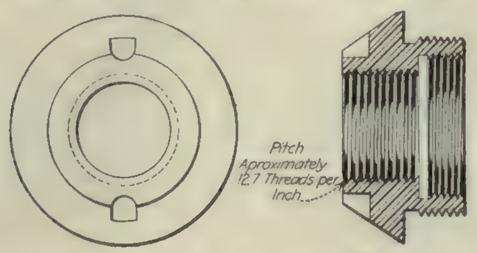


FIG. 36. THE ADAPTER

the shell would explode prematurely and if this explosion should occur before the shell left the barrel of the gun the gun would be wrecked.

The shell is marked with the lot number and the initials of the manufacturer and is then ready for the second Government inspection. This is an inspection of all machined surfaces, both interior and exterior, gaging of particular parts and checking up the weight of the shell.

After inspection the shell is coated on the inside with shellac varnish containing 25 per cent. of colophony, the melting point of which shall be approximately 60 deg. C. It is then slushed on the outside with a heavy

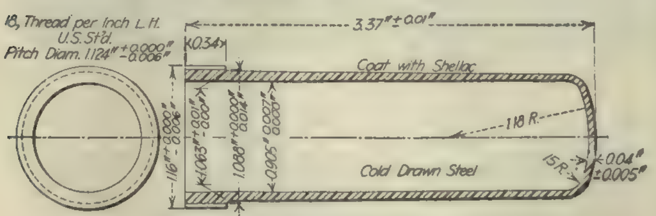


FIG. 37. BOOSTER CASE

grease to prevent rusting and then packed for shipment to the arsenal for loading.

The shells are shipped without adapters, booster casings, fuse sockets and holders, which are all made under an entirely separate contract.

Fig. 33 shows the shells loaded into trucks to be passed along from one operation to another. Note the marks in chalk on the ends of the trucks, such as V. F. 8, etc. This means that the shells contained in this truck came from the Valley Forge and that their heat number is 8.

Fig. 34 shows shells at several stages in the course of manufacture. *A* is a rough forging; *B* has the tit ground and has been centered; *C* has been cut off at the open end; *D* has been rough turned and bored; *E* has had the nose closed in; *F* has been thread milled, heat treated and finish turned; *G* has been ground on the bourrelet; *H* has had the nose profile turned and ground; *I* has had the groove turned for the copper band and the base formed; *J* has had the center tit cut off, the base ground and the band groove knurled; *K* has been copper banded; *L* has had the band turned.

Fig. 35 shows a group of banded shells.

The adapters, Fig. 36, are made from cold-drawn steel rod. They are blocked out and some portions finished in automatic screw machines and are then trans-

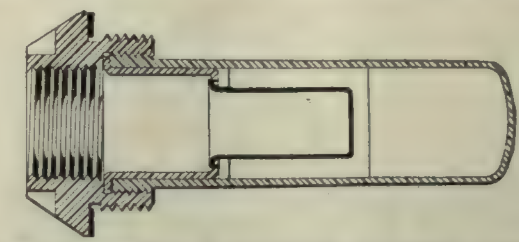


FIG. 38. ASSEMBLY OF ADAPTER, BOOSTER CASE, FUSE SOCKET AND HOLDER

ferred to hand screw machines for the final finishing. This includes many interesting operations which require several very accurate chuckings, but for obvious reasons these details cannot be made public at this time.

The booster case, Fig. 37, is press drawn from cold-drawn sheet steel, but as it is purchased all finished but threading, and as that is a very simple screw-machine operation, further details are of no interest.

Fig. 38 is an assembly drawing of the adapter, booster case, fuse socket and holder.

Teaching Oxyacetylene Welding

The great need for oxyacetylene welders in the army and out of it makes this illustration particularly timely. It shows two of the students at the Sweeney Automobile

TEACHING BY ACTUAL WELDING

and Tractor School, Kansas City, Mo., learning to become welders by doing the job themselves.

Oxyacetylene welding has become a part of the automobile and truck repair business, and is fast growing into other lines as well. General Pershing recently sent over a call for several thousand welders, and many are being trained for this work. This is one of the few trades where the skill of the individual worker makes him independent of machines, for this is something that cannot be taught in a few hours or even days when it comes to handling all kinds of metals under various conditions.

Teaching Human Engineering in the College Curriculum

By Fred H. Rindge, Jr.

Our universities have been so engrossed in turning out engineers who were taught only the mental and physical sides of the science that they overlooked the training of the individual from the human, or social, side. The tremendous influence of organized industry on the modes of thought have compelled many of these institutions to establish in their curricula a course in human engineering as a complement to the older branches. This article gives a broad idea of the subject in an interesting way.

These are days of great industrial and social problems in America. In the face of the war crisis it can be said that the nation as never before is looking to its engineers to solve many of these problems. The engineer of today and increasingly of tomorrow stands at the focus of the whole industrial situation, and he above all others must be able to look both ways; that is, he must understand clearly the points of view of both employer and employee. His opportunities for practical service daily become greater, and thinking men realize that to be a technical engineer is not enough—he must be a social engineer and a human engineer as well.

There is every indication that the engineering profession is becoming more alert to the significance of human engineering, as may be gaged by the references in the papers, magazines and books of the day to this phase of the profession. Its importance is proved by the fact that 30,000 business concerns in America have adopted some form of welfare work as a part of their operation. Engineering schools and universities are including in their curricula courses in human engineering. As an instance the Ohio State University for three days in October, 1916, held a great congress of human engineering, and others are being planned.

What the Subject Covers

Human engineering is a broad subject. It is that phase of engineering which studies and promotes the welfare and happiness of the employees in an industry. It deals with scientific and just methods of "hiring and firing;" with comprehensive schemes of training and education; with the improvement of working, living and leisure conditions; with fair methods of handling laborers, and with the growth of personal character and individual efficiency. Great business interests are demanding of our engineering schools a new type of graduate, who will clearly understand these principles and methods.

Naturally this raises the question, "How are our colleges and engineering schools meeting this demand?" Realizing their past neglect, many of them are now alert, and from visits to most of the important engineering schools of the country I am convinced that the next few years will witness many radical and greatly needed changes in the curricula, following the beginnings which have already been made.

Most of the important mining-engineering colleges are devoting periods to mine-rescue work, mine management, first aid, etc. Other colleges have courses in management of various kinds, emphasizing more or less the human side. Engineering students are now expected to take courses in political economy, economics, sociology or labor problems, and special lectures along human-engineering lines are given.

On the other hand while in many cases professors talk to their classes about the human phases of engineering, even though not indicated in the courses, nevertheless out of over 70 curricula of the best engineering schools which I have examined less than a third contain anything that could be said to deal with this vital subject. Even in these the treatment of the subject is limited and only a small number of the students take the course.

Results Obtained

In every case where colleges have broken this new ground the faculty, students, alumni and employing concerns have been pleased with the outcome, and though it may take some time to reach the ideal the attempts being made have given splendid results. A few examples, as proof, will suffice. Leland Stanford University has a course in shop administration, which touches the problem as it deals with wages, factory methods, etc. Northwestern University announces a course on "the public relations of engineers," including lectures and readings on the relations of a practicing engineer to other men; obviously this course has possibilities, but whether it deals with the conservation of human resources depends entirely on the professor. The University of Colorado has a course in works management which includes a study of the organization of labor, sanitation, etc. The institutions of prominence treat on such subjects as labor, wages, profit sharing, employers' liability, personal qualities involved in efficient management, general and departmental organization of working forces, application of the principles of efficiency engineering, and value of business ability and diplomacy.

The vital question is this: To what extent do employers desire technical graduates to possess character, an understanding of human engineering and a knowledge of how to handle men? A few years ago Prof. Hugo Diemer of Pennsylvania State College received responses to a questionnaire from 283 manufacturing concerns, a number of which employed engineering (especially mechanical) graduates. The first question asked was, "What personal qualifications as to character and temperament should an applicant possess aside from technical preparation?" Some of the answers to this question and the number of firms agreeing were: Good habits, clean manhood, temperance and sobriety, 25; steadiness and application, 20; obedience to superiors, disposition to submit to discipline and receive di-

rections in an agreeable manner, 17; ability to know men and to get along with them, 12; industry, 12; integrity, 11; patience and perseverance, 11; energy and forcefulness, 7; self-reliance, 6; speed, hustle, 6; common sense, 6; ambition, desire to advance through work, 6; interest in work, 5; even temper and self-control, 5; miscellaneous, 44.

Another question was, "What general nontechnical studies would best equip a candidate for your needs?" Some answers to this question were: Business practice and methods, system, cost keeping and accounting, 23; English, 18; shop management and economics, 6. One prominent employer significantly wrote: "There is something radically wrong with the engineering courses as they are now conducted, but no college seems to be able or willing to make such changes as the needs of the students and employers alike demand." However there is increasing evidence that many colleges are willing to face the facts squarely and try to meet the need.

Investigation of Dr. Mann

Dr. C. R. Mann of the Carnegie Foundation for the Advancement of Teaching has, in coöperation with the National Engineering Societies, just completed the most comprehensive investigation of engineering education ever undertaken. In a preliminary report written for the United States Bureau of Education he says: "The successful engineer today must direct the powers of men as well as the powers of nature. . . . For the past 50 years engineers have been absorbed in the work of inventing, constructing and perfecting machinery and the material conveniences of life. A large field of usefulness along these lines will always remain open to them. But the methods of this work have now been standardized and reduced to a system. Every large plant has its designing department and even its research laboratory. Relatively little attention has as yet been given to the scientific study of problems of the organization and control of the forces of men. These problems of the conservation of human resources are as much engineering problems as are those of the conservation of material resources. The demand for creative work in this field of human engineering is daily becoming more insistent."

Dr. Mann's letters to 7000 practical engineers throughout the country resulted in the following estimate of qualities which determine professional success: Character, integrity, responsibility, initiative, resourcefulness, 41 per cent.; judgment, common sense, scientific attitude, perspective, 17.5 per cent.; understanding of men, executive ability, 14 per cent.; efficiency, accuracy, industry, thoroughness, 14.5 per cent.; total 87 per cent. Knowledge of the fundamentals of engineering, 7 per cent.; technique of practice and of business, 6 per cent.; total, 13 per cent. Thus the human qualities comprise 87 per cent. of the engineer's success.

Most colleges take good care of the 13 per cent. qualities. The question therefore resolves itself into this: How can an engineering curriculum be adapted to develop the other 87 per cent.? It is evident that character, judgment and understanding of men cannot be developed by instruction and study alone. Some practical experience with working conditions and working people is necessary. The well-known scheme of the University of Cincinnati by which students spend half their time (5½ months, alternating every two weeks) at actual work in a plant helps greatly. Massachusetts Institute of Technology sends its advanced chemical-engineering students into seven different plants six weeks at a time, under a resident director, for a similar purpose.

Beyond this I believe one thing more is needed. Working with or having charge of men in an industrial operation is not the same as knowing men personally and intimately outside the shop. Suppose a student could find time to meet a group of foreign laborers one or two evenings a week to teach them English and citizenship. Suppose he could get to know each one well; could go into their homes, understand the conditions under which they were working, living and recreating; get an insight into their thoughts, motives, feelings—their very lives—this would be indeed worth while. It might mean teaching men who had very little and perhaps no knowledge of English the student teacher not knowing their language. This would demand patience, resourcefulness, sacrifice, initiative, good judgment and plenty of common sense. As he learned to know the men intimately they would come to him with all sorts of personal problems. His sense of perspective would be developed; his human sympathy would be awakened; his understanding and appreciation of all types of men would inevitably be enlarged. To stimulate ambition, hold interest and really get results would develop thoroughness and efficiency. And these are the very 87 per cent. qualities previously indicated! Instructing a group of American workingmen in mathematics, mechanics or other technical subjects; helping apprentices and working boys through clubs and other activities; in short anything really worth while which makes for friendly personal contact and mutual understanding would give the college student the training he needs.

What Yale Has Done

In view of this it is interesting to note that the Industrial Service Movement, which started at Yale eight years ago and has since spread to over 200 colleges, is helping to solve this particular problem. Dr. C. R. Mann in his report for the Bureau of Education says of this movement:

> The original object was to bring students while still in college into friendly contact with workmen and to develop among them a feeling of mutual confidence and good will. The work consists in (1) a study of welfare activities and of living and working conditions in American industries, and (2) a definite attempt to render some useful service to workingmen in the city. The latter is done principally through teaching English to foreigners, although there are classes in other subjects, as first aid to the injured, shop mathematics, civics, etc. Classes are small, in order to insure the element of personal contact, and are given at the workmen's home, in box cars, stores, pool rooms, boarding houses, shops or anywhere the men can be reached. The work is done voluntarily, without pay, and is independent of the college curriculum. This "industrial service work," as it has been called, under the guidance of the International Committee of the Young Men's Christian Association, has spread rapidly until now some 4500 students in more than 200 colleges are enrolled in it. The response and interest that it has called forth from students have created a demand for instruction on the human problems with which the students through it come into vital contact.
>
> Industrial service differs from ordinary social-welfare work in that it aids the development of the student in

widening his outlook, giving him deeper insight into the social aspects and the human responsibilities and opportunities of the engineering profession. . . .

Progress in engineering education demands the recognition of these facts. It therefore involves (1) the modification of traditional methods of instruction in such a way that the mastery of facts and of manual skill will be secured under conditions that impel thought and an appreciation of social use, (2) the extension of its field to include industrial production and the organization of human machinery.

It is evident, therefore, that an ideal course in human engineering, or its equivalent, should give students an opportunity for just this kind of practical experience. The movement also promotes other activities which might well be seriously considered by progressive engineering schools all over the country. Among these are: Special lectures in industrial management given by men who represent different points of view, such as employers, labor leaders, social workers, etc.; weekly discussions by groups of students; a special reference library on industrial and social problems; a bulletin board with the latest welfare material from various companies, etc.; inspection trips which will include a special study of the human side and special conferences of seniors to discuss their service opportunities after graduation.

For the past eight years the writer has been studying and working on this problem throughout the country, and he realizes the vastness of the field. Nevertheless the following outline of a proposed course in human engineering may be of interest. I think it involves most of the elements in other courses and is an attempt to summarize the combined thought of many whose counsel I have sought. Constant improvements in the course are to be expected and nothing is final. This outline is followed with slight changes at Pennsylvania State College and is being introduced in part in other institutions. Where too much material is suggested each institution will desire to make its own selection and adaptation.

Suggested College Course on "The Human Side of Engineering"

This outline is arranged to cover 64 or preferably 96 class periods—four or eight months work—at the rate of two or three periods a week. Certain topics may be omitted, if the assigned number of periods are lessened. Many subjects are suggested in order to permit of choice and adaptation to local conditions. The course should be supplemented by engineering trips to study certain industrial conditions and the betterment work of selected companies and social agencies. Reports and essays should be written. This is a course in human engineering, and should be directed by an engineering professor of large practical experience; other members of the faculty, sociologists, economists, selected engineers, employers, labor leaders and others may be requested to lead certain periods, as desired. Care has been taken to avoid biased judgment in selection of topics and references.

1. Introductory—The Human Factor in Industry.—Two periods. Showing that men comprise the most important element in any industrial operation, though in the past machines and processes have been given much more attention than has the human factor. Mechanical advance interrelated with human advance. The age of drive in industry is fast passing. Output depends in the last analysis upon men. The cost of labor in output. The relation of theory to practice in the realm of human engineering.

2. Historical—The Evolution of the Individual Worker in Industry.—From three to five periods. A brief summary of the history of industry with special reference to the influence of changing conditions upon the human factor. Industrial Evolution—The changes to the modern factory system, the rise of labor organizations, etc. The changing character of industry. The rising self-respect of the worker. Industrial unrest and the individual.

3. Industrial Organization—The Influence of the Modern System on the Worker.—Four to six periods. Plant location should be partly determined by human considerations. General and departmental organization. The employment function. Scientific selection of employees. The labor and welfare departments. The relation of wages, hours, etc. The problem of the foreman. Should foremen, superintendents, managers, etc., be chosen on the ground of their ability to deal sympathetically and successfully with men?

4. Human Factors in Production.—From 23 to 34 periods. (a) General—Capital and labor, immigration, unionism, Socialism, syndicalism, etc., conciliation and arbitration, human interests, motives and needs. (b) Working Conditions—Hours and wages, the minimum wage, industrial accidents and employers' liability, occupational diseases, insurance, compensation and pensions, employment of women, child labor, unemployment, etc. (c) Living Conditions—Housing, proper nourishment, poverty, home refinements, home gardens, thrift and savings, etc., coöperative stores, credit and banking coöperation, standards of living and family welfare; what relation has health to efficiency; proximity of home to factory; study of the budgets of typical working families. (d) Leisure Conditions—Amusements, intemperance, political influence, the social evil, education, etc.: their relation to working efficiency and contentment; industry's efforts to put a premium on temperance and character.

5. The Ethics of Engineering and Business.—Four periods. Approved standards and methods. Relationships of the technical engineer to his employer, to the employed and the general public.

6. Vocational Guidance and the Education of Employees.—Six to nine periods. What is our attitude toward vocational training? Should children be trained for a job or for life? Methods of education of foreign employees. American men and apprentices. Corporation schools, public night schools, correspondence study, special methods of various agencies, etc. To what extent does improving a man's education increase his working efficiency?

7. Coöperative Organizations.—Four to six periods. General—The church and affiliated societies; the school, social settlement, charities, municipal agencies, etc.

8. Legislation and Public Opinion on Industrial Questions—Municipal and Government Relationships.—Four to six periods. Extent to which welfare requirements have been incorporated in federal and state laws: Important specific laws and their influence. Enforcement of laws. Tendencies in industrial and social legislation. To what extent is public opinion a determining factor.

9. The Programs of Typical Companies—Industrial Betterment.—Five to eight periods. What has been and can be done along such lines as indicated above.

10. Scientific Management in Its Human Relations.—Two to five periods. Principles, importance of motion study, time study, division of labor, etc. The personal relations in the system. The idea of using efficiency systems to help men rather than to grind them down. How to get the men to understand this, etc.

11. Intelligent Dealing with Employees—How to Handle Men.—Four to eight periods (to be given by specialists). Examples of industrial leaders who have been successful in handling men. The hiring and firing of workers. Dealing with American workingmen, foreign laborers, colored workers, women and children.

12. Conclusion.—The engineer's responsibility for service.

There never was a day when America so greatly needed engineers and executives of broad sympathy, liberal education, an appreciation of the other fellow's point of view and a real knowledge of potentialities. The workers in the shops and mines are allies of the men under arms and they must be fairly and intelligently dealt with. This is a part of real war preparedness.

Sidelights

EDITED BY E. C. PORTER

In the seven months ending January, 1918, compared with that of the seven months ending with January, 1914, our imports from Europe fell 50 per cent., while those from other parts of the world increased 150 per cent.

* * *

The total amount of money in the United States at the beginning of 1918 was estimated at $6,256,198,271, or an increase of $1,244,000,000 during the year 1917. The per-capita circulation on Jan. 1, 1918, was estimated at $48.76 as against $43 a year before.

* * *

Bank clearings for February were $22,241,000, a new high record for February, compared with $21,630,000 in February, 1917, an increase of nearly 3 per cent. Exclusive of New York City, clearings were $9,981,000 compared with $8,836,000 a year ago, a gain of 13 per cent. About two-thirds of the cities reporting showed new high record for February.

* * *

In a paper read recently at Chicago, Major R. A. Millikan, professor of physics in Chicago University, stated that war was 85 per cent. science and engineering and 15 per cent. actual fighting. As one application of science he mentioned that it had proved practicable to locate the position of a heavy gun within 50 ft. by observations on the sound waves set up on its discharge.

* * *

We must work and save as never before in our history. We must increase our output and reduce our domestic consumption of all necessary products in order that there may be a great increasing volume of war materials going forward to our armies and the Allies who are fighting side by side with us. As the people reduce their personal consumption they will be enabled to finance the war by lending their savings to the Government, while at the same time they help themselves by increasing their personal resources and income.—Secretary William G. McAdoo.

* * *

The kaiser's speech to the German soldiers on the eve of their departure for China, July 27, 1900, shows why they are called Huns: "As soon as you come to blows with the enemy he will be beaten. No mercy will be shown! No prisoners will be taken! As the Huns under King Attila made a name for themselves which is still mighty in traditions and legends today may the name of German be so fixed in China by your deeds that no Chinese shall ever again dare even to look at a German askance. Open the way for kultur once for all."

* * *

Merchandise exports during January were valued at $505,000,000 compared with $589,000,000 the month before and $613,000,000 a year ago. Imports for January were $235,000,000 compared with $228,000,000 the month before and $242,000,000 a year ago. The balance of trade in our favor for January was $270,000,000 compared with $361,000,000 the month before and $372,000,000 for January, 1917. Present reports on exports include supplies going to our army overseas as at this time it is impossible to segregate them.

* * *

A garden at every section house is one of the food-producing measures which the Southern Pacific railroad is putting into effect this season. Agents, section foremen and trackmen, from Portland to El Paso and San Francisco to Ogden, are being instructed to convert to vegetable gardens all suitable ground available. In addition the company is endeavoring to lease all cultivable land which it owns (not used by employees) and a good deal of the right-of-way land adapted to truck gardening or agriculture is being leased. Vegetable gardens were made last year by hundreds of employees with great success.

* * *

The French government is manufacturing helmets from an alloy discovered by a Mr. De Montby, which contains from 92 to 97 per cent. of aluminum. It is suitable for use in the manufacture of aircraft and military equipment. According to *Engineering*, it is silver-white, has a specific gravity of 2.82, and a melting point of 1382 deg. F. Its tensile strength in castings is given as 30,000 lb. per square in. and in rods and sheets up to 64,000 lb., heat treated, its tensile strength is given as over 70,000 lb. per square in. It is claimed that it may be sand cast, die cast with or without pressure, hot and cold forged, annealed, drawn, rolled, stamped, hardened by temper, polished, electroplated and soldered. It withstands the action of all acids except hydrochloric.

* * *

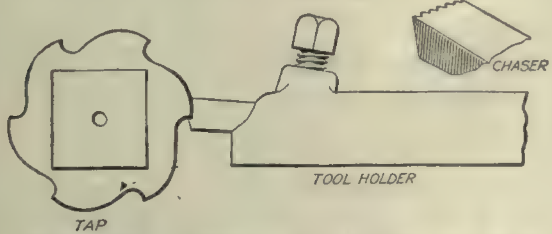
A report recently issued by the United States Bureau of Labor Statistics on accidents in the machine-building industry indicates that in spite of all that has been done to prevent accidents there are still too many industrial casualties. The bureau investigated 194 plants and found that on an average each worker lost 5.6 working days out of 300 in a year, due to accidents. Yard labor shows the highest percentage, with 29 days lost per worker due to accidents in a year. Boiler shops also show a high rate of lost time due to accidents, primarily as the result of insecure trestles and scaffolding. The high rate of accidents in yards is due to general neglect of safe location and construction of transportation systems, coupled with a lack of safety precautions and instructions. Accidents from falling objects are more frequent apparently than any other, the annual rate being 14 per 1000 workers. Cranes and hoists appear to cause the most serious accidents if the average time lost through accidents due to this cause is considered as a measure of the severity of the injury.

Making Chasers Without Special Equipment

By R. H. Smithson

Having noted upon various occasions articles in your columns upon the subject of chasers, I am sending you the accompanying sketch, which needs little description.

Place a tap of the required pitch between the centers of the lathe with dog or other means of driving it, and gear the lathe to the same pitch. Hold the blank to be cut by suitable means in the toolpost, and cut in the same manner as a thread. The clearance is determined



EMERGENCY METHOD OF MAKING CHASERS

by the angle at which the work meets the cutter (tap), and of course can be regulated by raising or lowering the level of the work. Best results are obtained with taps of large diameter, but the writer has successfully used taps as small as $\frac{5}{16}$ in.

[With the work presented at the angle shown, we should expect trouble from the tendency of the cutter to "dig" and chatter. To obviate this tendency we should provide means of holding the work on, or even below the center line of the cut. When the work is presented at the latter angle, the cutting edge of the chaser will be on the under side.—Editor.]

Correcting Holes in Jig Plates

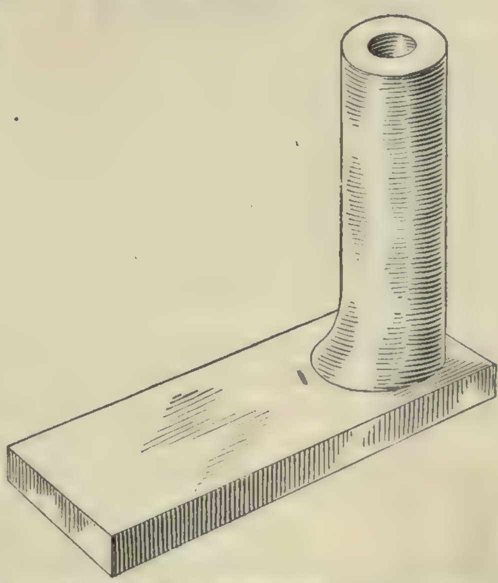
By James H. Follen

It often happens in shops doing close work on jigs and fixtures that on inspecting the location of the holes some are found to be slightly out. The following method is a good way to correct the error and will give results that are commercially accurate:

In our plant we put the jigs through inspection after boring the holes and before the bushings are ground to size outside. If a hole is found to be slightly out, we correct it by using the clamping bushing shown. This is a piece of tool steel turned and bored, leaving a tail for clamping. It is then hardened and the hole is ground to a size large enough to allow stock for the correction of the error. Then the outside is ground to a standard size at the same setting, making the hole and periphery absolutely concentric.

A reamer is then made to fit the hole exactly, though sometimes the hole can be made the nearest standard size and a standard reamer can be used instead.

This guide bushing is clamped over the hole to be corrected and is set in the exact position by using the outside to measure from, the same as one sets a button. The hole in the jig is then corrected by reaming out through the hole in the guide. The permanent bushing will of course have to be ground to fit the new size.



GUIDE FOR CORRECTING JIG HOLES

With a careful man on the job, and using the Johannsen blocks for setting, amazingly accurate results can be attained. This method is especially useful on large jigs that would entail considerable expense to place back on machine for corrections.

The writer knows of a case where a large jig that had to be within limits of 0.001 in. and was destined for the scrap pile was corrected with only a few hours' labor by this method.

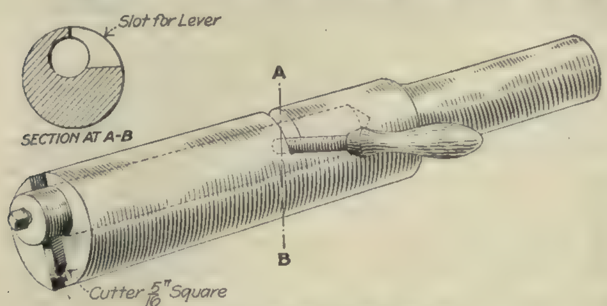
Tool for Cutting Internal Grooves

By C. C. Spreen

The tool shown in the illustration is designed to be used in the turret of the screw machine. The body of the tool is turned to fit the bore of the work in which the groove is to be made, and is of the required length to reach the point to be grooved and extend a sufficient distance outside the work to make room for the operating handle.

A hole is drilled longitudinally in the tool body for nearly its full length, this hole being off center by

an amount equal to the depth of the required groove. At a distance from the end of the tool body greater than the distance from the outside of the work to the point being grooved, a slot is made transversely around the tool body over one quarter of its circumference plus the width of the slot. A bar having near one end a $\frac{1}{4}$-in. square hole to hold a tool bit, and a setscrew for holding the latter in place, is fitted into the hole in the tool body and a small hole drilled diametrically through this bar to line with the transverse slot above mentioned. A piece of drill rod is fitted to the hole in this central bar, working freely through the



INTERNAL-GROOVING TOOL

slot in the tool body, the length of which slot permits the turning of the central bar one-quarter turn about its own axis. Thus, if a tool bit be fitted to the square hole in the central bar in such position that its point is just flush with the circumference of the tool body when at an angle of 90 deg. from the direction in which the axis of the bar is offset, turning the central bar one-quarter turn will advance the point by an amount equal to the amount of eccentricity of the axis of the bar.

An ordinary file handle on the operating lever completes the tool, the construction and method of operation of which is very clearly shown in the illustration.

Truing a Flywheel

By N. Denny

The flywheel on the engine of a direct-connected 150-kw. generator ran out of true, and on removing the wheel to remedy the defect it was discovered that the

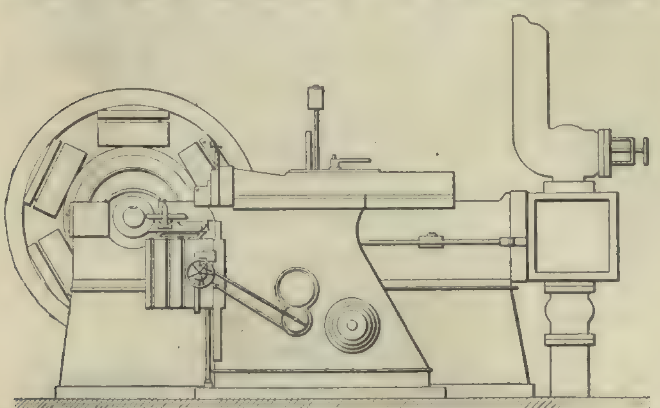


FIG. 1. TURNING THE GENERATOR SHAFT

hub was cracked and the shaft worn to a depth of 0.025 in. in spots.

A new split flywheel having a bore $\frac{1}{16}$ in. smaller than the original was ordered, and steps were taken to remedy the defects in the shaft.

To take down the machine was out of the question, so a 16-in. shaping machine was set up at right angles to the shaft, with a turning tool secured to the table, as in Fig. 1. By taking light cuts and shifting the shaping machine as required, the shaft was trued while turning in its own bearings. The worn keyway was straightened out by setting the shaping machine in line with

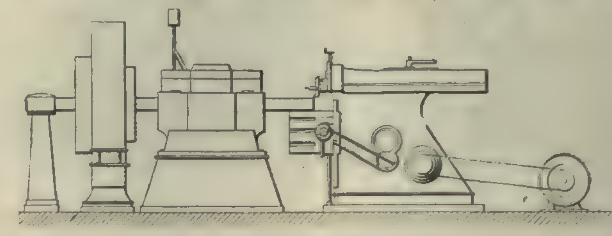


FIG. 2. CUTTING THE KEYWAY

the shaft and using a square-nosed bent tool, as in Fig. 2. A small motor furnished the driving power for these operations.

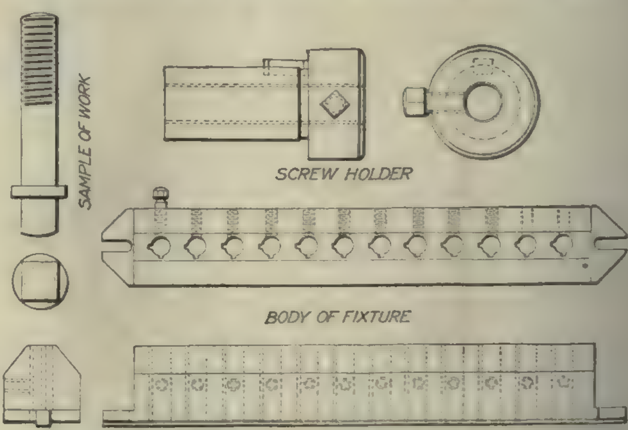
The new flywheel was bored 0.001 in. smaller than the shaft, and when the hub bolts were shrunk in place and the key fitted, the flywheel ran true.

The saving made by doing the job in this manner can be readily figured when the time required for the entire repair is considered, which was 26 hours.

Fixture for Squaring Screw Heads on the Milling Machine

By Frank H. Walker

The illustration shows a fixture which we have used in place of the dividing head commonly used in small shops for squaring the heads of $\frac{1}{2}$-in. collar head screws, with the result of greatly reducing the time consumed in this operation. The body of the fixture is of cast iron. The holes were bored in the boring mill to insure



FIXTURE FOR SQUARING SCREW HEADS

alignment, and the splines are accurately cut at right angles to each other on the slotting machine.

The bushings are made of machine steel, casehardened and ground. The head is knurled for the operator's convenience in handling. The bushings must be a good fit in their respective places, and the inside diameter must conform closely to the size of the screw to be squared, or the tightening screw will throw the work out of alignment. Bushings can of course be made to accommodate any size within range of the fixture.

The Profiteer

WE hear much of profiteering in some quarters, but we rarely meet a man who answers to the name. No one admits the title; it is always the "other fellow."

Who is the profiteer?

Everyone who demands or secures an unfair return for his labor or his investment.

The man who demands an exorbitant profit on his product; who puts on an extra price because it is a war contract or for the Government, or because the stress of war permits him to do so.

The man who demands an excessive price for a second-hand machine; who speculates in machine tools when they mean as much to the cause as the cannon they are to produce.

The man who advances rents to an exorbitant figure; who uses his monopoly of a piece of land to squeeze out an extra profit; who unnecessarily raises the price of foodstuffs.

The man in the shop who demands a wage entirely out of proportion to his output; who fails to do his share in the great work that must be done.

The man who delays production by not working as regularly and as steadily as his strength permits; who lets his high wage blind him to the responsibility of keeping on his job.

The man who uses the present crisis to further his own selfish ends; the manufacturer who will attempt to lower labor standards by employing women, and the labor leader who would force the closed shop under present conditions.

We cannot justify ourselves by what the other fellow has done. Each must answer for his own conduct. If we have failed to do our best in supplying munitions of any kind; if we have added to the burdens of war by unfair wages or profits; if we have let our own pleasure or profit interfere with the getting of supplies to our boys in France; if we have shirked in any way—let us determine NOW to sin no more.

Let us remember that the profiteer, the slacker and the traitor are first cousins.

Editorials

The Lack of Airplanes

The acknowledged failure of the aircraft program is perhaps the most discouraging of recent events. It is all the more disheartening because there seems to be no legitimate excuse for not building several hundred machines for use in France.

There can be no denying that even those high in authority were over-optimistic and too prone to advertise what we were going to do. Much of this was, however, based upon the assumption that designs would be promptly decided upon. Had this been done we should not now be apologizing for delays.

We have no patience with the calamity howlers who tell us that the Liberty motor is a failure—that we should have adopted this or that motor instead—or with those who assure us that the reason we are not producing enough airplanes is because of our inability to either design or build or because we could not get the wood, or the linen, or other supplies.

There were logical reasons for building the Liberty motor, which, instead of being a new idea plucked out of the blue sky, had two years of experience that cost close to a half a million dollars behind it. According to some of the best engineers it has been made ready for production with comparatively few necessary changes. And it has to all appearances given an excellent account of itself. No one with ordinary sense expects perfection in motors or anything else or of capacity.

There is no apparent lack of ability to build planes of any type that may be desired. We have the plants and the machinery and the men to design and to build them. We have or can get the wood, linen and other necessary material. We lack none of these things. And yet we are distressingly far behind with our production of aircraft; the fact that we have failed is all too plain.

What then is the reason for our failure to live up to our elaborate program?

Not the failure of the motor, nor the plane, nor yet the inability of the manufacturers to produce either in large quantities. Alas! it has been inability of those in authority to decide upon a practical machine and stick to it long enough to allow some to be built.

What the aviation branch of the army has lacked is someone with enough vision and backbone to order a large number of the best airplanes we could get. They would not be perfect—nothing ever is. They would have been criticised—that is to be expected. But we are sure that the man who braves criticism and orders the best he knows has a clearer conscience than the one who thinks he is playing safe when he dares not decide on anything.

It is much better to be damned for making a mistake than for doing nothing.

We have built thousands of training planes; we could have built at least hundreds of bombing planes, if not of battle planes. And who knows what effect this might have had on the great drive.

We have personally visited the largest motor and plane plants within a month and have, we believe, found many of the reasons for the delay. We had intended printing these conclusions in this issue. But as we go to press we are assured that a positive decision has been reached and that definite orders have been placed to build a large number of planes for our army in France.

With this assurance the *American Machinist* is not only willing, but glad to omit unpleasant details of past delays and to urge patience until the present plans have had time to bear fruit. We must not forget that our first aim is to win the war. And criticisms which do not help to correct mistakes are worse than useless.

Make Your Sacrifice for Democracy

The offering of a Third Liberty Loan is a call to patriotism. It comes at a time when the war in which America is engaged has reached the crucial stage. It is made while a world watches anxious to learn whether those who have promised to make democracy safe throughout the earth are prepared to make sacrifices for the cause they have championed.

It is not sufficient that we should love America. We must live America. Our self-respect impels to constant remembrance of those who, offering their lives in the trenches, look to us at home to furnish the money which shall provide them with food, clothing, hospital supplies and the munitions that shall minimize to some extent the dangers which they face.

The call to patriotism is a call to service and to sacrifice. Not all are asked to make monetary sacrifices in order to subscribe generously to this loan. But this does not relieve any from the obligation of service; it withdraws from none the privilege of sacrifice for America. There is no special virtue in buying Liberty bonds—it is merely the performance of a plain duty.

What must be appreciated and lived is the fact that sacrifice for our country is necessary. Sacrifice of time, of comfort—perhaps even of some part of the family life that is so sacred and so precious.

You know the truth about these bonds; you understand why it is necessary for your Government to issue them. But does your neighbor? Every moment of your time that can be spared from personal duties should be devoted to the work of enlightenment.

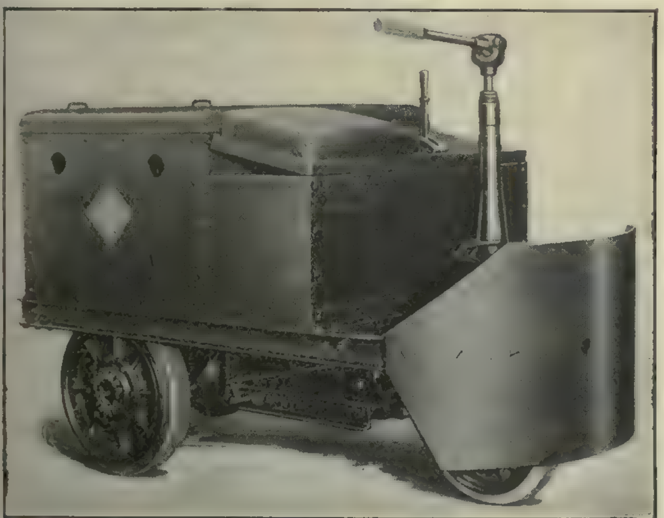
The Government pays good interest on the bonds you buy; but the return you will receive will be as nothing compared with the benefits that will accrue to you if you help yourself by helping the sale of these bonds at the cost of some ease and comfort.

The agents of the enemy of America and of civilization endeavor to spread the idea that this war is a rich man's war. That lie must be nailed, and it will take time to nail it if employers of labor do not show by their actions that they realize that it is democracy's war and support it with more than their pocketbooks.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Elwell-Parker Electric Tractor

The illustration shows a new electric tractor that has recently been placed on the market by the Elwell-Parker Electric Co., Cleveland, Ohio. The tractor is known as the company's type TA. The drive is single-worm reduction to the two wheels through a full floating axle, the steer being through the single front wheel by means of a handwheel or lever. Three speeds are provided in either direction, the maximum being 625 ft. per minute without load. A seat-actuated circuit-breaker is used. The tires are solid rubber of the

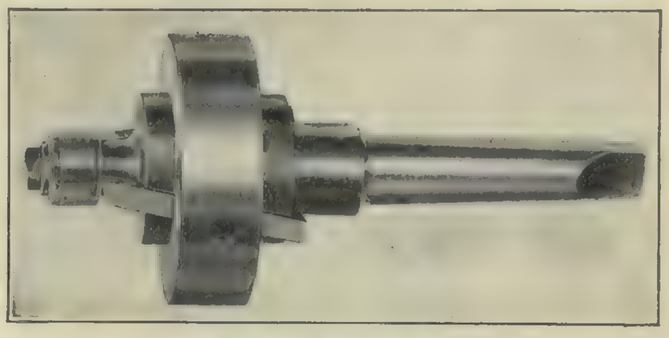


ELWELL-PARKER TYPE TA ELECTRIC TRACTOR

press-on type, 20 x $3\frac{1}{2}$ in. The frame is mounted on springs and has a length of 70 in. and a width of 41 in. The maximum drawbar pull is 850 lb. and the normal 300 lb. The battery used is a 30-cell Edison or a 16-cell lead-plate battery.

Genesee Facing Tool

The Genesee Manufacturing Co., Rochester, N. Y., is now manufacturing the facing tool illustrated, which is for the purpose of counterboring, facing and forming operations. The features claimed are that the chip space is not reduced by repeated sharpenings, and that no special jig or machine is necessary for grinding. In grinding, the blades may be tested with a square, and after being finished are replaced in their slots against the bushing, this automatically bringing each cutting edge into proper alignment. The blades are placed at an angle of 12 deg. for steel, malleable iron, etc., and radial for brass and other soft material. The tool is made with either two or three cutters and the



GENESEE FACING TOOL

blades can be easily replaced. The tool is at present made in four sizes without outside diameters of from 2 to $4\frac{3}{8}$ in. having facing capacities of from $1\frac{1}{4}$ to $3\frac{1}{2}$ in. respectively. The shanks are Morse taper from No. 2 to No. 4.

Springfield Gun-Boring Lathe

The illustrations show a machine recently designed and built by the Springfield Machine Tool Co., Springfield, Ohio, for the purpose of boring the tubes, jackets and bands for field guns. The machine consists of a heavy bed carrying at one end a headstock driven by a 35-hp. variable-speed motor. The power is transmitted to the rear of the headstock by means of a silent chain running in a bath of oil, and from there is transmitted to the spindle through gears giving four mechanical changes of speed. These gears are of chrome-nickel steel, heat treated and hardened, with the exception of the large gear back of the chuck, which is of high-carbon vanadium steel. A ball thrust bearing is incorporated directly behind the chuck. Forced-feed lubrication is used for all working parts within the headstock. The feed is transmitted to the carriage through the feed rods shown at the front and through a system of gearing consisting of a worm and worm-wheel, spur gears and a rack and pinion, being finally delivered to two large racks on top of the bed. The gear reduction amounts to 2400 to 1. A handwheel

at the front is provided for small carriage movements and a rapid-traverse mechanism is also incorporated. This is shown in the rear view of the machine. One of the illustrations shows a close view of the carriage. The center lever is the quick-return lever, while the long lever in front of the apron is the power-feed lever. The handle to the right, pointing vertically, is the interlocking lever, which prevents the rapid-traverse mechanism being engaged while the feed mechanism is in operation, thereby preventing two different rates of travel being imparted to the carriage at the same time. The handle to the left, pointing vertically, is for operating the electrical mechanism, which controls the motor and is used for starting and stopping the main drive motor. This view also shows a saddle which carries the drill. The rear view of the machine shows the rapid-traverse mechanism and also the system for furnishing cutting lubricant. The rapid-traverse screw is driven by a 3-hp. electric motor, which also serves to drive the rotary pump which delivers 26 gal. of cutting compound per minute at a pressure of 100 lb. per square inch. The lubricant used is light, such as a water-cutting solution, and is delivered in large quantities. This not only keeps the drill cool but the backward flow washes out the chips. A system of telescoping brass tubes serves to carry the liquid to the drill.

FIG. 1. SPRINGFIELD GUN-BORING MACHINE

Length of machine, 28 ft.; hole through spindle, 15 in.; capacity, holes up to 7 in. in diameter and 21 ft. long; horse power of variable speed motor, 35; mechanical speed changes, 4, which together with the variable-speed motor gives spindle speeds of from 20 to 200 r.p.m.; diameter of balls in thrust bearing, 1 in.; drilling feeds, ten, 0.0015 to 0.016 in. per spindle revolution; weight without electric equipment, 28,000 lb.; with electric equipment, 31,000 lb.; capacity of compound pump, 26 gal. per minute at a pressure of 100 lb. per square inch.

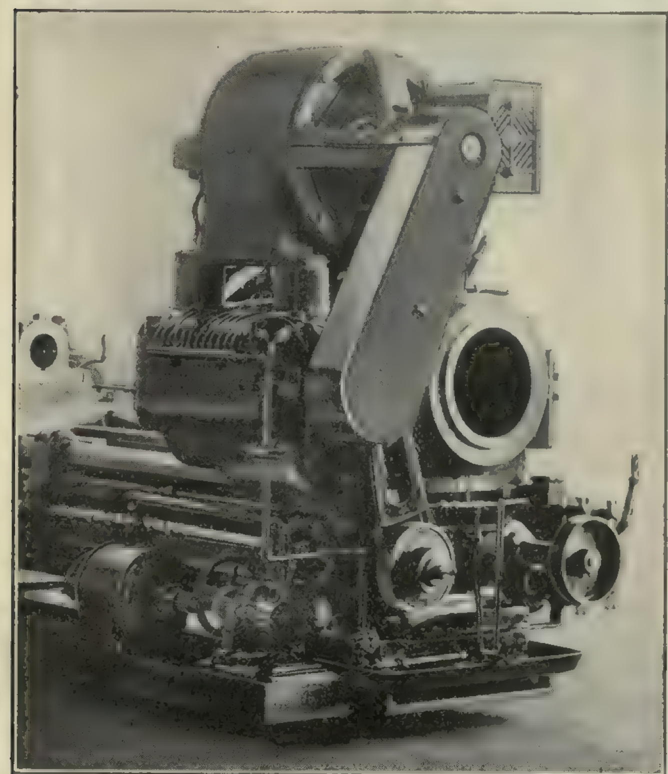


FIG. 2. A REAR VIEW OF THE MACHINE SHOWING THE OIL-DISTRIBUTING PIPES

The feed motion is transmitted from the intermediate shaft in the headstock to a two-step cone pulley by means of a silent chain, thence through a belt to a gearbox at the front. A train of gears gives five changes, which with the two-step cone gives 10 different drilling feeds to the carriage. The entire machine stands in a steel pan which catches the chips and drilling compound. The machine is provided with a work rest and with a bar rest, the function of the latter being to guide and steady the drill as it enters the work. This is necessary, due to the extreme length of the boring bars.

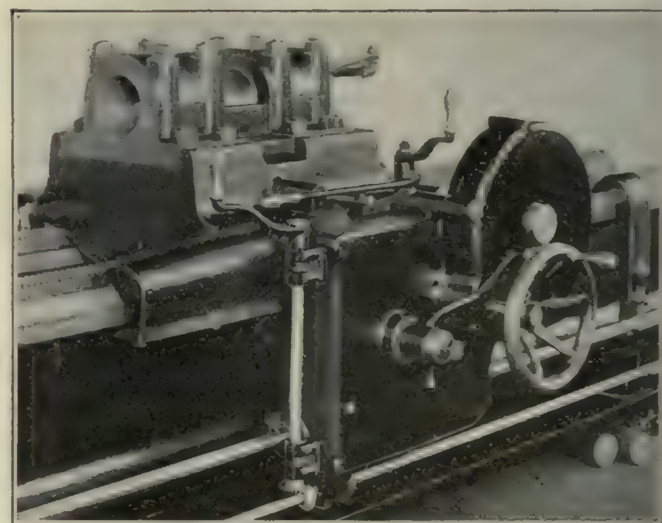
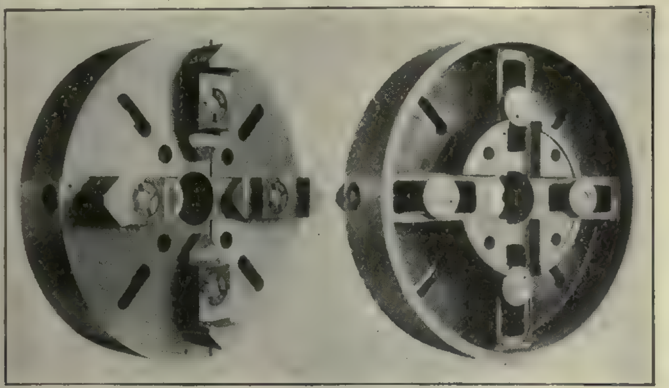


FIG. 3. A NEAR VIEW OF THE CARRIAGE SHOWING THE CONTROL LEVERS

Simplex Improved Chuck

The illustrations show an improved form of a chuck now being manufactured by the Simplex Tool Co., Woonsocket, R. I., which was previously described on page 830, Vol. 46. It is claimed that this chuck is so made that it is impossible to strain the jaws so that they only grip at the back. It will be noticed that each jaw has a through bolt to hold it tightly to the face of the chuck, these bolts being adjusted by means of countersunk nuts at the front of each jaw. It is claimed that the chuck has great gripping power and that it will retain its accuracy indefinitely. The back of the chuck is so made that a back plate can be attached to secure it to the lathe spindle.



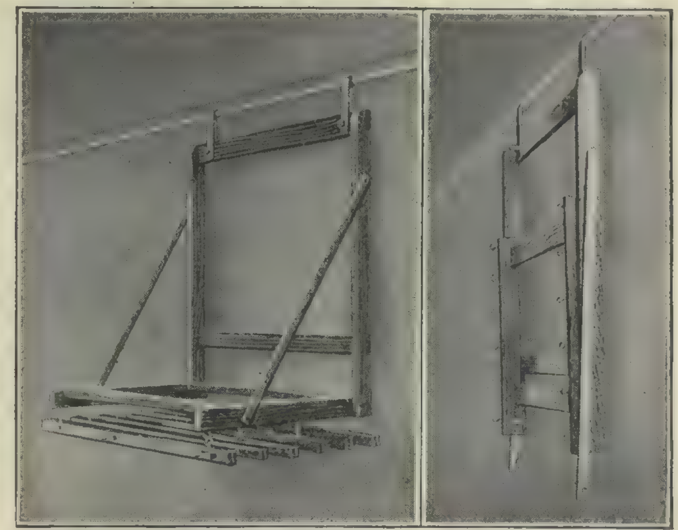
INPROVED 4-JAW CHUCK

Sidney 25-In. Lathe

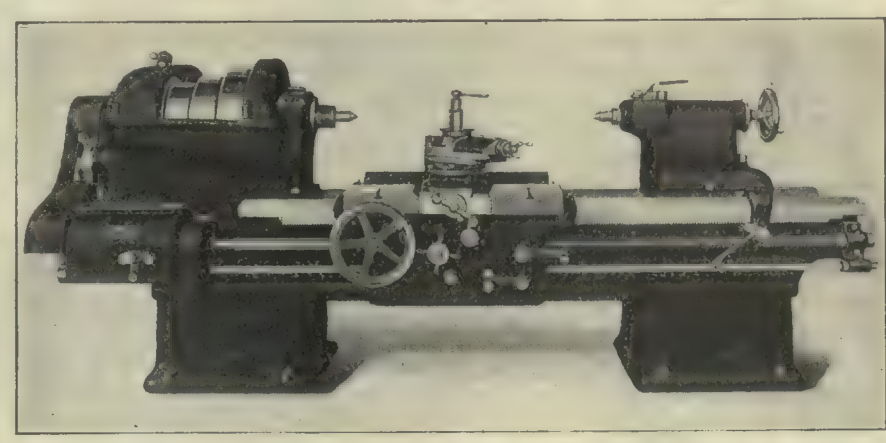
The 25-in. heavy-duty lathe illustrated is one of the recent products of the Sidney Tool Co., Sidney, Ohio. The bed is made with double-wall cross girts spaced 2 ft. apart, while one large way is used in front and one small one at the rear. The ways are cast with a 20-per-cent. steel mixture which it is claimed tends to minimize wear. The carriage is said to be of unusual depth, due to the construction of the top of the bed, and is drilled to receive taper attachments and also grooved to receive the tongue on taper attachments. The compound rest swivels completely around, is graduated in degrees and is clamped to the cross-slide by means of bolts. Taper gibs with end-screw adjustment are provided on both cross-slides, these gibs being so placed that they will not receive the thrust of the tool. The headstock is of the closed type, the spindle being offset 1 in. The spindle is of 50-point carbon steel and runs in phosphor-bronze bearings equipped with sight-feed oil cups. The thrust bearing is bronze to steel. The apron is of the double-plate pattern, giving double bearings to all gears, and is grooved, pinned and bolted to carriage. The lead screw is of 40-point carbon steel. The quick-change gear mechanism forms a complete unit and is mounted at the front of the machine. The lathe is built with bed lengths of 10, 12, 14, 16 and 18 ft., regular equipment including compound rest, two-speed friction pulley countershaft, large and small faceplates, thread-chasing dial, steadyrest, follow rest and wrenches.

National Folding Wall Rack for Blueprints, Etc.

The illustrations show a wall rack that is being marketed by the National Co., 273-279 Congress St., Boston, Mass., for use with the Presto blueprint holder described on page 1059, Vol. 47. It will be noticed that this folding wall rack is provided with hooks for suspending it from ordinary picture molding or it can be bolted or nailed directly to the wall. The device is made of varnished oak and all metal parts are nickel. The dimensions of the rack ready for use are 24 in. wide, 20 in. deep and 30 in. high, while the dimensions folded are 24 in. wide, 4 in. deep and 30 in. high. The illustration at the left shows the rack ready for use with six Presto holders hanging from it.



NATIONAL FOLDING WALL RACK FOR BLUEPRINTS, DRAWINGS, ETC.

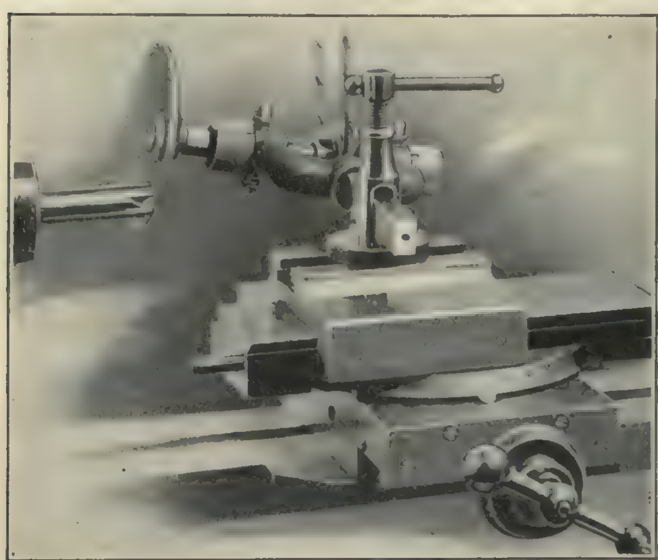


HEAVY-DUTY 25-IN. LATHE

Swing over shears, $27\frac{1}{2}$ in.; swing over carriage, 19 in.; width of carriage, 10 in.; length of carriage, 36 in.; distance between centers with 10-ft. bed, 4 ft. 6 in.; cone diameters, 11, $13\frac{1}{2}$ and 16 in.; front spindle bearing, $4\frac{1}{4} \times 6\frac{3}{4}$ in.; rear spindle bearing, $3\frac{1}{4} \times 4\frac{5}{8}$ in.; size of hole in spindle, $2\frac{3}{16}$ in.; size of centers, Morse No. 5; back gear ratios, $4\frac{1}{4}$ and $11\frac{1}{2}$ to 1; diameter of lead screw, $1\frac{11}{16}$ in.; threads per inch on lead screw, 2; diameter of tailstock spindle, 3 in.; travel of tailstock spindle, $10\frac{1}{2}$ in.; travel of compound rest, 5 in.; capacity of steadyrest, 8 in.; size of tool used, $\frac{7}{8} \times 1\frac{3}{4}$ in.; threads cut, 1 to 46; gearbox feeds, 0.005 to 0.220 in. per spindle revolution; weight with 10 ft. bed, 7000 lb.; additional weight for 2 ft. of bed, 300 lb.

Gale-Sawyer Toolpost Grinding Attachment

The illustration shows a toolpost grinding attachment that is being marketed by the Gale-Sawyer Co., 33-37 Wormwood St., Boston, Mass. It will be noticed that the attachment has a swiveling device. This is

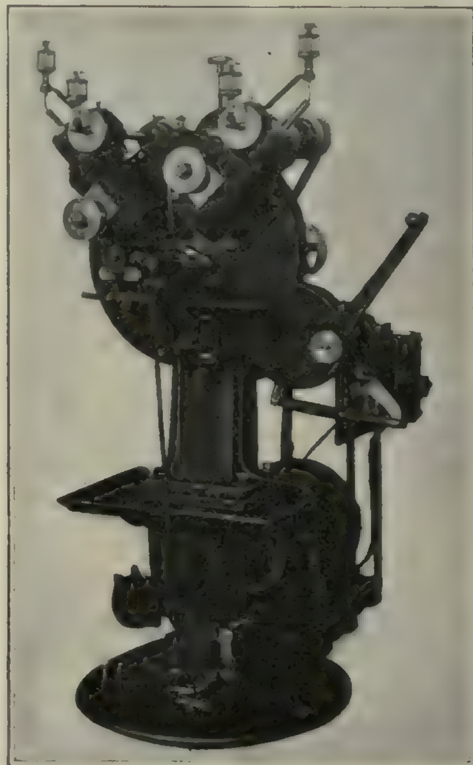


TOOLPOST GRINDING ATTACHMENT

graduated and, it is claimed, permits adjustment for a range of work impossible with other toolpost attachments. This is said to be especially valuable in sharpening cutters with end teeth and doing other similar operations. The spindle is designed to operate at speeds from 8000 to 12,000 r.p.m. The illustration shows the device equipped with a 3-in. saucer wheel.

Langelier Multiple-Spindle Drilling Machine for Ignition Tubes

The machine illustrated is for drilling in one operation twenty-four 0.031-in. holes in the walls of the primer ignition tubes. The machine is hand and foot operated, the drilling being done by two 6-spindle multiple drilling heads located 90 deg. apart on the upper half of a vertical faceplate. The spindles in one head are offset to a position midway between those in the other head, and each head drills diametrically through both walls of the tube. The drills are held in small taper-threaded collets. The drilling heads are ball bearing and are driven by an endless, woven-canvas belt at the back of the machine. A screw belt tightener is used to obtain the proper tension. The feed is operated by a hand lever mounted on a sleeve pinion which meshes through an intermediate gear with a ring gear located concentrically in the vertical faceplate to which the drilling heads are attached. The ring gear is mounted on ball bearings so as to make the "feel" of the hand lever as sensitive as possible. The ring gear is connected to the feed sleeve by means of double pinions having friction clutches. The feed lever has a spring return. The spindles run at 4800 r.p.m. Cutting fluid is supplied by a rotary pump. The tube to be drilled is held and located in position by means of a self-opening and closing jig mounted on a slide, the function of which is to carry the tube from the loading position to the drilling position and vice versa. The slide is operated by a foot lever, the depressing of which moves the slide to the loading position and opens the jig. The releasing of the foot lever causes the jig to close and then moves it to the drilling position. The tube is held at the ends by means of 45-deg. cups. The jig has guide bushings and an open top which permits of quick loading and unloading. A thumb spring lever is used for lifting the front end of the tube out of the jig so that the operator can take hold of it. The machine is driven



LANGELIER MULTIPLE-SPINDLE DRILLING MACHINE FOR IGNITION TUBES

by 3-hp. Westinghouse electric motor mounted on the base of the machine. The floor space occupied is 32 x 62 in. The Langelier Manufacturing Co., Arlington, Cranston, R. I., is the manufacturer.

Matthews Castellating Machine

The machine shown in Fig. 1 is made by the Matthews Engineering Co., Sandusky, Ohio, and is sold by the J. R. Stone Co., Detroit, Mich. This machine is intended to castellate nuts or other small parts suitable for chucking. The pieces to be castellated are placed in a hopper and feed down a chute to the chucks. As a piece is chucked it is carried around under the milling saws which feed downward and then automatically lift as the chuck table indexes. Ample provision is made to supply the saws with coolant from a reservoir in the base of the machine.

Fig. 2 shows the machine as viewed from above, and will give a good idea of the arrangement of the head parts.

Another view of the working heads is shown in Fig. 3. The pieces to be castellated are plainly shown feeding down the chute. The hopper revolves counter-clockwise.

The nuts, which are thrown into the hopper, fall into slots cut around the periphery, since the hopper is inclined at an angle of 30 deg. They are released by a slot in the hopper aligning with the slot in the chute. The hopper base has a groove cut just below the slot in the hopper. In this groove the ejectors and spring ride, being operated at the proper place by a cam. In case the nut is upside down, the rounded portion falls into a hole in the hopper base plate, which prevents it from leaving, and it is carried around and again mixed with the other nuts. The hopper does not have a uniform circular motion, but pauses for an instant as each slot is aligned with the chute. This serves to help jolt the nut out into the chute.

The hopper is made to revolve by a ½-in. round leather belt running to a pulley on the hand-feed shaft.

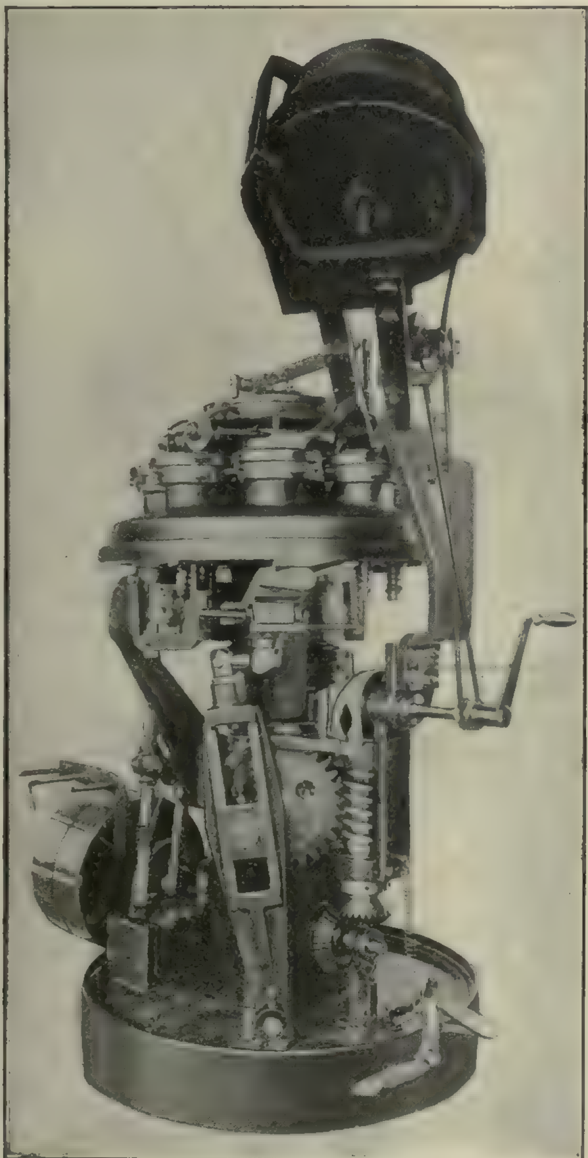
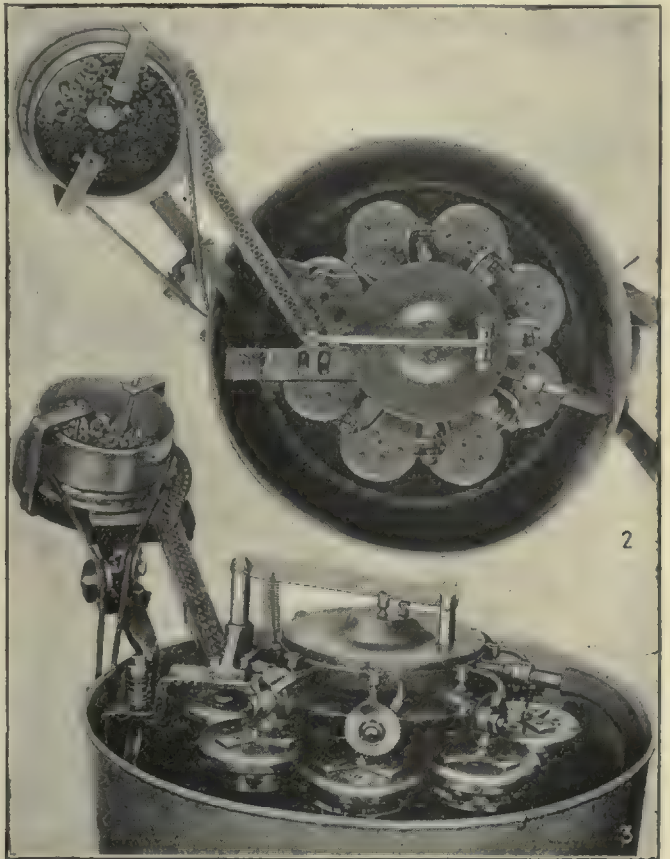


FIG. 1. MATTHEWS CASTELLATING MACHINE

Sizes of nuts handled, ¼ to ½ in. hexagon, S. A. E. standard; output, 600 to 1400 per hour, according to size; size of cutters, 2½ in. diameter; speed of cutters, 160 ft. per minuute; size of drive pulleys, 16 in. diameter by 3½ in. face; height of machine, 4 ft. 8 in.; floor space, 3½ x 3½ ft.; weight, about 1500 lb.

As the hopper has an intermittent motion and the pulley on the hand-feed shaft a continuous motion, the belt ships on the small pulley during the action of the intermittent mechanism. In the lower end of the chute a hole is cut directly in position over a chuck, the exact size of the nut being fed. As the feed push finger descends it pushes the nut through this hole against spring jaws. These spring jaws hold the nuts in the chute until the push finger again descends and pushes the next nut into the chck. The hopper is timed to feed one nut a second, and as the machine uses but



FIGS. 2 AND 3. VIEWS OF THE UPPER PART OF THE MACHINE SHOWING WORK IN PROGRESS

one nut every four seconds there is a reasonable certainty that the chute will always be full.

As a nut is chucked and carried around to the first saw station the saw cuts a slot from the hole to the outside of a flat by feeding straight down onto the work. This slotting is repeated six times as the nut is carried around to the stations under the six saws. At each indexing of the table a chuck moves 45 deg. and each chuck indexes 60 deg. After a nut has been castellated it is pushed up out of the chuck and swept off.

Export of Electrical Goods

The disappearance of German competition has greatly favored the expansion of the American electrical industry. Owing to the export restrictions in vogue in France and England, the United States is about the only country at present that is in a position to replace Germany in the world's market. The following figures will show the great progress made by the United States in the exportation of electrical goods since the war: For the years ending June 30, 1914, 133,000,000 fr.; 1915, 105,000,000 fr.; 1916, 160,000,000 fr.; 1917, 275,000,000 fr. These figures show that the value of exports for 1917 was 70 per cent. above those of 1916 and 105 per cent. above those of 1914.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., April 20, 1918.—One of the advantages of having the railways taken over by the Government is the standardization of locomotives, which has already begun. For the first time in the history of the country all of the railroads are now subject to a single management and to a single control in their purchases. This makes it possible to enforce highly desirable standards which were heretofore out of the question.

The work of preparing standard specifications and drawings was intrusted to a committee comprising 11 railroad officials and representatives of the three principal locomotive builders. Twelve standard specifications have been agreed upon, and are as follows:

The Specifications

Two sizes of the Mikado type, 2-8-2, based respectively on 55,000 and 60,000 lb. per axle; the lighter of these has a weight in working order of 290,000 lb., and the heavier 325,000 lb.

Two sizes of the Mountain type, 4-8-2, based respectively on 55,000 and 60,000 lb. per axle, the lighter having a total weight in working order of 320,000 and the heavier of 350,000 lb.

Two sizes of the Pacific type, 4-6-2, based respectively on 55,000 and 60,000 lb. per axle, the former having a weight of 270,000 lb. and the latter 300,000 lb. in working order.

Two sizes of the Santa Fé type, 2-10-2, based respectively on 55,000 and 60,000 lb. per axle, the lighter having a weight of 360,000 lb. and the heavier 390,000 lb. in working order.

A six-wheeled locomotive, 0-6-0, with tender, 55,000 lb. per axle; weight in working order, 165,000 lb.

An eight-wheeled switching, or hump, locomotive, 0-8-0, with tender, 55,000 lb. per axle; 220,000 lb. in working order.

A six-couple Mallet locomotive, with trucks, 2-6-6-2, based on 60,000 lb. per axle, weighing in working order 540,000 lb.

The tenders have been standardized with tanks of 8000, 10,000 and 12,000 gal. respectively.

No one railroad will be compelled to order all of the 12 standards, and it is probable that even the large trunk lines will find that half of this number is sufficient for their needs. It will, however, greatly simplify the building of locomotives for the rehabilitation of our railroad motive power, which is so badly needed, and also greatly reduce the cost of carrying spare parts by the different roads.

As is always the case when any kind of standardization is proposed there are those who fear that it will prevent improvements and discourage new ideas. That such fear is unfounded may be seen from the automobile industry, which, perhaps, has standardized more of its products than any other branch of manufacture.

It is probable that for the duration of the war at least we can well afford to omit special new locomotive development; but when we return to normal conditions an experimenting department should be established for the purpose of trying out new devices for all the railroads instead of a dozen or more railroads spending money on the same experiments. The money that has been needlessly spent on experiments during the past 25 years would go a long way toward paying the war debt. When we consider that on the Santa Fé Railway alone there have been at times over 300 different types of locomotives to keep in repair, the advantage of confining all experimental work of this kind to one railroad can easily be estimated.

The Concrete Ship

The Emergency Fleet Corporation of the United States Shipping Board has now developed the concrete ship to a point where it would seem to be advisable to experiment further. But the corporation did not feel that it had the right under existing authority to do so, and so asked Congress to acquire or establish suitable plants for building concrete ships. This would include the right to secure the material for enlarging or extending the plants now being used or that may hereafter be acquired or established, and to construct, purchase and requisition or otherwise acquire such concrete ships to the amount of \$50,000,000. Of this sum \$15,000,000 was asked for, and was quickly granted, as shipping is the vital question at this time.

While many have been skeptical as to the ability of the concrete ship to withstand the vibration of reciprocating engines and the shocks of heavy waves, others who have followed the matter closely believe that the concrete ship is a feasible proposition, and as they can be constructed rapidly it is certainly worth trying in the present emergency.

Intensive Training

An interesting departure was the commencement under Government supervision of the first course of intensive training in employment management at the University of Rochester, N. Y., late last month, when about twenty prospective employment managers sent by manufacturers having war contracts (fortunately among them are shipbuilding plants and several departments in Washington) began a six-weeks' intensive-training

course in the theory and practice of employment management. Rochester factories are providing what may be called the laboratory work and are assisting the university in presenting the theory of the management of personnel. Incidentally this is another example of the way the manufacturers of Rochester coöperate along progressive lines, and it is especially helpful at present.

The course is under the supervision of the Industrial Service Section of the several departments at Washington, and was requested by them as a necessity in handling the question of employment in the various departments, in which are included the Emergency Fleet Corporation, the Ordnance Department, the Quartermaster's Department, the Department of Labor and the Navy Department.

A Hopeful Phase

An interesting and hopeful phase of the situation is that the establishment of this course, which is to be started later in Boston, New York and other places, is official recognition of the function of personnel management in factory administration. This is distinctly a progressive move which cannot fail to be helpful in handling employment cases in all parts of the country.

Under the head of employment management are gathered all the activities relating to human relations, such as legislation, safety, education, recreation, "hiring and firing," discipline, wages and the payment of pensions, sick benefits, etc. By bringing all these questions together under one head, each subsection being in charge of a specialist, a long step has been taken in the solution of scientific industrialism, if it may be so called.

Fortunately, there seems to be no misconception of the fact that six weeks of training is all that is necessary, and only those who have had the proper basic preparation are admitted. It is the aim to have manufacturers with war contracts select men who, in their opinion, will succeed, and they will be responsible for them, the qualifications being enthusiasm, varied industrial experience, good education and a liberal point of view. The Department of Labor is sending two of its field agents in the federal employment service to the first course, and the navy also contemplates sending its assistant superintendents from some of the navy yards.

It is unfortunate that we have so few men and women who are really expert employment managers. Too many are impractical theorists with no conception of the real problem or of its far-reaching possibilities. The best of instructors are none too good in this important work.

School for Inspectors

With this as an example is it not advisable to inaugurate similar schools for inspectors? And the idea might also be extended to include the question of specifications, at least in so far as their interpretation by the inspector is concerned. It is safe to say that nothing delays production more than unreasonable specifications and needless inspection, and anything that can help to modify either of these regulations will do more to hasten production than anything I know of.

Men with some mechanical foundation can be taught many things of real value which will aid greatly in securing a big output; they can be shown the difference between vital defects and imperfections that do not interfere with the proper functioning of a piece; they can be taught that "perfectness" is an unknown quantity, and that practically anything can be rejected if an inspector tries hard enough, and that the best inspector is he who can pass the greatest number of usable pieces.

One of the problems that is bothering some manufacturers is that of providing suitable, or I might say satisfactory, quarters for the inspectors. Generally this is not an easy task, as there are a large number of them, many of whom are somewhat fastidious, and they often specify the kind of desks they want, the kind of typewriter they prefer (the machine, I mean), and sundry other details. This is an important consideration, as the cost of this equipment, coupled with requests for innumerable reports from other divisions, adds largely to the overhead charges of a shop.

In the case of cost-plus contracts there are many reports of various kinds, including perpetual inventories, invoices, shipping receipts and what not. To many these methods often seem like useless labor, but if they stopped to think what might happen if everyone were allowed to do exactly as he pleased, with no accounting, they would perhaps be a little more lenient in their judging. Care should be taken, however, not to call for unnecessary reports and other data. They are not only an expense to the manufacturer but they clog and delay the machinery of production. In too many cases there seems to be more reports than action.

Partisan Criticism

The most inexcusable criticism which crops out in Congress and in the newspapers is the kind that is so evidently partisan that it shows on its face. The attack on George Creel by some of the Senators and the attacks on Secretary of War Baker by some of the newspapers are in this class. We are too apt to forget that many of the exasperating delays are due to the system rather than to the incumbents of the offices. We quite overlook the fact that similar mistakes occurred in 1898 with a quite different administration and that one of the chief "kickers" at the present time helped to start a round-robin of protest at that time. The conditions were different, but that war was a pink-tea party compared to this. Constructive criticism is always in order, but the kind that is being printed in some papers would be called seditious if it appeared in some of the less influential publications.

The Reason for the Slot in the Screw Head

By T. Daniel

In a certain well-known munition factory men were employed in packing pasteboard boxes containing loaded cartridges into wooden shipping cases, the covers of which were fastened with screws.

For obvious reasons the use of a hammer was forbidden on this work. One morning the superintendent caught a workman—who was paid by the piece—pounding his screws halfway home. Rushing up to the offender the official demanded in tones of biting sarcasm: "What are the slots in those screw heads for?" "How in thunder could you get 'em out?" was the instant rejoinder.

Machinery Trades and the New Loan

The machinery and machine-tool men are getting busy on the Third Liberty Loan drive. They have appointed a special committee consisting of 43 well-known machinery men headed by J. W. Lane (president E. W. Bliss Co.) chairman; R. L. Patterson, (president American Machine and Foundry Co.), vice chairman; Charles B. Houston (E. W. Bliss Co.), secretary; Norman Dodge (vice president Mergenthaler Linotype Co.), director of speakers; Charles A. Hirschberg (publicity manager Ingersoll-Rand Co.), publicity director.

The committee is as follows:

M. H. Avram (Slocum, Avram & Slocum), L. Barron (secretary De La Vergne Machine Co.), Leigh Best (vice-president American Locomotive Co.), R. K. Blanchard (Neptune Meter Co.), G. D. Branston (treaurer Manning, Maxwell & Moore), Arthur W. Buttenheim (president McKiernan-Terry Drill Co.), W. L. Callister (W. L. & J. T. Callister), De Courcey Cleveland (president Central Foundy Co.), C. Philip Coleman (president Worthington Pump & Mach. Corp.), C. I. Cornell (treasurer Pratt & Whitney Corporation), F. W. H. Crane (president R. Hoe & Co.), J. J. Cuehler (president Columbia Machine W. & M. Iron Co.), C. G. Curtis (president Curtis Turbine Co.), A. Davis (president Davis-Bournonville Co.), F. S. De Lano (treasurer American Car and Foundry Co.), H. H. Doehler (president Doehler Die Casting Co.), George Doubleday (president Ingersoll-Rand Co.), F. F. Fitzpatrick (president Railway Steel Spring Co.), Henry Fuller (vice president Fairbanks-Morse Co.), P. H. Gill, president P. H. Gill & Sons), R. E. Gilmore, (general manager Sperry Gyroscope Co.), D. H. Haynes (treasurer American Machine and Foundry Co.), J. H. Hayward (treasurer Hayward Co.), W. T. Hunter (secretary A. Schrader's Son, Inc.), Isaac B. Johnson (president Isaac G. Johnson & Co.), J. C. Kelly (president National Meter Co.), W. P. Kethart (secretary H. D. Berner & Winterbauer Co.), Hy. C. Knox (treasurer American Brake Shoe & Foundry Co.), John Lidgerwood (president Lidgerwood Mfg. Co.), T. Frank Manville (president H. W. Johns-Manville Co.), T. J. Menten (vice president Schaeffer & Budenberg Mfg. Co.), Edw. T. Morse (secretary and general manager Morse Dry Dock and Repair Co.), C. E. Murray (president Metropolitan Engineering Co.), Henry Prentiss (president Prentiss Tool and Supply Co.), Jos. T. Ryerson (De Mant Tool and Machine Co), E. A. Stillman (president Watson-Stillman Co.), H. R. Swartz (president Intertype Corporation), Charles Taylor (Clark, Dodge & Co.), Herbert G. Thomsom (president Anchor Post Iron Works), J. M. Turner (president General Acoustic Co.), J. H. Walbridge (president Lalance & Grosjean Manufacturing Co.), J. Harvey Williams (president J. H. Williams & Co.) and J. B. Wing, (treasurer Dexter Folder Co.).

Personals

Chris Myers, formerly shop foreman of the General Ordnance Co., Derby, Conn., has been appointed shop superintendent.

Fred Clausen has been promoted to the position of factory superintendent of the Independent Pneumatic Tool Co., Aurora, Ill.

F. S. Cole, formerly of the Imperial Belting Co., Chicago, Ill., is now a member of the industrial-bearing division of the Hyatt Roller Bearing Co., Metropolitan Building, New York City. Mr. Cole will specialize on the sale of Hyatt roller bearings for line shafting.

Vilhelm Christensen of V. Lowener, 114 Liberty St., New York, Copenhagen, Stockholm, Christiania and Moscow, has gone to Copenhagen, where he will join the tool department of the main office of V. Lowener in order to stimulate the use of American tools in the Scandinavian countries. Mr. Christensen spent several years in this country studying the use of small tools and appliances.

Obituary

Rufus Franklin Emery, secretary and treasurer of the Westinghouse Airbrake Co., Wilmerding, Penn., an officer and director of several other large and important corporations, died suddenly on Thursday afternoon, Apr. 11, 1918. Mr. Emery was 48 years of age. He was stricken with heart failure while seated at his desk in his office at the Airbrake Works in Wilmerding, Penn. Several of his business associates who were in the office at the time rushed to his assistance and medical aid was hastily summoned, but he expired before a physician could arrive. The body was removed to his home, 132 Hawthorne St., Edgewood, Penn. Mr. Emery was a member of the Edgewood Borough Council at the time of his death, and was also a member of the Duquesne Club, the Edgewood Club, the George W. Guthrie Lodge (F. & A. M.), the Westinghouse Airbrake Veterans' Association and the Crescent Canoe Club of Oakmont. He was assistant secretary of the American Brake Co., assistant secretary and director of the National Brake and Electric Co., a director of the Vulcan Crucible Steel Co., secretary, treasurer and a director of the Westinghouse Friction Draft Gear Co., and treasurer and a director of the Westinghouse Traction Brake Co. Mr. Emery was born near Boston, Mass., and in 1891 he became affiliated

RUFUS FRANKLIN EMERY

with the Westinghouse interests, in the upbuilding of which he played an important part. He was a public-spirited citizen and took an active interest in various religious, social, civic and patriotic movements.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers. Spring meeting at Worcester, Mass., June 4, 5, 6 and 7, with headquarters at the Hotel Bancroft.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's Hotel. Donald H. C. Tullock, Jr., secretary, Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Gas Engine Association will hold its eleventh annual meeting at the Hotel Sherman, Chicago, Ill., June 3 and 4. The headquarters of the association are at Lakemont, N. Y.

The spring convention of the National Machine Tool Builders' Association for 1918 will be held Thursday and Friday, May 16 and 17, at the Marlborough-Blenheim Hotel, Atlantic City, N. J. Charles L. Taylor of Hartford, Conn., is secretary.

A joint convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held at Cleveland, Ohio, May 15-17. Among the important subjects to come up for action will be Government control of fuel, transportation and shipping of materials and price fixing. The coöperation of labor in war activities will also be discussed at length.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings, first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

Providence Engineering Society. Monthly meeting, fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

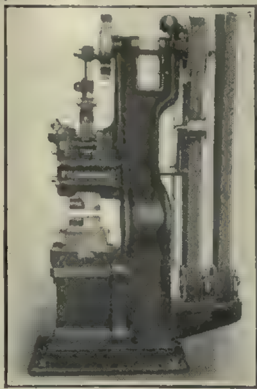
Western Society of Engineers, Chicago, Ill. Regular meeting, first Wednesday evening of each month, except July and August. E. N. Layfield, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

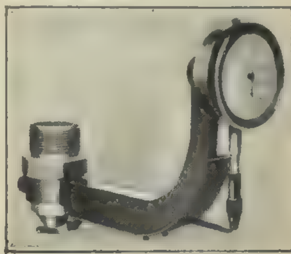
Hammer, "Fairbanks"
United Hammer Co., Oliver Building, Boston, Mass.
"American Machinist," Apr. 4, 1918

The "Fairbanks" power hammers are now being fitted with a new-type, adjustable, bronze taper gib and faceplate. It is claimed that this new gib takes up any wear in the ram guides and makes possible a much finer ram adjustment than heretofore. The new gib and faceplate may be applied to any of the "Fairbanks" hammers now in use.



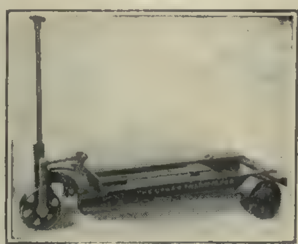
Brinnell Impressions, Attachment for Measuring Depth of
Pittsburgh Instrument and Machine Co., 111 Water St., Pittsburgh, Penn.
"American Machinist," Apr. 4, 1918

A new attachment for determining the depth of impressions made by the Brinell machine in testing materials. It is claimed that the depth of impression can be measured with considerably more accuracy than the diameter of the impression. This machine, it is claimed, permits the determination of depth readings to 0.01 mm., one complete revolution of the hand of the dial indicator representing a depth of impression of 1 mm. The device is so arranged that it may be quickly attached to the Brinell instrument manufactured by this company.



Conveyor, Elevating "Type H"
Cowan Truck Co., Holyoke, Mass.
"American Machinist," Apr. 4, 1913

The Type H transveyor on which a number of improvements have recently been made. For heavy-duty service, carrying loads up to 5000 lb. The platform may be elevated 3 in. by means of a hydraulic ram which is operated by a few strokes of the handle. Lowering the truck is accomplished by means of a foot pedal which releases the pressure on the ram, allowing the platform to return to its lowered position without shock. The machine is built in six sizes and is mounted upon three metal wheels 10 in. in diameter.



Lathe, Combination with Boring and Milling Machine
George W. Fleming Co., 12 Broad St., Springfield, Mass.
"American Machinist," Apr. 4, 1918

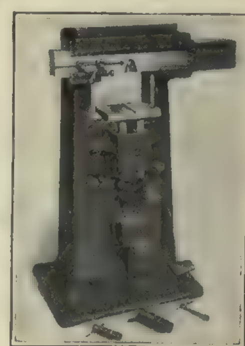
The bed of this lathe slides to the left, allowing the machine to be used as a boring or milling machine or a gap lathe. Length overall with bed closed, $83\frac{1}{2}$ in.; length overall with bed open, 104 in.; lathe takes between centers with bed closed, 36 in., with bed open, $57\frac{1}{2}$ in.; swing of lathe over ways, $17\frac{1}{4}$ in.; swing of lathe in gap, 32 in.; turning capacity in gap, 25 in.; swing of lathe over carriage, 9 in.; longitudinal feed of milling-machine table, 20 in.; vertical feed of milling-machine table, 15 in.; cross-feed of milling-machine table, $7\frac{1}{2}$ in.; dimensions of milling-machine table, $32\frac{3}{4}$ x 8 in.; taper in lathe spindle, Morse No. 4; taper in milling spindle, No. 12 B. & S.; diameters of cone pulley, 4, 6, 8 and 10 in.; front spindle bearing, $2\frac{1}{4}$ x $4\frac{5}{8}$ in.; rear spindle bearing, $2\frac{3}{4}$ x $3\frac{1}{4}$ in.; hole through spindle, $1\frac{1}{2}$ in.; weight, 3200 lb.

Thread-Milling Fixture
Hall Gas Engine Co., Inc., Bridesburg, Philadelphia, Penn.
"American Machinist," Apr. 11, 1918

This device is for use in cutting either internal or external threads of any form or pitch and either straight or taper. It is claimed that the device enables a full thread to be cut up to a shoulder or to the bottom of a hole. The thread may also be timed to start at any point. Has a hollow spindle allowing threads to be cut on any length, the work being held by a spring collet chuck. Is mounted upon a milling machine or lathe and can be removed when the machine is desired for other work

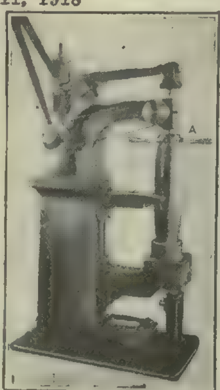
Marking Machine, Hydraulic No. 12
Martin Machine Co., Greenfield, Mass.
"American Machinist," Apr. 11, 1918

For marking either cylindrical, flat or irregular shaped metal parts. It is claimed that the machine will make even and clear impressions irrespective of an uneven working surface, as the pressure varies with the resistance of the die. In operation, oil pressure raises the work-holding table to the operating point and when this is reached acts upon the slide and traverses the die across the work to be marked. Travel of slide, 8 in.; height of machine, 50 in.; adjustment of table, 0 to 6 in.; floor space, 27 x 22 in.; weight, 900 lb.



Hammer, Shell-Caulking and Peening
High Speed Hammer Co., Rochester, N. Y.
"American Machinist," Apr. 11, 1918

This hammer is especially adapted for caulking and peening gas checks on 155-mm. shells. One or two revolutions of the tool A when under slight pressure will remove any burrs or sharp edges from the dovetail in the base. With the gas check in place and the lead gasket dropped into position, the hammer is started, and elastic blows at the rate of 900 per minute struck by the revolving peen just above the tool A caulk the gasket at all points.



Hammer, Riveting
High Speed Hammer Co., Rochester, N. Y.
"American Machinist," Apr. 11, 1918

Designed for heading copper rivets used in holding heavy harness together. It holds the washer, or burr, tightly to the work and at the same time compresses the parts to be riveted. The hammer strikes 2600 blows per minute and will head a rivet every two seconds.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Apr. 18, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$33.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	.....
*Bessemer, Pittsburgh	36.15	37.25	38.95
*Basic, Pittsburgh	32.00	33.95	40.00
No. 2X, Philadelphia	34.25	33.75	40.00
*No. 2, Valley..................	33.00	33.95	38.00
No. 2 Southern Cincinnati...........	35.90	35.90	[illegible]
Basic, Eastern Pennsylvania..........	32.75	33.75	36.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier from jobbers' warehouses at the cities named:

	New York Apr. 18, 1918	New York One Month Ago	New York One Year Ago	Cleveland Apr. 18, 1918	Cleveland One Year Ago	Chicago Apr. 18, 1918	Chicago One Year Ago
Structural shapes ...	$4.195	$4.195	$4.50	$4.20	$4.10	$4.20	$4.50
Soft steel bars	4.095	4.095	4.35	4.20	4.00	4.10	4.25
Soft steel bar shapes.	4.095	4.095	4.35	4.20	4.00	4.10	4.25
Plates, ¼ to 1 in. thick	4.445	4.445	6.50	4.20	5.00	4.45	5.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Apr. 18, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.60
Warehouse, New York................	4.70	4.25
Warehouse, Cleveland	4.10	4.00
Warehouse, Chicago	4.10	3.90

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Apr. 18, 1918	New York One Month Ago	New York One Year Ago	Cleveland Apr. 18, 1918	Cleveland One Year Ago	Chicago Apr. 18, 1918	Chicago One Year Ago
*No. 28 black.......	5.00	6.445	6.445	7.50	6.385	6.25	6.45	6.25
*No. 26 black.......	4.90	6.345	6.345	7.40	6.285	6.15	6.35	6.15
*Nos. 22 and 24 black	4.85	6.295	6.295	7.35	6.235	6.10	6.30	6.10
Nos. 18 and 26 black	4.80	6.245	6.245	7.30	6.185	6.05	6.25	6.05
No. 16 blue annealed.	4.45	5.645	5.645	6.70	5.585	5.95	5.65	5.95
No. 14 blue annealed.	4.35	5.545	5.545	6.60	5.485	5.85	5.55	5.85
No. 10 blue annealed.	4.25	5.445	5.445	6.55	5.385	5.80	5.45	5.80
*No. 28 galvanized..	6.25	7.695	7.695	6.50	7.635	5.75	7.70	5.75
No. 24 galvanized...	5.80	7.245	7.245	9.00	7.335	8.00	7.40	8.00
*No. 26 galvanized..	5.95	7.395	7.395	8.70	7.185	7.70	7.40	7.70

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Apr. 18, 1918	One Year Ago
New York	List plus 10%	List plus 25%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Apr. 18, 1918	One Year Ago
New York	$15.00	$9.50
Cleveland	15.00	7.00
Chicago	15.00	8.25

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

3/8, 11/32, 5/16, ¼, 7/32, 3/16	21.00 @ 30.00
No. 8, 5/32 and No. 10	
1/8	
No. 12	
3/32, No. 14 and 1/16..	
No. 18	
No. 20	

¹ Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long.........	16.00
¼ by 19 in. long.........	14.00
3/8 by 19 in long.........	12.00
½ by 21 in. long.........	12.00

***Special Welding Wire**

1/8	33.00
3/32	30.00
1/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Apr. 18, 1918	Cleveland Apr. 18, 1918	Chicago Apr. 18, 1918
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel..	7.50	8.00	8.25
Spring steel (crucible analysis)	11.00	11.25	11.25
Coppered bessemer rods..	7.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel....	9.00	8.25	8.25
Floor plates	6.19½	6.00	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
1/8, ¼ and 3/8..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3.......	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, ¼ and 3/8..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4......	29%	17%
4½ to 6......	44%	32½%	4½ to 6.......	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Apr. 18, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	34.00
Tin, in 5-ton lots................	87.00	85.00	55.00
Lead	6.95	7.25	9.75
Spelter	7.00	7.75	10.75

*Government price.

ST. LOUIS

Lead	6.80	7.10	10.50
Spelter	6.75	7.75	10.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Apr. 18, 1918	New York One Month Ago	New York One Year Ago	Cleveland Apr. 18, 1918	Cleveland One Year Ago	Chicago Apr. 18, 1918	Chicago One Year Ago
Copper sheets, base.	31.50-33.00	32.00	44.00	35.00	44.00	34.50	43.00
Copper wire (carload lots)...........	32.00	32.00	39.50	34.00	43.00	34.50	40.00
Brass sheets	30.75	30.75	45.50	30.00	43.00	40.00	43.50
Brass pipe base....	36.50	36.50	47.50	41.00	52.00	30.00	47.50
Solder ½ and ½ (case lots)	62.00	62.00	33.88	49.50	33.50	48-50	34.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Apr. 18, 1918	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	29.50	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill.. 19.00

	In Casks Apr. 18, 1918	In Casks One Year Ago	Broken Lots Apr. 18, 1918	Broken Lots One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	20.00	23.00	20.50	23.25
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Apr. 18, 1918	One Year Ago
New York	13.00	36.00
Chicago	21.60	37.00
Cleveland	15.50	35.00

WAR-TIME REPAIRS IN THE NAVY

BY FRANK A. STANLEY

The repairship "Vestal" is the flagship of the train of the fleet. It has been in commission several years and has executed an endless number of naval repairs of all classes in its various departments. Today, under the conditions of war, it is busier than ever.

THE night before last Thanksgiving, in company with the officers of the U. S. S. "Vestal," I sat at dinner in the comfortable messroom of the flagship of the train, enjoying the conversation about the table, which following a discussion of war topics, questions of naval tactics and marine matters in general, gradually drifted to a subject of immediate personal interest to everyone present—naval repairs. For back of sea warfare, as behind land conflict; back of naval action and behind ship and fleet accomplishment, lies the persistent necessity of engineering upkeep and mechanical repair without which no naval unit may perform its avowed service to the country for any definite period or protracted time.

And this was the flagship of Rear Admiral Rodgers, commander of the train—the "Vestal," sister ship of the "Prometheus," both floating machine shops, which since the date they were placed in commission have attended to an amazing number and variety of repairs for our numerous fighting ships and the vessels of the auxiliary fleets. So it was only natural that the discussion on Thanksgiving Eve should drift to such practical matters as the overhauling of main and auxiliary machinery, the replacement of broken cylinder heads, piston rings, condenser buckets, worn-out brasses, cracked steam pipes and a multitude of other details that have helped to occupy the attention of the repair man ever since the inauguration of steam-propelled vessels, just as they are bound to maintain their grip on his time and efforts so long as steam and motor ships traverse the Seven Seas.

The morrow having been designated on the calendar as a holiday, someone ventured to express the hope that no rush of work might come aboard overnight to tie up the crew of mechanics on their day off. On the word, true to his cue, came a messenger from the deck: "Officer from the battleship ——, sir. Wants to know if we can repair a receiver pipe for them the first thing in the morning; cracked just above the lower flange and running part way round the pipe. Ship's sailing in the afternoon, sir." Just as prompt the reply from the repair officer at the table: "Tell him to send the pipe over

FIG. 1. ON BOARD THE REPAIRSHIP "VESTAL"—OFFICE TO THE LEFT

here at 7 o'clock in the morning and a boat for it at 9." Now a receiver pipe is a receiver pipe; and a crack is a crack. The pipe may be 12 in., 16 in., or larger, and the crack may extend for a distance of only a few inches or it may run halfway around the circumference. In any event the pipe is of copper, and although with its dangling legs 8 or 10 ft. long it may be curved up into an awkward bit of material to handle, an expert coppersmith has ways and means of getting at a break of this character, and two or three hours' time with suitable brazing apparatus at hand will enable him and his assistants to overhaul a badly damaged length of pipe and put it in condition again for regular service.

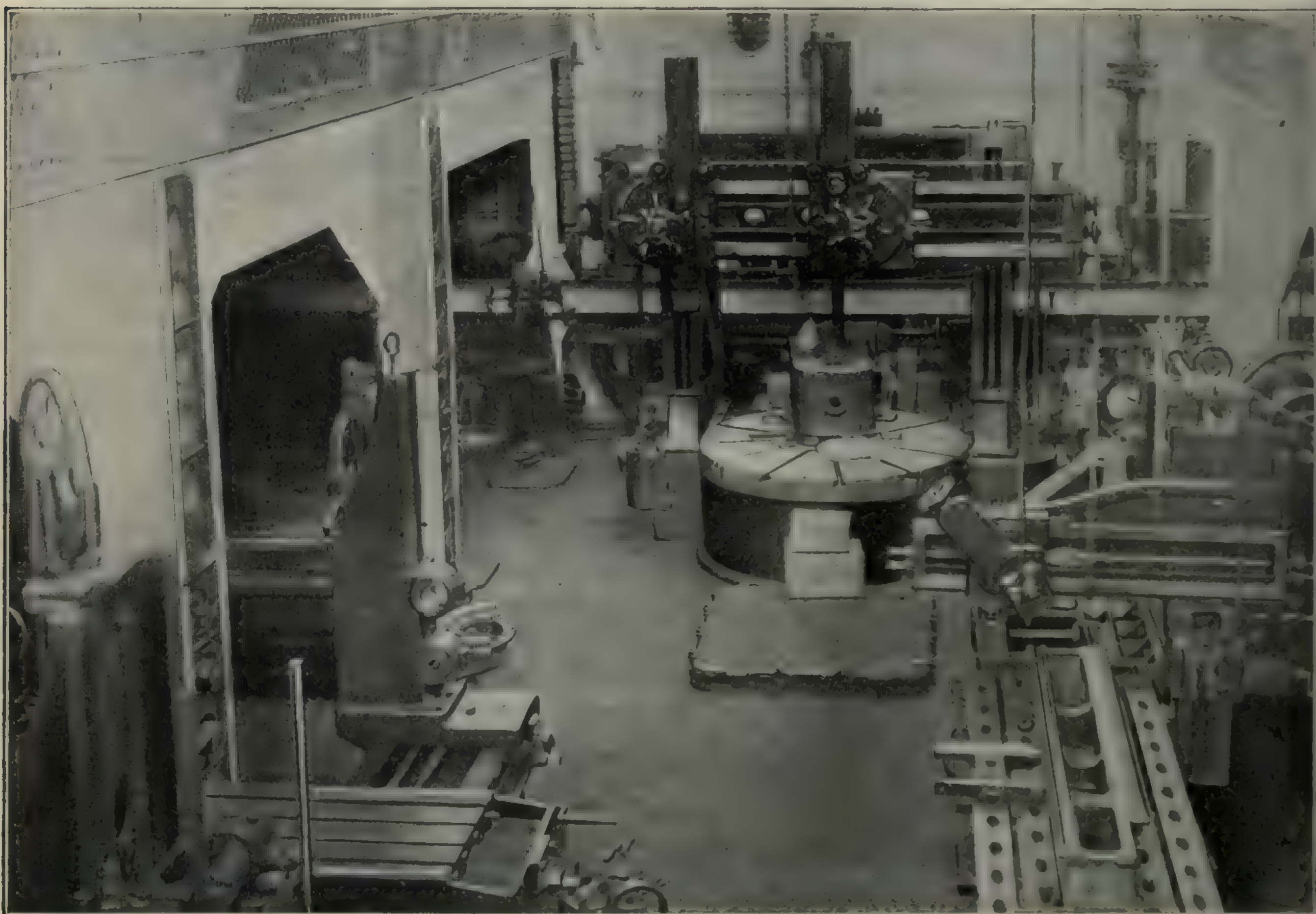


FIG. 2. THE "VESTAL'S" MACHINE SHOP WITH WORK ON BORING MILL AND PLANER

So, knowing his work, his men and his equipment, our repair officer was making no spectacular play in his ready response and no dubious promise of an early delivery hour for the completed work. His long experience with tools, with workmen and with work had taught him to estimate the difficulties of a mechanical problem quickly and to arrive at a solution expressed in time units by the mental process of cancelling the elements of the work by the factors of labor skill and shop appliances. And in the outcome his method proved correct as it had in innumerable instances before.

Through the courtesy of the Secretary of the Navy and the commander of the Atlantic fleet, I had been granted permission to visit certain ships for the purpose of securing photographs, sketches and data for descriptive articles on naval-repair operations afloat during war times. Authorized to join the "Vestal" at a certain Atlantic port, I hastened aboard ship and was at once extended every facility for my observations by Admiral Rodgers, commander of the train, Captain Klemann, commander of the "Vestal", and Commander Keyes, repair officer, with whom, as with other officers and men in the vessel's shops, I spent many interesting and instructive days studying the operations connected with wartime repair work.

The year before I had been extended the privilege of making a long cruise on board the sister repairship, the "Prometheus," which had been newly placed in commission on the west coast. Her voyage at that time consisted in steaming around from San Francisco to the New York navy yard with a naval oil tanker in tow, but unaccompanied by any fighting ships. Therefore the articles prepared on board were necessarily confined to descriptions of the vessel herself as a floating machine shop and foundry, with details of her new mechanical equipment and an outline of certain individual repair undertakings that developed en route.

Further Opportunity to Study Ship Repairs

Now, with the nation at war, the arrival of instructions to visit the "Vestal" brought me the opportunity of witnessing all classes of naval repairs as done on board ship at one of our most important naval bases. My arrival happening to coincide almost exactly with the appearance on board of the battleship of the receiver pipe referred to above, it seemed quite likely that my initiation into the "Vestal's" shop methods was scheduled to get under way bright and early Thanksgiving morning.

However, as affairs came about, the ceremonies were far advanced and nearly concluded before I went below to the coppersmith's shop on Nov. 29, and shortly after all was over—and without any assistance from me at that. It was too late to unlimber a camera and get into action, for the repaired pipe was already proceeding skyward at the end of a line dropped through the hatch above; but with sketch pad and pencil I managed to record the important features of the work itself. As the special apparatus utilized in the brazing operation was still in the coppersmiths' gallery, sufficient material was available to enable me to put together the details of the process followed, and illustrations pertaining thereto will be presented a little later on along with data obtained from the men actually engaged upon the work.

Let me say in passing for the moment to other activities on board ship that the skill and rapidity with which this copper-pipe job was passed through the shop and put overboard into the battleship's boat came as a revelation even to one accustomed to spend much of his time in commercial repair shops where time is always of importance. It must be confessed that upon turning in the night before, suspicion had lingered with me that if that boat came across for her hurry-up job at the stipulated hour of 9 a.m., her crew would have plenty of time to discuss the forthcoming Thanksgiving turkey with the "Vestal's" mechanics before the copper cargo was shipped for return to the waiting battleship. But I had deceived myself, as related. The boat, arriving precisely on the hour, came alongside just in time to stow the brazed pipe, even then suspended for her, over the rail, and so far as the men of the repairship were concerned, the battleship was quite at liberty to up anchor and put to sea as soon as she had hoisted in her now returning motor sailer.

After this lesson on what can be accomplished by mechanics afloat I nailed the inscription "Watchful Waiting" over my stateroom door, then abandoned the room altogether during working hours and established headquarters below decks, where nothing in the nature of repair work could possibly enter or leave the shops without being passed directly in front of a 5 x 7 camera equipped with operating strings direct connected to a shutter set on a hair trigger.

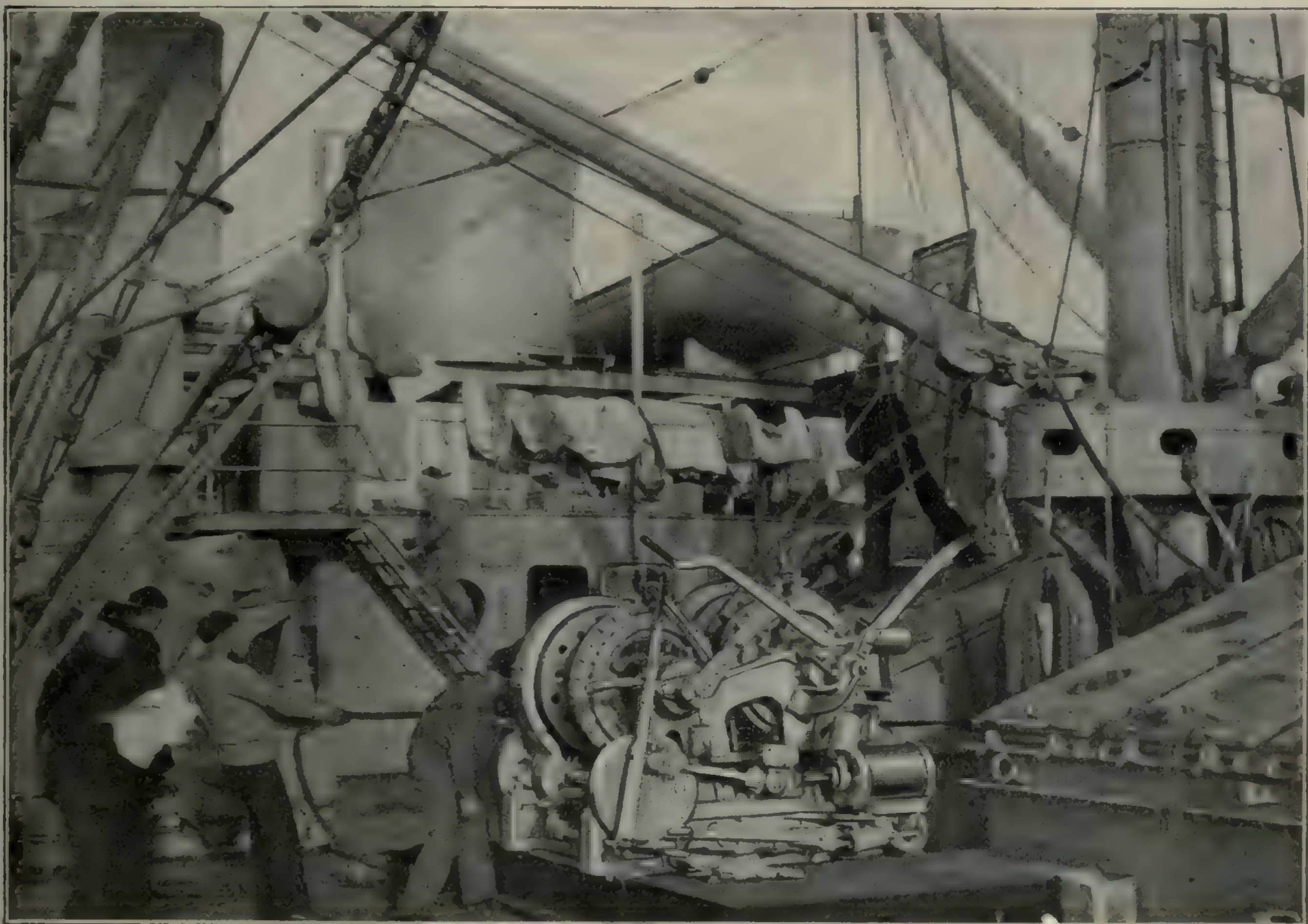


FIG. 3. HOISTING WORK FROM THE FOUNDRY WITH DECK WINCH

Now that we are comfortably located on the train flagship and have made automatic provision against missing anything of interest in connection with operations in the vessel's shops, let's answer a question that is frequently asked by people who work and travel, who read and talk, but who nevertheless seem to have overlooked until recently a very important arm of our naval establishment—the train of the fleet. It is not a new branch of the navy; it is not based upon a unique principle of any kind, although in its development a multitude of novel details have been evolved and incorporated into the train organization and its almost innumerable activities.

The designation is a bequest from the old army organization under which was grouped the equipment and

personnel of a suborganization for handling the paraphernalia of the fighting troops, a feature eventually expanded to include the responsibility of details of supplies, transportation, ammunition, engineering and sanitation.

So in our navy, along with the increase in fighting ships, a train has been built up to perform for them a service comparable with that of the army train for the man with the gun, until today this inconspicuous branch of the fleet operates repair ships, colliers, oil tankers, supply and hospital ships, and assumes the responsibility of looking after the needs of the fighting vessels and the men on their decks in the direction of food, clothing, fuel, ammunition and general supplies in infinite detail.

The vessels in the train organization are not armored and their guns are of small caliber only, as they are not intended for heavy conflict, but are expected to hold off submarines and small raiding craft. In time of battle the train would of course be held in some secure naval base where out of reach of disaster it would still be immediately available for aiding the fighting fleet and supplying its necessities along the lines indicated.

FIG. 4. A SET OF MAIN ENGINE-ROD BRASSES READY FOR RELINING OPERATIONS

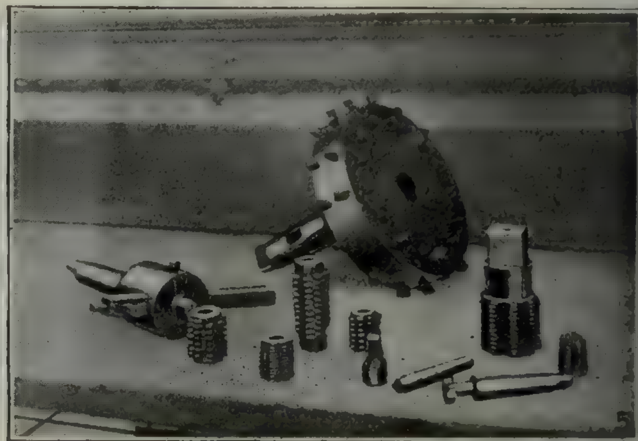


FIG. 5 A FEW "VESTAL"-MADE TOOLS OF VARIOUS TYPES OF CONSTRUCTION

Now while it is the intention to hold this series of articles rather closely to the subject stated in the title head—naval repairs on board ship—there are certain other lines of activity in the round of duties on the "Vestal" that may well be touched upon in this the opening chapter.

First, as this is the train flagship, there are various matters of an administrative character that are here developed and carried into effect. Then, as the ship remains at the naval base for extended periods while other vessels come and go, there are numerous duties that devolve upon her force, such as the handling of the mails for ships at sea (sometimes there are a thousand sacks aboard awaiting the return of the fleet) and other matters having a direct bearing upon the welfare and comfort of their crews.

Normally the ship is required to carry six months' supply of all classes of materials used in connection with her repair operations and other work, besides personal supplies for her crew in sufficient quantities for the same period. So the upkeep of her stores is a very important branch of itself, for there are several thousand unrelated items carried on the schedule of supplies, and every item means the storing of many individual pieces, which in many instances extend into the thousands.

But, of all centers of industry, a ship of this kind has her work so systematized that although many of its details may vary from day to day it resolves itself into almost regular routine. For with work in endless variety coming aboard from every direction a fund of experience has been accumulated that enables everything to be proceeded with in orderly fashion and with the sure knowledge that the outcome will be successful. There is little in the general run of work that is of a repetitive character. Most of it falls into one or other of a number of general classes with which the ship's forces have become familiar.

Consequently the repair officer and his staff who have enjoyed many years of practical training along these immediate lines are enabled to keep the work passing through the different shops in a most effective manner. They understand the peculiarities of each job as it arrives, and when it goes to the pattern shop, foundry, machine shop and other departments they know the exact processes it must pass through and that it will be shipshape and according to the blueprint when completed.

The "Vestal" has a record behind her of several years of practical operation as a floating repair shop, and long familiarity on the part of the personnel with the mechanical equipment and the possibilities of the various departments has resulted in the ability to handle work at a rate and in a variety to astonish the forces of the general shop ashore.

The System Used

Now I wish to explain here that reference to systematized undertakings should not in any way bring up a vision of an elaborate, complex process under which a job is received, routed and followed through the shops and, when completed, delivered to the ship originating the work. Quite the opposite. There is a system, and it is so simple and satisfactory that it will be described later on in other articles. In the meantime the shops are at liberty to proceed with their legitimate business—the turning out of repairs with the greatest expedition possible. This is something over

and above and far more important than the perpetuation of an intricate system that, granted it could be applied to the activities of a floating shop of this kind, could hardly bring about more satisfactory results even though kept in operation by the additional force detailed to sustain it.

Departmental Details

If now the beach engineers and mechanics (I mean no disrespect for I am a beacher myself) who have followed me thus far around the repairship will kindly glance "top side" they will see on the port side of the superstructure deck in the illustration Fig. 1 the commodious business headquarters of the "Vestal's" repair officer and his office staff composed of a young draftsman and a yeoman, whose duties correspond to those of a stenographer and clerk ashore. Snug though this office may be—its deck area not exceeding 12 or 14 ft. square—its limited force handles all the details of the repair-office system, and from this little deck structure are issued all of the job orders and drawings for the workshops below.

FIG. 6. A FOUNDRY CORNER SHOWING CUPOLAS

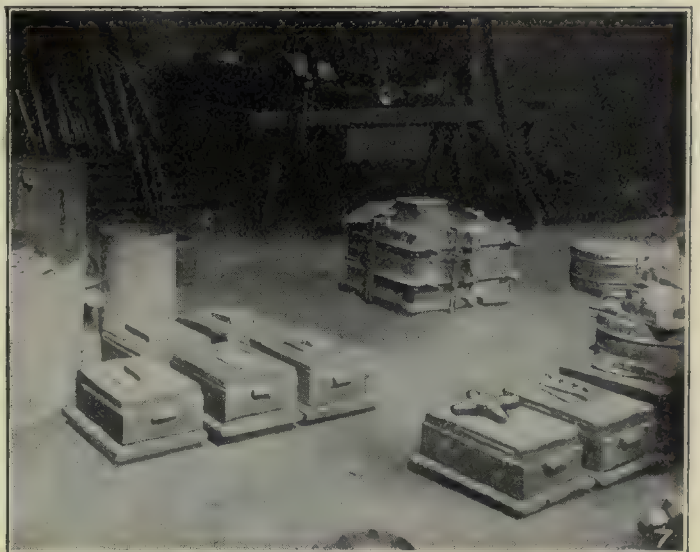


FIG. 7. MOLDS SET UP FOR POURING IN FOUNDRY

In its compact and orderly interior arrangement the repair office typifies other departments aboard, where owing to physical restrictions as to space and diversity of operations every foot of deck area must be utilized to maximum advantage.

Over the repair-officer's desk come every month hundreds of work orders from the different ships of the fleet. An order may mean the making of a single, simple piece, or when analyzed it may be found that it represents the overhauling or complete rebuilding of a machine or piece of apparatus composed of many factors. So in the course of a month's time the individual items repaired or newly produced through the combined efforts of pattern shop, foundry, forge and machine shops coppersmith and electrical shops may aggregate thousands in number.

Naturally a characteristic feature of the ship's undertakings is the hurry and rush attending their completion. Of course all ships of the fleet carry spare parts, and a breakdown at sea is not necessarily a serious incident, particularly if occuring to some minor apparatus, which is immediately replaced by a duplicate part drawn from the stores.

Similarly in respect to the main machinery. Here too, with spares available for running parts, any accident befalling the equipment is not likely to extend beyond the ship's own resources for effecting the repair, at least temporarily.

Each vessel has its own repair force, which is under constant practice, and its own shop equipment, which suffices for many classes of work, although as a matter of necessity the space allotted to the repair shops on these fighting ships is restricted and the capacity for machine operations is as a rule limited to such as can be accomplished on two or three moderate-sized lathes, a shaping machine or two, a drilling machine, and possibly a small planing or milling machine. So far as I am aware there are no big gap lathes, boring mills or large planing machines on any of our dreadnaughts, battleships or other fighting vessels. The work that falls within the province of these larger tools is done at the naval base by the regular repairship, for it has the machine equipment and the men.

As soon as a ship installs any of her spares, orders for new ones are sent to the repair vessel. If the ship is to remain for some time at the base it may be decided to overhaul certain of her equipment, and this means more work for the repairship. If a vessel steams in for a short stay there is always considerable work to turn over to the repairship, all of which is generally of a pressing nature.

A ship at a naval base is supposed to be ready for service at almost any moment. A vessel may steam in after long sea duty, and it having been found say that the main crankpin brasses in her connecting-rods require overhauling they are removed and sent over to the repairship for the attention of the mechanics and a set of spare bearings are installed in the rods. Then, perhaps, comes a sailing order and out steams the ship for a few weeks' cruise. Upon her return to the base the rod brasses, now in proper condition, are sent back to her and placed with her spare parts for future installation when needed.

Almost any morning one may stroll onto the "Vestal's"

deck and find an interesting repair job there that was sent aboard while you were still at breakfast. If you inquire as to its origin you may learn that such and such a ship sent it over; but if you take a glance over the water you may also discover that she has in the meanwhile steamed away from the base and you will not hear another word of her until she returns quite as unostentatiously as she made her departure.

Thus the work of repairs goes steadily onward whether the ships of the fleet are anchored nearby or steaming afar. In the cases of absent vessels there are naturally some awkward factors introduced into certain of the repairs sent to the "Vestal," as, for example, in establishing allowances for fitting of some new part into an old piece of machinery in operation at the time on a vessel a thousand miles away from the repairship. Here again long experience and sound judgment are invaluable.

The "Vestal's" Shops

If you will now step down the machine-shop hatch we will start here for a very brief inspection of some of the ship's shops, reserving details of operations, however, until later.

From the end gallery over the main machine shop we secure a view reproduced in Fig. 2. Looking down the center and side bays we see the big vertical boring and turning mill at the far end, a heavy extension-gap lathe under the starboard gallery, a large, horizontal boring machine directly beneath us and an open-side planer to the right.

There are various other tools under the galleries, and a number of lathes, turret machines, milling machines and other tools above. The main shop is served by a traveling crane operated from below.

The toolroom is on the port gallery, and an inspection of this department will reveal the fact that the ship makes many of her own tools and turns out some remarkable work of this character. The group in Fig. 5 illustrates a few classes of tools of "Vestal" make, including special taps, hobs, milling cutters, big facing mills, sweep cutters, etc.

Foundry and other Departments

Going aft toward the foundry we are just in time to see a set of four main engine rod brasses deposited on the "Vestal's" deck where, Fig. 4, they are ready to be lowered into the pipe and coppersmith's shop for relining. Just beyond, a deck detail is occupied, Fig. 3, raising the foundry hatch cover and hoisting a load of castings from below.

The foundry, Figs. 6 and 7, is, as we shall find, one of the busiest departments on the ship, and its equipment is equal to that in any good establishment of the kind ashore. The description of some of the work turned out here must await another time, as must also the accounts of the work done in other of the ship's departments. It may be mentioned, however, that during the three months preceding Oct. 1 last about forty thousand pounds of iron and composition metal were poured and something like a thousand castings of various kinds produced.

We will also defer for the present the inspection of the pattern shop, the forge shop with its big steam-hydraulic forging press and oil-fired heating apparatus, the copper shop and other departments of interest.

Price and the Man

By Entropy

Mr. Schleimer reduces (page 1047, Vol. 47) the whole matter of employee relations to dollars in pay envelope without stopping to consider that experience indicates very strongly that reduced labor turnover goes with these very improved conditions which he likes but does not consider to have a cash value.

It is true that there are many men who have left good jobs for a few cents a day more pay; but it is also equally true that many others have left good jobs to go to other places where the wages were not so good, but where some of the things that make life worth living were present. There is no place where the labor turnover is so great as in the new munition plants and shipyards where the highest wages are paid. If one can imagine a shipyard where little boys in knee breeches are drawing $5 a day at heating rivets, and where any man who can get hold of a second-hand kit of carpenter's tools can make fifty dollars or more a week, where the labor turnover is less than 300 per cent. a year it is because that yard has something to offer its men besides what is in the pay envelope.

This applies more directly to the thinking men, the men with families, the men on whom in the long run we depend on to keep things going. Reducing the labor turnover means that we get a larger proportion of this type of men, and we get them because we are offering them these intangible things. Sometimes they come to us after roving for years from one place to another.

It may be said that this is a selfish point of view; that these better working conditions attract all the superior type of men to the places that can offer them, which means the places that can command capital. This is true; but workmen are rapidly growing careful—some will say independent—so that soon they will decline to apply even to shops that do not offer such surroundings that work becomes at least mildly enjoyable. All this means, unfortunately, that it is getting harder and harder for a workman to shift from employee to employer; that is, it makes it more difficult for a small shop to get started with limited capital. Possibly this is just as well, for the thing that has produced great numbers of failures in the past has been that of trying to start in business with too little capital, or rather tying up too large a part of a small capital in tools and machinery rather than in stock and facilities for doing work easily.

Under the conditions of today, where every man must be employed for the good of the country, high wages to some extent take the place of these better surroundings; but that is only relative and results in a see-sawing of wages higher and higher, so that the employer who does take good care of his men finds himself penalized by the overbidding of his competitors for labor. This bidding does the owner of the dirty, ill-tooled shop no lasting good, as men will not stay with him, and he finds his labor turnover prohibitively high and eating into his profits.

From every point of view it is necessary that any shop that wishes to compete successfully for competent labor must keep up with the times and offer at least as good surroundings as the large and successful shops find it desirable to give.

Operations in the Manufacture of High-Explosive Shells

SPECIAL CORRESPONDENCE

Data in munition-manufacturing operations are eagerly sought by all plant managers engaged in this production, and the following article is based on carefully compiled data and published for the benefit of such.

THE subject of high-explosive shells and the details of their manufacture may appear to many readers to have reached the verge of exhaustion. This supposition is far from being correct, however, for there is every indication that millions of these steel projectiles will be rquired in the near future to further our operations in the world conflict.

Shell making on an extensive scale is comparatively new in the United States, and many of the pioneers in the field have suffered severely from costly experiments. These experiments have been unavoidable in many cases because so many apparently insignificant portions of the work and operations thereon have proved the most obstinate to overcome.

The embryo munition maker will be eager for every minutely detailed operation, from the rough forging to the O.-Kd shell, and by becoming thus informed he insures himself against greatly reduced profits and, what is even more important, a diminution of the amount of almost priceless material that is often relegated to the scrap heap.

It is the purpose of this article to shed light on some of the lesser operations and the manner in which they are accomplished by a number of successful munition makers now actively engaged in shell manufacture.

The A. P. Smith Manufacturing Co., East Orange, N. J., has furnished the carefully compiled operation data here presented. This, together with the notes and comments by F. W. Van Ness, the superintendent, should be appreciated by those interested:

3-IN. COMMON STEEL SHELLS, HIGH EXPLOSIVE, A. P. SMITH MANUFACTURING CO.

Operations	Number of Machines Used	Name of Machine	Size of Tools	Kind of Steel	Lubricant	Speeds	Feeds
1. Grind tit	1	Hand grinding machine, Norton Wheel 24-P	14 x 2-in.			5,500 ft. per min.	
2. Cut-off open end	2	Davis cutting-off machine	3/4 x 1 1/2 in.	Becker cobalt	Acme Cutting Compound	75 ft. per min.	0.015 in. per rev.
3. Center	1	Turret lathe with air expanding mandrel	3/4 x 1/4-in. combination center reamer	Rex A.A	Mineral oil	300 r.p.m.	
3a. Nick	...	Home-made hydraulic press					
4. Rough turn and face base	4	Fairbanks lathe	3/4 x 1 1/2-in.	Becker cobalt	None	75 ft. per min.	1/16 in. per rev.
5. Drill cavity	1	Colburn drilling machine	1 3/4 drill	High speed	Acme Cutting Compound	120 r.p.m.	0.010 in. per rev.
6. Heat treat	1	Quigley continuous furnace					
7. Rough and finish bore	8	Bullard turret	1/2 in. square and 3/4 x 2 3/4 in.	Becker cobalt	Acme Cutting Compound	100 r.p.m.	0.030 in. roughing, 0.100 in. finishing
8. Recenter	1	18-in. LeBlond lathe	Center drill	Rex A.A.	None		
9. Second rough turn	3	18-in. Le Blond lathe	1/2-in. square	Becker cobalt	Acme Cutting Compound	100 ft. per min.	1/16 in. per rev.
10. Counterbore	3	18-in. LeBlond lathe	Special	Becker cobalt	Acme Cutting Compound	75 ft. per min.	Hand
11. Finish turn	3	17-in. LeBlond lathe	1/2-in. square	Becker cobalt	Acme Cutting Compound	125 ft. per min.	1/32 in. per rev.
12. Weight cut	1	18-in. LeBlond lathe	1/2 in. square	Becker cobalt	Acme Cutting Compound	100 ft. per min.	Hand
13. Rough band score	1	18-in. LeBlond lathe	Special form	Becker cobalt	Acme Cutting Compound		
14. Cut grooves and radius	1	18-in. LeBlond lathe	Special form	Becker cobalt	Acme Cutting Compound	100 ft. per min.	Hand
15. Grind bourrelet	1	Norton grinding machine, Norton wheel 50-M	14 x 2 in.		Soda water	6,000 ft. per min.	Hand
16. Cut off tit	1	18-in. LeBlond lathe	1/2 x 1 1/2 in.	Becker cobalt	Acme Cutting Compound	300 r.p.m.	Hand
17. Finish face base	1	18-in. LeBlond lathe	1/2-in. square	Becker cobalt	Acme Cutting Compound	100 ft. per min.	0.030 in. per rev.
18. Finish band score and knurl	1	18-in. LeBlond lathe	Special form	Becker cobalt	Acme Cutting Compound	100 ft. per min.	Hand
19. Cut cover groove	1	18-in. LeBlond lathe	Special form	Becker cobalt	Acme Cutting Compound	100 ft. per min.	Hand
20. Thread nose	2	Holden & Morgan thread-milling machine	Hob	High speed	Acme Cutting Compound		
21. Grind base	1	Gardner disk-grinding machine					
22. Stamp	1	Dwight slate marking machine					
23. Wash	1	Soda tank with steam jets					
24. Banding	1	Watson-Stillman press					
25. Put in fuse socket	1	Vise					
26. Finish fuse socket and nose	1	18-in. LeBlond lathe	1/2-in. square	Becker cobalt	Acme Cutting Compound	125 ft. per min.	1/16 in. per rev.
27. Turn band	1	18-in. LeBlond lathe	Special	Becker cobalt		300 r.p.m.	Hand
28. Put in base cover	1	Punch press					
29. Number	..	By hand					
30. Lacquer	.	Air brush					
FUSE SOCKETS							
1. Form drill and ream	3	No. 10 Foster turret		Becker cobalt	Acme Cutting Compound	100 r.p.m.	Drill: 0.090 in. per rev. Forming Hand
2. Face shoulder and ends	1	18-in. LeBlond lathe	Special	Becker cobalt	Acme Cutting Compound	150 r.p.m.	Hand
3. Mill wrench holes	1	Special milling machine					
4. Threading outside	2	Holden & Morgan thread-milling machines	Hob				
5. Tap and face to length	2	American turret	Special		Acme Cutting Compound	40 r.p.m., 100 r.p.m.	Hand
6. Drill and tap setscrew hole	1	3-spindle drilling machine					
7. Hand tap to remove burr							

Regarding the points which have given us the most trouble, I would say that we can think of none in particular that gave us any serious trouble. The main thing to bear in mind all the way through the operations is to arrange the stops on the machine so that you gage from the proper point for each operation; also be sure that your operations are so arranged that the inside bore will be concentric with

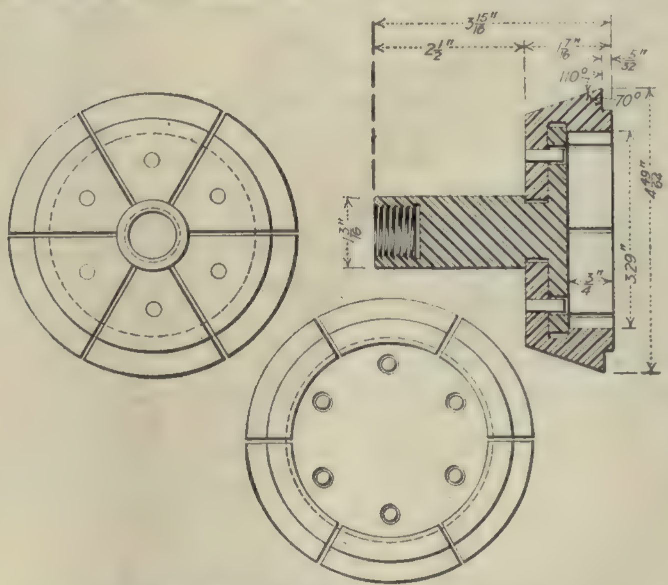
the outside turning; also in turning the nose of the shell, gage from the front end of the shell. Another point is to carry the work on centers as long as it is practical.

The boring operations have given some contractors considerable trouble on account of not having their boring bars properly made and the cutters properly ground. If sufficient chip clearance is not allowed for the boring bar the chips will score the inside of the shell. If the lubricant is not forced right on the point of the cutting tool it does very little good when you are running at high speeds. The finishing reamers should be ground with as little clearance as practical. We grind them by attaching them to a tool block that has a cam at the bottom, which corresponds to the form of the cutter, and in this way all cutters are ground uniformly. We start with a clearance of 2 deg. where the cutter works on the bottom of the cavity of the shell, and gradually increase this clearance to 5 deg. at the center of corner radius and back to 2 deg. on the side.

THE A. P. SMITH MFG. CO.

The notes and table of operations applying to the manufacture of 18-lb. British shrapnel plugs, as furnished by Fittings, Ltd., Oshawa, Canada, are safe guides to follow by those engaged in this branch of munition manufacture. The sketch of the shrapnel grinding chuck is self-explanatory and may prove useful in overcoming faults developed in grinding operations.

Our experience on munitions is confined to 13-lb. British shrapnel and shipping plugs, the same size plug being used for all sizes of shells. All our shells have been made on



CHUCK FOR SHRAPNEL GRINDING

engine lathes, the operations being divided and simplified as much as possible, the only other machines used being an upright drilling machine for threading the nose and grinding machines for finishing the body after hardening. The profile of the nose was turned on an engine lathe. We have used two styles of grinding machines, one made by the Modern Tool Co. of Erie, Pa., and the other by Sheldons, Ltd., of Galt, Ont. We found that the collets were unsuitable for our work and the improved collet shown herewith was designed by the writer.

Operations	Speeds	Best Lubricant
Turning	60 r.p.m.	Cataract Co.'s Mystic Cutting Compound
Boring powder cups and disk seat	40 r.p.m.	Cataract Co.'s Mystic Cutting Compound
Thread chasing 2 in. in diameter, 12 per in.	50 r.p.m.	Cataract Co.'s Mystic Cutting Compound
Thread with die	....	....
Steel used—any kind of good high-speed steel *	....	....
Grinding wheel, Norton, Hart and carborundum	....	....
Work speed on modern grinder	65 r.p.m.	Soda water
Work speed on Sheldon grinder	115 r.p.m.	Soda water

* Stellite was tested but was not found satisfactory.

W. H. ROSS.

The sequence of operations from the forging to the shipping room, as followed by A. B. Jardine & Co., Hespeler, Ont., covers the subject thoroughly. The notes accompanying the data often strike just the points being sought.

We are machining and assembling British 18-23. shrapnel shells. The sequence of operations follows:

1. Annealing.
2. Rough cutting off base end.
3. Cutting off base end and open end.
4. Centering.
5. Rough turning.
6. Second turning.
7. Cutting wave-rib and copper-band groove.
8. Boring for powder cup and steel disk.
9. Heat treating.
10. Scleroscope test for hardness.
11. Nosing in point end.
12. Boring, facing and tapping nose.
13. Grinding body.
14. Turning profile.
15. Preliminary shop inspection.
16. Cutting center tit off base and finishing base of shell. The shell receives preliminary inspection by government inspectors after this operation.
17. Pressing on copper band.
18. Turning copper band.
19. Filling shell, screwing on socket and soldering.
20. Turning brass socket.
21. Final shop inspection. The shell receives final inspection by government inspectors after this operation.
22. Painting, boxing and shipping.

The points that cause trouble in the machining of shells are many, some of the most confusing being where the limits of sizes overlap, viz., a shell with thickness of base at the high limit and the length over all at the low limit makes the length from bottom of powder cup to the nose of the shell too short. There are a number of other cases where limits overlap, and these are usually found by experience.

JNO. JARDINE.

The John Bertram & Sons Co., Ltd., Dundas, Canada, furnish material relating to the operations required on 8-in. shell work. It has stated its willingness to answer questions pertaining to this branch of munition manufacture.

On 8-in. shell work the boring probably gave us the most trouble until we made a grinder which ground the cutters perfectly true with the holder shank. We used three heads: the first with stepped blade, the second with blades of true form, but notched, and the third with finishing blades. First and second heads had three blades, but the third head only had two. We are now tooling up for 6-in. shells, but are glad to answer any direct questions with reference to our work on the 8-in. or 18-23. British shrapnel.

SPEEDS AND FEEDS

Speeds and feeds are about as follows: Roughing, 135 ft. per minute, 3-32 in. depth of cut, 0.05 in. feed per revolution; finishing with 2-in. circular tools of high-speed steel. 90 ft. per minute. For lubricant we have been using lard oil, but we are going to try a solution that will enable us to avoid so much cleaning.

H. G. BERTRAM.

The troubles experienced by the Canadian Locomotive Co., Ltd., Kingston, Ont., in the manufacture of 4.5 British high-explosive shells are tersely set forth in the superintendent's note. The operation list is quite complete:

Operation	Speeds	Best Lubricant
Drilling	....	....
Rough turning	60 to 70 ft. per min.	British - American Oil Co. "Lubro"
Boring	50 to 60 ft. per min.	....
Thread chasing	10 ft. per min	....
Finish turning body and profile nose	90 ft. per min....	....

Red cut superior, stellite and double Mushet steels were used and Norton grinding wheels when obtainable.

Our chief troubles are the fuse seat, retainer seat and the threads in the nose of the shells. A rigid shop inspection at each operation is most essential. It is easier to avoid troubles than to correct them later. We are making 4.5 British high-explosive shells.

J. FARRAR, Superintendent.

The Union Switch and Signal Co., Pittsburgh, Penn., furnishes the methods employed by it in the successful manufacture of 5-in. British high-explosive shells:

Operations	Speeds	Best Lubricant
Rough turning..........	78 ft. per minute......	Compound soda ash, mineral-lard oil, and water
Finish turning..........	115 ft. per minute.....	None
Boring..........	Same as rough turning	....
Threading..........	....	Vaseline and paraffine

Steel used Red Cut, Cobalt and Midvale extra special.

The value of the foregoing information is readily apparent to shell makers who have been struggling in a direction at variance with the methods stated, and it is to be hoped that conservation of energy and materials will result from an application of like operations to similar cases.

Fishing for Inventive Suckers

By E. A. Dixie

I was recently granted a couple of patents on a certain mechanical device that has nothing to do with this story. Since the patents were issued I have been swamped with letters from fake concerns that want: To print my life's history; to print an illustrated description of the "patent" (not the invention); to sell the patent for me, etc., etc. Some of the letters are very amusing; most of them are poorly typed on poor paper, but all of them rave about the millions of dollars in just such "patents" as mine.

One of them sent me (although I am over the draft age) a "questionnaire." So having nothing better to do I will answer it and mail the original to the sender and a copy to the *American Machinist*. The answers I have given in italics.

Questionnaire

Is this your first patent? Answer—*No.*

Have you sold this or any other patent? Answer—*Yes and no.*

Have you any invention which you have not patented? Answer—*Yes, hundreds of them.*

Is your patent for sale? Answer—*Which one*

Are you a United States citizen or an alien? Answer—*Yes.*

If alien, of what nationality? Answer—*Not an alien.*

What is your age? Answer—*Middle aged; just about midway between first and second childhood.*

Are you married or single? Answer—*Yes, and by a strange coincidence all my brothers and sisters are too.*

What is your present, your past occupation? Answer—*M.E., E.E., E.M., technical writer, mechanical expert, etc., etc. You see I'm one of these terribly clever guys.*

Are you of an inventive turn of mind or was your invention of an accidental nature? Answer.—*You do not specify which invention, so I will endeavor to give you illustrations of both types, one the child of a great mind (my own); the other the result of an accident (also my own) induced by an alien-enemy banana peel.*

How I Came To Invent "Retroverted Rifling"

The trend of my efforts in mechanical invention has always been toward simplicity of construction.

In the conventional gun factory the tube is first bored and then rifled. This is done with a multiple-tool rifling head which is given a rotary as well as a longitudinal movement in order to produce either the uniform or the increase helix as required. The bore is small and the chips are confined in it so that they often choke the head. In this way the operation is rendered slow and tedious.

To a titanic brain like mine, how easy it is to simplify! But invention, even with me, is a process of evolution.

My first idea was to eliminate the costly rotating mechanism for the rifling head, cut the grooves straight and then twist the tube. The result was staggering! But there was little gain in speed because the chips still were confined by the bore and clogged the grooving head.

My next revolutionary improvement was the result of entirely subverting all the principles of the art as then known.

I cut the rifling on the outside of the tube where there is no chance for the chips to clog. They have the whole shop in which they can wander round. They can coil lovingly round the operators legs or employ their time profitably till the clean-up man gets them, by consorting with other chips and chippies (diminutive) from other operations. Then after the outside is rifled how simple it is to extend a long nickel-steel arm through the rough-forged bore of the gun, grasp the muzzle end of the tube with a manganese-steel hand (affixed to aforementioned nickel-steel arm) and turn the tube inside out just as mother used to do when darning stockings! My next improvement was attained by combining my first and my second improvements, i.e., cutting the grooves straight on the outside, turning the tube inside out and twisting the tube to the desired helix.

But even as I sit here typing this my ever active brain cannot resist the temptation to entirely subvert the new principles it itself has evolved. The thought is in embryo, but I can say this, the big gun of the future will have a central solid bar. This bar will be rifled on its exterior. The projectile will be hollow and embrace the central bar. The copper driving bands will be on the inside and not on the outside of the projectile. The gun tube will be smooth bored.

Again I find myself evoluting so the gun mentioned in the previous paragraph is already, so far as I am concerned, obsolete. But of this the latest and most priceless gem in the diadem of my thoughts I can say nothing lest the enemy forestall us.

Accidental Invention

Just talk to any old-timer about the early days of the telephone and he will tell you how the stock went begging at a few cents a share; those same shares are now worth thousands of dollars each.

The telephone was a utility that just had to "arrive," as the French say. Clear merit put it where it is today.

Go into any machine shop and you will see dozens of safety devices, gears and punches, etc., are all guarded. Why? Because the laws of the land demand that they shall be guarded. The man who first put a guard on the back gears of a lathe was laughed at. Why? Because unless you go behind the lathe and reach up you can't get your hand caught in the back gears.

Well the gear-guard inventor died poor, but later someone who knew the game made a guard and then pulled the proper wires till gear guards were made compulsory. Most of the guards had little inherent merit; they had to be legislated.

There are meritorious inventions by the score that would need the whole force of the legal talent of the whole United States to compel their use; of them my slipless-peel banana is one. We need not go into the details of how I came to think of it. We have all of us in unguarded moments had our minds very close to banana peels. At such times the words banana peel closely associated with vitriolic adjectives would pour in a scorching torrent from our lips.

The invention is simple, but it requires legislation to compel its adoption.

Immerse the bunch of bananas in a fair quality of fish glue (fish glue is essential so that the purchaser will not forget that he has bought bananas). Before drying the bunch, coarse bar sand is dusted in a nonchalant manner over each individual fruit.

The result is a slipless banana peel.

Do you read any technical or inventors' publications? If so, name them. Answer—*No, I write them.*

Are there any incidents in your life that may prove of interest or instructive to inventors? If so, please state them. Answer—*Yes my early experiences with quack patent attorneys. These will appear shortly in book form; price $6 net. In order to avoid the rush I suggest that you remit at once.*

[As the "slip" is usually caused by the inside of the peel we believe that sand would necessarily have to be applied both inside and outside.—Editor.]

A Gaging Kink for Surface Grinding

By Fred H. Bogart

The difficulties of gaging the thickness of work while being surface ground on a magnetic chuck have never been very satisfactorily solved either by the devices put out by the machine-tool builders themselves or by any of the more common methods in use in manufacturing plants.

So many variations of conditions arise in the process of grinding large quantities of irregularly shaped pieces on a magnetized table that the most carefully designed surface indicators which will work perfectly under ideal conditions become unreliable or inoperative after a short period of constant use. The direct reason for this is that any form of indicator sufficiently delicate to read to thousandths of an inch is too delicate to stand up under the bumping that must necessarily occur as the contact shoe slides from piece to piece while the table traverses or revolves. Where the shoe is not adjusted to the work to give a constant reading the permanently affixed indicator has little advantage over the older method of taking one piece off and measuring it with a micrometer. Both methods require that the operator work down to size by the cut-and-try process; both necessitate the stopping of the table and the thorough cleaning of one piece before the measurement is taken, and these wasted periods, repeated as they often are three or four times before the required size is registered, aggregate more in most instances than the time consumed by the wheel in cutting away the material. The only advantage of the permanently affixed indicator over hand measuring is that with the former the magnetizing current does not have to be shut off to take the measurement.

Surface grinding in quantity is dirty work, and particularly where there is considerable stock to remove and the work is done wet the accumulation of slush in the crevices between the parts on the table makes it almost certain that some dirt will work in under the edges of the work if the magnetic pull is released for any reason. All such factors contribute to a large volume of spoiled work, or at least to a large percentage of parts outside the prescribed limits, necessitating extra inspection and a special dispensation.

A Clever Wrinkle

A method which I have seen used only in one plant, and therefore believe is not commonly known, impressed me as a simple and clever wrinkle for getting around many of the practical difficulties of measurement on this class of work. It was a scheme of the operator himself, a man of no mechanical experience, but "broken in" on that particular machine to produce duplicate parts in large quantities. The machine had been equipped with a dial indicator, but it had been discarded as too uncertain of operation. The method the man was using had been devised by him not to increase production or save his employer money, but to save himself the dirty job of cleaning and measuring a part two or three times every load of the table.

At the time I saw the operation he was grinding steel disks about $\frac{3}{16}$ in. thick to a limit of 0.003 in. Assuming the thickness dimensions were maximum 0.188 in., minimum 0.185 in., his procedure was as follows: On the first tableful he worked down to his maximum limit by cut and try, taking off one piece and micrometering it according to common practice. The first load finished he selected a single disk from the lot measuring 0.188 in., cleaned its surface with a little gasoline, blued it with a swab out of a bottle of solution he kept handy, and put it on the table with the second load. No matter how dirty the water or work got during the process of grinding you could always plainly see that one blue disk sweeping around the circle.

During the early stages of the grinding the operator doctored a second disk ready for his next load. When he thought he was nearing size he watched his blue disk. The moment the wheel touched it and the blue disappeared up came the grinding wheel, and it was reasonably sure that the parts would then measure between 0.186 in. and 0.187 in. and warrant cleaning off the table before making a measurement. That man was certainly turning out the work with splendid accuracy and with very little wear and tear on his nerves, and the only trick that I could see was to always pick a dummy disk measuring to the maximum thickness.

On some classes of work this method would be open to the criticism that it cuts down production by reducing the unit capacity of the table. If the table held only a few pieces this would be worth consideration, but the quantity would not have to be very great to pass the point where the saving of time in measuring would more than offset the loss of space.

Machining Gasoline-Engine Parts

BY M. E. HOAG

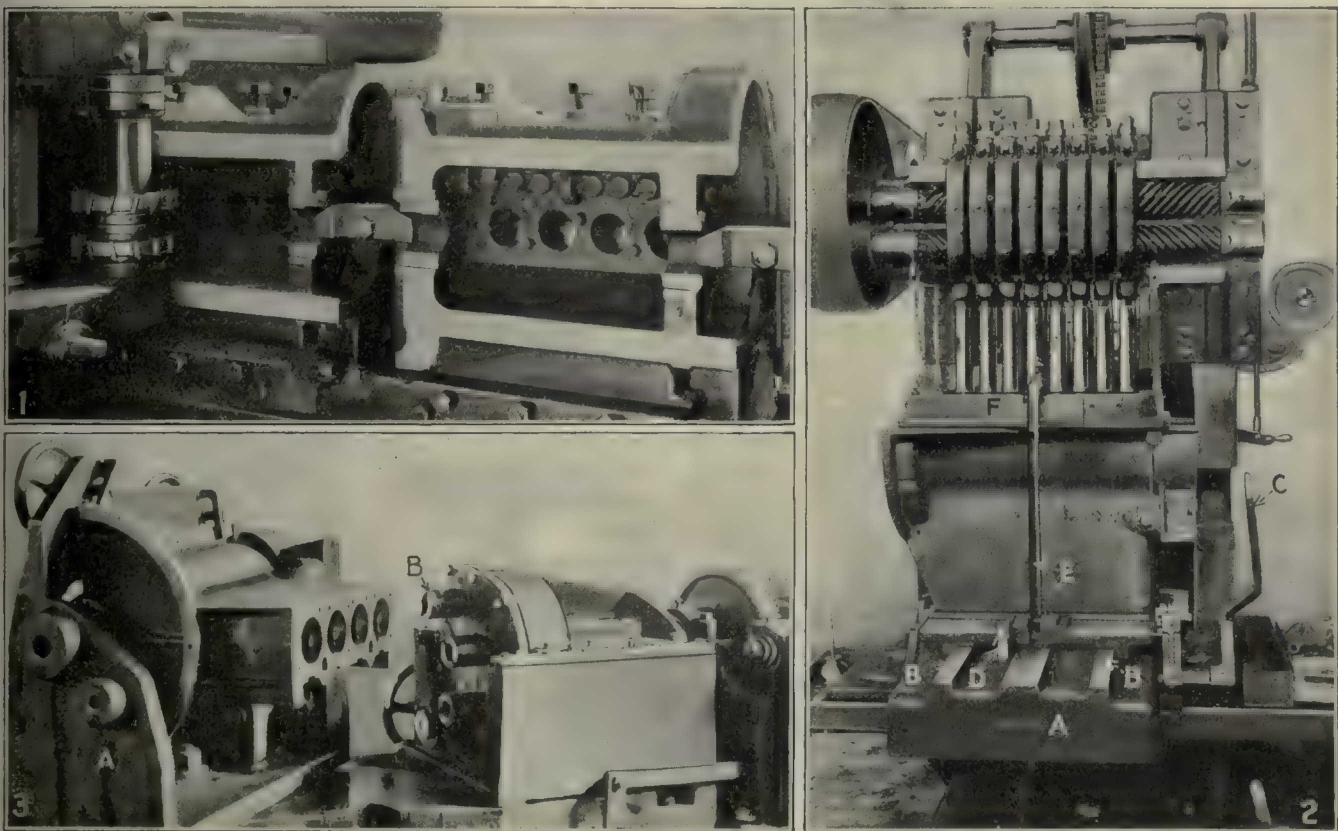
A number of unusual tools and methods in the machining of gasoline-engine parts are described, some of which should prove of interest to readers.

IN machining cylinder castings of gas engines built by the Root & VanDervcort Engineering Co., at Moline, Ill., one operation is the facing of top and bottom surfaces and bearing seats as shown in Fig. 1. For this operation six open jigs are mounted on an Ingersoll milling machine so that both tops and bottoms are faced to size in the one operation, no finishing cut being necessary. As the castings come through the machine the bearing seats are milled with the two cutters, as shown in the illustration. The clamps and binding screws for fastening the castings in the jigs are heavy and substantial, and this together with the design and weight of the jigs secures the necessary rigidity to finish the pieces with one cut. After facing, two holes are drilled and reamed at opposite corners of the lower face by the use of a simple drill jig, and from these two holes location is made for all succeeding operations. The fixture used in drilling the push-rod holes is shown in Fig. 2. The base *A* has two ways *B* on which slides the fixture operated by the lever *C*. Positive stops at the rear and the removable locking stop *D* at the front of the fixture locate it with relation to the drill spindles.

A swinging clamping lever *E* holds down the bushing plate *F* in position while the drills operate. Two pins in the bushing plate enter the two reamed holes in the cylinder casting and locate it.

It will be noticed that the bushing plate *F* is attached to the machine head by four chains in such a way that the raising of the head raises the bushing plate clear of the work when finished and again lowers it ahead of the drills when a new casting is placed for drilling, which saves considerable time and work for the operator.

The main bearings, camshaft bearings and bearings for the generator are bored in the cylinder casting with the special rig shown in Fig. 3. The bed of this boring machine is mounted on a concrete base to raise it to a convenient height above the floor. That part of the machine *A* which jigs the casting swings on a central pivot. This permits the boring bars to be inserted, after which the jig is swung back to position and the bars coupled to the driving heads by a simple bayonet joint, as shown at *B*. This machine takes up very little floor space and does not require long boring bars. It also does away with knuckle joints by insuring alignments of the spindles and bars.



FIGS. 1 TO 3. WORK ON CYLINDER CASTINGS
Fig. 1—Facing cylinder castings. Fig. 2—Drilling push-rod holes. Fig. 3—Boring bearings in cylinders.

The oil pans are drilled on a Natco multiple-spindle drilling machine, shown in Fig. 4, 38 drills operating at once on the top, bottom and both ends of the pan. The jig for this work is so arranged that the work starts at *A*, where the bell crank case is drilled with seven holes. The piece is then moved to *C*, where 13 holes are drilled in the top and 14 in the bottom; it is then passed to *D*

and four holes drilled in the small end. The drill bushings for the bottom and both ends of the pan are carried in the plate *E* which is attached to the machine head by bolts at each corner so that it is raised and lowered with the drills, thus doing away with the manual labor of a helper. The bolts are free to slide in the plates so they will not interfere with the lowering of the drills as they enter the work. Suitable location is obtained by hardened plugs and bushings. The drill

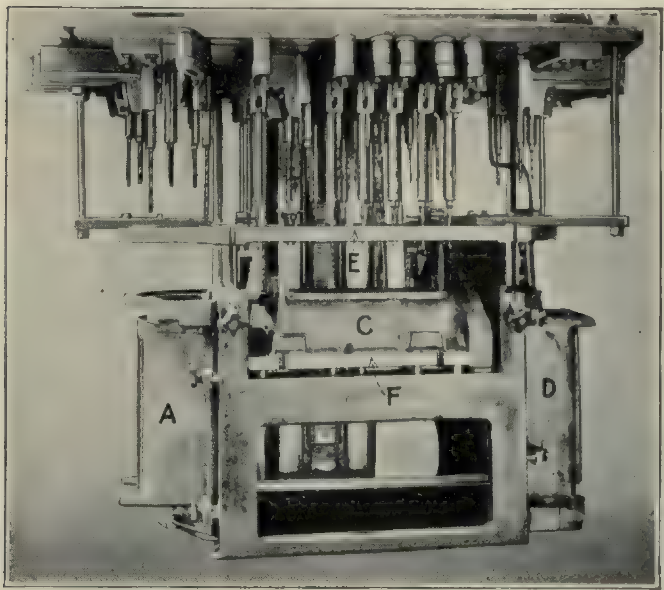


FIG. 4. DRILLING HOLES IN OIL PANS

bushings for the holes in the bottom are carried in two separate plates, one at the front *F*, which is removable to permit placing the work, and the other at the rear, which is attached to the machine head by chains and is raised and lowered by the machine. Swinging locking bolts clamp the work and bushing plates in place.

The Return of Labor to the Factory

The Ministry of Labor of Great Britain has issued the following outlines of a scheme of demobilization:

The Reconstruction Committee appointed by the late government to consider plans for the ultimate demobilization of the forces has now presented to the War Cabinet a scheme for effecting the discharge and the resettlement in civil life of the members of the forces. The scheme is the result of very careful consideration of all the aspects of the problem by the committee and the government departments concerned. Obviously it would be premature to make public the details of this scheme at the present time, but a full announcement will be made in due course. It may be stated, however, that the responsibility for carrying out demobilization will rest with the Admiralty and the War Office, so far as the naval and the military arrangements are concerned, and with the Ministry of Labor as regards the resettlement of discharged soldiers and sailors in civil life.

The lords commissioners of the Admiralty and the Army Council have accepted as the basis of their plans for demobilization the principle that after a lasting peace has been assured men must be released from the forces in accordance with civil rather than naval or military requirements.

In order to help the sailors and soldiers to get back into civil life as quickly and as easily as possible the Ministry of Labor proposes to use the machinery of the employment exchanges, which are the only national organizations sufficiently strong for the purpose; but in order to assist the ministry and the exchanges to carry out the task that will be imposed on them the Minister of Labor proposes to invite the employers' associations and trade unions to give him the fullest assistance, both centrally and locally. In the first place a central committee, to be known as the Labor Resettlement Committee, has been set up, constituting representatives of the employers and the trade unions in the principal industries in equal numbers, together with representatives of the departments concerned with demobilization. The Minister of Labor will be chairman of the committee, and he has appointed Lord Burnham to be vice chairman. To this committee the minister will look for advice and information on all general questions affecting resettlement.

Local Committees

In addition to the Labor Resettlement Committee local advisory committees have been formed in connection with all the principal employment exchanges, consisting of representatives of the employers and trade unions in the principal local industries in equal numbers, to whom will be added for the purpose of demobilization a certain number of representatives of local bodies particularly concerned with the welfare of discharged soldiers. It is hoped that a great deal of the work of finding employment for discharged men and of adjusting the difficulties that may arise in individual cases will be performed by these committees, which the minister regards as a vital part of the machinery for the resettlement of industry.

Further, in addition to the general questions which will be dealt with by the central committee, and the local or individual questions which will be dealt with by the local advisory committees there are a number of problems which can only be satisfactorily solved on a basis of industry. The minister is accordingly very anxious that joint standing industrial councils shall be set up for the organized industries as soon as possible on the lines recommended by the Whitley Report, to which he would be prepared to refer immediately a number of problems of this kind, which require careful consideration by workmen and employers sitting together. The functions of these councils in regard to resettlement would be coördinated by the central committee.

Results Sought

By means of the machinery described above the minister hopes to secure that arrangements shall be made for coping with the problems of resettlement over the whole field of industry, which shall be in harmony with national and local requirements and also with the peculiar needs created by the conditions obtaining in each of the principal industries. The government feels that the problem can only be successfully dealt with in close coöperation with employers' organizations and trade unions throughout the country, and the plan which has been drawn up and has been generally approved by the War Cabinet has been devised with this end in view.

Laying the Rails for Future Business

BY FRANCIS H. SISSON

The address which follows was delivered by Francis H. Sisson, vice president of the Guaranty Trust Co. of New York, before the annual meeting of the Chamber of Commerce of the United States, held at Chicago, Apr. 11, 1918.

IT SEEMS too obvious to require repetition, yet apparently the fact is still little understood that the efficiency and adequacy of the arteries largely determine the health of the body.

For a period of 30 years, with an increasing intensity of action, this country has pursued the policy of constriction and starvation toward its arteries of commerce through which the lifeblood of the body economic must flow. Sclerosis and paralysis inevitably followed. In striking proof of the folly of this treatment, when the necessities of war force the Government to take over the care of this ailing patient all the nostrums, quack remedies and prescriptions of the years are thrown out of the windows and a complete change of treatment is prescribed.

This new treatment has general approval for the conditions of today, but what of tomorrow? That is the question which the business men of the United States must face and answer if this country is to achieve its oft-described "manifest destiny."

The present Government control of the railroads, while representing a progressive step, cannot be considered as offering a solution of the transportation problem; it is a temporary and extreme measure forced by the exigencies of a great crisis for which there had been no preparation.

The incalculable importance of the railroads in every phase of our individual and national existence was dramatically, I might even say tragically, demonstrated last winter when the grim specters of cold, hunger and want stalked in the wake of transportation paralysis. Never before in our history have we so thoroughly appreciated the importance of distribution as an economic factor. It is to be hoped that we will never forget this costly experience.

The demands of war, sudden and colossal as they are, have not been responsible for this deplorable state of affairs; they merely accelerated and accentuated the inevitable result which would have come sooner or later under existing conditions. We are simply reaping the harvest of a decade of railroad baiting born of ignorance, prejudice and political expediency, which, as a people, we did not understand and the consequences of which we did not anticipate.

THE SHACKLED GIANT

Punishment visited on the many for the sins of the few, the reduction and limitation of rates, the multiplication of regulations and regulating bodies, the increase of taxes and impositions, the rising costs of labor and material have for the last 10 years added new bonds to bind this modern Gulliver of ours until he lay helpless, the victim of those he should live to serve. The strong hand of the Government, in taking over the railroad situation, has released many of these shackles, and by coördinating direction and operation is restoring that ability to serve which has been denied the achievement of its purpose.

But the foundations for the unprecedented economic struggle which inevitably will follow the present armed conflict must be laid now. We were woefully unprepared for war; we dare not be equally unready for peace. And one of the chief factors in preparing for the future unquestionably is that of railway extension, for the carriers will play as important a part in helping to win the battles of the prospective international combat in trade fields as they are today in speeding our military strength to the battle line of freedom for the victory which democracy must and will win.

Are these great weapons in our commercial warfare to be privately or publicly owned and operated? Why have they not been equal to the occasion and how can they be made so? Can preparations for the future be made in the light of the past?

In recent years we have lost sight of the great influence which the railroads have exerted in the development of this country and we have forgotten that our great resources are far from fully developed. But now, as we face humanity's arch enemy and as we watch the burdens of financing our share of the war mount day by day, we are coming to understand that we shall have ample use for all our resources, all our productivity, all our distributive facilities. We must create new wealth to meet the destruction of the old.

CONSTRUCTION AND IMPROVEMENT RETARDED

We are beginning to comprehend the significance of the prophecy of that astute and farseeing railway executive, the late James J. Hill, who in a now famous letter to the Governor of Minnesota in January, 1907, predicted that American railroads would need to expend at least $1,100,000,000 annually on construction and improvements for the succeeding five years if they would competently handle the business of the country.

According to Mr. Hill's estimate, then, $5,500,000,000 ought to have been spent in the five years between 1907 and 1912. As a matter of fact only a little more than $5,100,000,000, according to property-investment figures of the Interstate Commerce Commission, was put into the roads during the 10 years from 1906 to 1916. And the cost of road and equipment rose from $12,400,000,000 in 1906 to $17,500,000,000 in 1916, or about 40 per cent. Yet, despite these serious handicaps, the ton mileage grew during the same period from slightly more than 215,800,000,000 to 343,000,000,000, or 45 per cent. The total tractive power increased 62.5 per cent., and the capacity of freight cars 59.7 per cent. The increase in mileage in that period was only 14 per cent.

New investment in railroads in 1914 aggregated $512,000,000; in 1915 it was $263,000,000, and in 1916 only $258,000,000. During the two latter years especially should the roads have been permitted to prepare for the increased handling of the traffic which war was sure to bring. Even as early as 1915 it was manifest that we might be drawn into the European maelstrom, and certainly as a wise precaution we should have made

ready for such an emergency. In extenuation, however, as Horace Greeley observed of us Americans, "our foresight is not as good as our hind sight by a darn sight."

The history of the development of our railway systems is divided into several periods, which have their own individual and significant characteristics. Up to 1851 the railroads were passing through a period of experimentation in which they were considered largely as supplementary to the various waterways which at that time were the main means of communication. There were then approximately 9000 miles in this country.

The period of prosperity following the discovery of gold in California led to a period of intense activity in railroad construction, which was temporarily halted by the panic of 1857. During this period some 17,000 miles of road were built, and it was the period of extension of certain main lines to the West. The Rock Island reached the Mississippi, and was speedily followed by the other "granger" roads. By 1860 many of the principal lines in the Southern states had been opened. The total of railway mileage in that year was 30,826 miles.

The period subsequent to the Civil War was characterized by the exceedingly rapid growth of our railway system to the Pacific Coast. Of the total construction in this period, about one-half of the mileage was west of the Mississippi and Missouri rivers. The panic of 1873 and the overextension of the railways naturally checked the construction of new lines.

There was another period of great activity in railroad building during the early '80s, in which the Atchison, Topeka & Santa Fé and the Southern and Northern Pacific roads were opened. During the year 1882 11,000 miles of road were laid, the record being exceeded only by the year 1887, when 13,000 miles were built. Another panic, that of 1884, again brought railroad development practically to a standstill until 1886, and in the three years 1886, 1887 and 1888 a total of 26,000 miles of railroads was built.

Ten Years of Inactivity

Through several panic years the period from 1890 to 1900 was a time of inactivity in railroad construction. Furthermore the main trunk lines and the principal systems had been built, and the only demand for new construction in any part of the country consisted of branch and subsidiary lines.

The low-water mark in railroad extension for this period was reached in 1897, when only 1600 miles of road were built in the entire United States. During the period of depression from 1893 to 1897 an average of less than 2000 miles was built annually.

The year 1900 marked an upward trend in railroad construction and also in business conditions. The forming of large combinations of industry was begun, and the period of this activity continued up to the panic of 1907, which checked active construction.

From 1907 to 1914 the country was recovering from the effects of the panic of 1907. In 1913 and the beginning of 1914 there was another serious depression, which many financial leaders thought was a sure sign of an approaching panic. Within a few months after the outbreak of the European war, however, there was an improvement in general business conditions and a remarkable expansion of the commerce of the country.

But in the face of this rapidly growing need we find the figures of railway extension dropping to 1532 miles in 1914, 933 miles in 1915 (the lowest for any year since the Civil War), 1098 miles in 1916 and 979 miles in 1917.

The railroads had not kept pace with the growth of the country and could not bear the added burdens of war. Lack of credit born of governmental regulation had wrought this finish. The decline of railroad credit following the enactment of the Hepburn Act and the amendment giving the Interstate Commerce Commission power to suspend rates was continued with deadly certainty. Rates moved ever downward, expenses piled ever upward, uneconomic laws and multiplied regulations consumed revenues. Banks and investors looked elsewhere and the unremitting conflict of the public wrought its own undoing. Now the Government has stepped in to assume the burden of its own creation. What next?

Must Restore Railway Credit

It is certain, if we are to have private ownership of transportation, the cornerstone of the foundation of our future facilities must be the restoration of railway credit. The companies must be enabled to raise the means to develop those much-needed facilities adequately. The folly of the Government's attitude toward the railroads in the past has been strikingly exemplified in the policy of restricting the earnings of the roads without any guarantee of return to them. Naturally the result was to undermine railway credit and to rob the companies of the only source at their disposal for increasing their services to the public.

The increase in the population of the country in the 10 years from 1908 to 1916 was a little less than 20 per cent. A commensurate increase in commercial and industrial activity to meet this growth and the new conditions we face will require a proportionate increase of ton mileage per capita which can only be made possible by an increase in railroad trackage. Such extension can be made possible only with private capital, which will not be attracted to the railroad field until that field is put on a par with others.

Low Returns on Capital

This situation is made clear when we consider that since 1890 the rate of return on capital invested in our railways ranged from 3.35 per cent. to 5.83 per cent. in 1907. Even in 1916 the return was but 5.80 per cent., and in 1917, it is estimated by the Bureau of Railway Economics, it was only 5.72 per cent.

On capital invested in manufactures in this country 17.12 per cent. was earned in 1900, 13.06 per cent. in 1905, and 12.04 per cent. in 1910, while a much larger yield was enjoyed in 1916 and in 1917. Testimony was adduced before the Newlands Committee of Inquiry which showed that the 10-year average return on railway stocks was only 4.6 per cent. as compared with 10.9 per cent. on national bank stock, 14.5 and 18 per cent. on sugar stocks, 16 per cent. on zinc-mining stock, 16 per cent. on machinery and manufacturing stock, 18 per cent. on steamship-company stock, 20 per cent. on petroleum-company stock, and 48 and 50 per cent. on copper-mining company stock.

Keeping in mind the constantly increasing costs of labor and materials it is not to be wondered at, therefore, that while the railroads ordered 151,711

freight cars in 1907, they were able to purchase only 79,367 in 1917; that while they bought 3482 locomotives in 1907 they could acquire only 2704 in 1917; that the number of new lines built in the three years ending with 1917 was 80.2 per cent. less than in the three years ending with 1907; that the number of freight cars ordered was 55.8 per cent. less, and that the number of locomotives ordered was 53.1 per cent. less.

With the confidence of investors in the railroad business destroyed, this curtailment of equipment and extensions was logically to be expected regardless of how much it should have been prevented and was deplored when last winter's crisis came.

Need of Intensive Development

The demands of war must be met at whatever price they exact, and there is no doubt that the Government will proceed as far and as rapidly as possible to meet them. It is imperative to do so. But one cannot help thinking of the incalculable advantage which the Government would have at present in speeding up our martial activities if the roads had been allowed sufficient return on the capital invested in them to have made the proper extensions and to have provided the necessary equipment. Money, materials and men which now could be devoted to the production of munitions will have to be allocated to the improvement of our transportation facilities. And every productive resource, every minute is precious.

But this unfortunate state of affairs should have a beneficial effect. It ought to impress upon us the need for wiser provisions, particularly with reference to intensive development in order to cope with the problems which will be created as soon as peace is declared.

Room for Growth

How sorely such development is wanted may be obtained from the fact that on the average there are only 8.55 miles of railroad for every 100 square miles of our country. New Jersey has 31.11 miles of railroads per hundred square miles of territory, Pennsylvania 25.95, Ohio 22.39, Illinois 21.67, Connecticut 20.74, Indiana 20.74, Delaware 17.05, Maine only 7.57, North Dakota 7.52, Texas 6.05, Montana 3.32, Oregon 3.21, Utah 2.60, New Mexico 2.48, Nevada 2.11 and Wyoming the least of all, 1.95.

It may be well to quote here a few brief but very pertinent extracts from the testimony of Alfred P. Thom, counsel to the Railroad Executives' Committee, in the hearing before the Joint Congressional Committee on Interstate and Foreign Commerce in November, 1916.

"The railroads must go on growing as the days go and as human genius grows and human interest grows," declared Mr. Thom. "They must go on growing and keep pace with the rest of the world, or you put the hand of paralysis upon the people who must have those accommodations or die. They will have to be provided.

"How is this increased transportation facility, this constant growth in transportation facility, to be provided?" Mr. Thom asked. "Is there anyone who dreams that it can be supplied out of earnings? Is there any man of affairs anywhere who believes that you can continue to build the needed transportation facilities out of earnings? If so he needs to open his eyes, because that is not even a remote possibility. It is impossible to build, to renew, to extend, to amplify and to increase the transportation facilities of this country without the constant input of new money."

As conditions in 1916 forecast the needs of the railroads Mr. Thom estimated that during the succeeding 10 years approximately twelve hundred and fifty millions of dollars a year would be required in order not to constrict the business and productive energies of the country and in order to supply them adequately with the facilities which they will increasingly demand. This estimate does not include the money needed for refunding maturing debts, which Mr. Thom placed at $250,000,000 a year, so that the total requirements of the railroads for new money during the decade of 1916 to 1926 would on this basis be a billion and a half dollars a year.

The Development of Great Areas

Unless the Government's future policy toward the railroads is such as to insure fair regulations and just returns, which will be absolutely essential if new capital in sufficient quantity is to be attracted to the extension of our transportation facilities, the development of our great resources in the West, Northwest and Southwest will be arrested. And the retarding of such development now, of all times, would be a national economic disaster.

The Rocky Mountain and the Pacific Coast sections, for instance, have more than two trillion four hundred and twenty-seven billion tons of coal, according to the estimate of the United States Geological Survey. In addition, there are large and important oil fields and almost inexhaustible deposits of oil bearing shale which may be used in the future for manufacturing oil.

The water power of these territories is estimated at a minimum of 23,000,000 and a maximum of 44,000,000 hp. as compared with a total of 32,000,000 hp. for the whole manufacturing industry of the United States in 1914. The war has taught us the value and use of electrical energy, and it is more than probable that our vast unworked water power will become the basis of a new and important industrial life in the Western states.

There are large untilled areas of farm lands awaiting cultivation in this country. The large areas of virgin forest and untouched mineral resources in our Western states will be worked in the near future. With the development of the enormous resources of Alaska and the growth of our trade with the Orient a tremendous expansion in these states is bound to occur, and that will occasion railway extensions as well as an intensive development of existing mileage.

The sixteen Southern states, with a population of more than 33,000,000, in 1916 had a railroad mileage of 92,128, or about 11 miles of road for every 100 square miles of territory. But the industrial development they are destined to enjoy as their large variety of natural resources and great possibilities are made available will require an intensive and extensive development of their transportation facilities. Not only are these states rapidly becoming the predominant cotton-manufacturing section, but in recent years they have furnished more than 50 per cent. of the lumber produced in the United States and contain about half of the country's iron ore deposits. The total capital invested in manufacturing industries in the Southern states, it is sig-

nificant to note, increased from $1,971,000,000 in 1904 to $3,456,000,000 in 1914, and the value of their products increased from $2,333,000,000 to $3,730,000,000 in the same decade. These facts and figures certainly provide sufficient evidence of the forthcoming need for a widespread extension of our railway net south of the Mason and Dixon Line.

Central and Eastern States

In the large industrial section of the country east of the Mississippi River and north of the Potomac River the density of our railway network is the greatest. In such industrial states as Ohio there has been little actual increase in the railway mileage as measured per 100 square miles of territory since 1896, but there has been an intensive development of the railways in double tracking and sidings and improvements of facilities. Unfortunately figures published by the Interstate Commerce Commission do not give the amount of intensive development of mileage of various states, but it is quite safe to assume that the major portion of every 100,000 miles of extra tracks and sidings built since 1906 has been constructed in central and eastern regions. Here are the centers for the distribution of our products. Here has been the greatest expansion of industry during the war, and here the pressure upon the railway system of the country has been the heaviest.

With the development of our trade and industry after the war there ought to be a great deal of railway extension in this territory, particularly double tracking and improved terminals.

During the remainder of the war the Government and industry will not be able to spare the productive energy to make these extensions. At best there will be an increase in the amount of equipment, and a coördination of railway lines and of terminal facilities will undoubtedly increase the ability of the railway system to carry a larger amount of traffic.

Under-maintenance of the existing roads is likely to be the characteristic feature of the operation of the railroads during the war, and it will mean that on the return of peace American railways will have to put a great deal of money into improvements and betterments and into extensions of the lines in order to catch up to the demands of the business of the country. It is roughly estimated that for every dollar of increased gross return $5 should be spent in extensions and improvements.

The Maintenance of the Roads

Construction work of any character at the present time would draw money, materials and labor from the more pressing and immediate needs of war. But we can and should plan for them at the earliest possible moment, and in the meantime we should make adequate provision for the maintenance of the roads, for unless they are properly maintained new extensions would be almost futile.

Such provision cannot be made alone upon a computation of costs for maintenance during the three years ending June 30, 1917, the period specified as the basis of financial readjustments in connection with Government control of the railroads for the duration of the war. The reason immediately becomes patent if we remember that today the purchasing power of a dollar is about 60 per cent. of what it was in those years, while the cost of labor has steadily risen and the prices of materials have advanced 75 per cent. or more in the last three years. Consequently the only fair basis for determining the allowance to be made for maintenance is that of prevailing prices. The year 1917 not only showed a reduction in net revenue of $133,000,000 in spite of an increased gross return, but an even greater decrease in effect because of the lessened value of money as a token of exchange. For instance, the average earnings of the period 1915-1917 which cover the Government's guarantee will at present prices have a purchasing power of only about 65 per cent. of the average period from 1910-1913.

The Government should definitely protect holders of American railway stock by providing that the money equivalent of maintenance expenditures, plus a deferred maintenance reserve (which ought to be established for each year of Government operation), should bear a relationship to the average monetary expenditures of the railways for maintenance for 1915, 1916 and 1917, as indicated by the increased cost of maintenance materials in each year of Government operation as compared with the average cost for those three years.

Fluctuations in the buying power of the dollar cannot justly be ignored by the Government in either its rate structure or maintenance allowance any more than in the wage scale.

New Power Rules Railroads

One vital fact is apparent today above all others—the scepter in the railroad world has passed out of the hands of the railroads' executives and the bankers who financed them. The American people control the situation through their political representatives, and they will determine the whole course of the future. The burden of right decision lies with them, and they will suffer or prosper in accordance with the wisdom shown.

No class of people will exercise so powerful an influence in reaching this decision as the shippers; they must learn, if they have not learned already, that the thing of most vital importance to them is getting their goods to market. The rates at which this service is rendered are incidental to having such service prompt and adequate. The long struggle of the shippers to hold down rates in defiance of the economic trend of the times and the obvious necessities of the railroad situation have worked the undoing of the shippers as well as of the railroads, and they are suffering under the situation they themselves have largely caused. To serve their own ends in the future they must take a constructive attitude toward the transportation question and lend a hand in the successful solution of the problem.

As evidence that the shippers of the country prefer an extension of facilities to a continuation of the fight for lower rates may be cited the fact that there was comparatively little opposition on the part of the shippers to the increase asked by the railroads in the original and supplemental 15 per cent. rate cases.

Under the great pressure of the situation the commission was finally persuaded to allow some increases in rates, but most of them came too late to do any good or to have any effect on stimulating railroad credit.

A lack of understanding and vision on the part of the Interstate Commerce Commission and a too ready

yielding to political sentiment have rendered it not the constructive friend of transportation which it should be, but transportation's fearful, hectoring keeper.

It is obvious that we should adopt a definite, comprehensive and adequate policy for developing our railroad extensions, a policy based upon definite, determining factors. Our railroads must keep pace with our industrial expansion; it is imperative that this relationship be strictly maintained. Our transportation facilities must not be outstripped by the growth of our population; they must in fact respond fully to the increasing needs of our people. In other words, if we would avoid a repetition of the economic strain through which we have just passed as a consequence of the transportation situation our railway-extension policy must be directly predicated upon the increases in our population and our business.

Facing the New Order

It seems very certain that from the present plan of coördinated, centralized operation, with its many savings and added efficiencies made possible by Government control, there will be no reversion to the old system of competitive private ownership and conflicting regulation.

If not that then what do we face? On every hand we hear the prophecy made that the present control of the railroads by the Government is but the first step toward Government ownership, and that once unified under Government direction the railroads will never be "unscrambled." It is argued that when the economies thus made possible are achieved neither the railroad owner, nor user, nor worker will wish to return to the old order.

Failures in Public Ownership

But the fact may be boldly stated at this point that in no country in the world where Government ownership of railroads has been attempted has it been successful, with the single exception of Prussia, where, under the arbitrary mandates of a military autocracy, some degree of efficiency and profit has been secured. Further it may be stated that in no important instance has the experience of our own Government in business operation been such as to warrant the conclusion that such activity could be profitably extended. Still further it can be maintained that there is a sufficient majority of failures in public ownership of other public utilities in this country clearly to demonstrate its wastefulness and inefficiency under our present form of Government and at our present stage of political progress.

The privately owned railroads of the United States have the lowest freight rates, the lowest capitalization per mile, the greatest operating efficiency and pay the highest wages of any railroads in the world.

If private ownership has failed, both when unregulated and when over-regulated, and Government ownership gives no promise of success, what plan offers for meeting the situation?

Various suggestions of a central federal corporation, regional holding companies, Government guarantees and plans calling for profit sharing with the Government above a fixed return have been frequently made. Somewhere along this line of thought lies a rational solution. It is very certain that the old days of enforced competition, anti-trust laws, anti-pooling laws, conflicting state regulation, wasteful competition and duplication of service would not be permitted by a public alive to its own interests.

It seems equally certain that Government ownership would not be permitted if the public were equally alive to its real interests. The hour has arrived for the suggestion of some plan which will be ready for adoption when the crisis of war has passed and the pressing needs of business demand the return of normal business conditions and the operation of economic rather than martial law. Somewhere within the meaning of the words "coöperation" and "partnership" lies the answer. The public interest in transportation is paramount and must be protected, but public interest and private interest need not be in conflict if intelligently regarded.

Regional companies representing both private and public capital under private operation with Governmental participation in the management and earnings above a just guarantee would seem to assure the necessary extension of railroad facilities. In unity of interest and understanding progress towards the desired goal should be possible.

Patterns for Emergency Repairs

By Frank R. Calkins

Sometimes machine repair parts are so urgently required that time of delivery is a consideration second only to utility. This has proved particularly true in

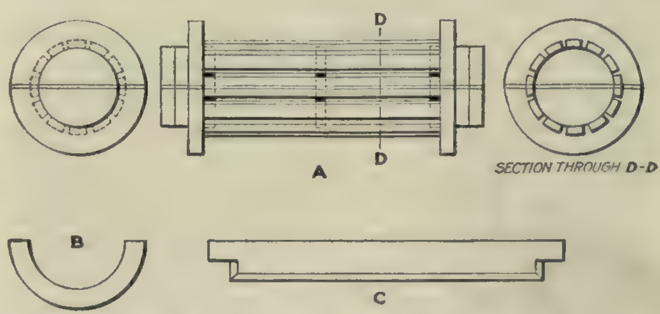


FIG. 1. CYLINDER LINER PATTERN

making repairs to several of the interned German vessels where machinery had been, so far as possible, ruined by their former crews.

The two instances of emergency pattern work cited here goes to show that the mechanical genius capable

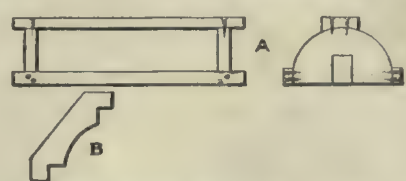


FIG. 2. SWEEP CORE BOX FOR LINER PATTERN

of rising to the occasion is quite as likely to be found in the obscure little shop as in the one with a wider reputation.

A broken cylinder liner from one of these ships being of such size as to preclude the possibility of its use as a pattern, the problem of producing a new casting in the shortest possible time was solved as follows:

Pieces of lumber were rough planed to the thickness of the flanges plus finish, and shaped on the band-saw. Core prints were got out by the same method and secured to position on these flanges. On the inner side of the flanges circular pieces or headers of the same size as the core prints were fastened. Strips of lumber of the thickness required in the metal were cut to the length of the casting desired and secured by nailing to these headers at each end to form a roughly cylindrical pattern. A similar circular piece formed a support at the center of the frame to prevent distortion while ramming up. When these roughly worked odds and ends of lumber were assembled, as shown at *A*, Fig. 1, the result was a "pattern" from which, with due care on the part of the molder, a mold could be made, and the time consumed by the patternmaker amounted to hardly more than would be spent in studying the blueprint in the ordinary course of events. Of course, when this pattern was drawn, the resulting mold was a very rough-looking affair, but with the aid of two semicircular pieces *B* and a sweep *C* all irregularities were smoothed out, and with a little extra mold finishing a satisfactory casting was turned out without undue waste of valuable time.

The core box was equally simple, two semicircular pieces being rough sawed to the required size and notched on the diameter line for the core arbor. These ends were then connected at the right distance apart by three pieces of timber concaved on one side to conform to the curvature of the core, the completed core box being shown at *A*, Fig. 2.

This skeleton box was then clamped to a plate and rammed in the usual manner, allowing a surplus of sand to be finished off by the sweep shown at *B* being drawn lengthwise of the core. The casting which resulted from this rudely formed pattern and core box was not only fully up to the specifications, but what was of almost equal importance was delivered ahead of the required time.

Another Hurry-up Job

Another ingenious method of overcoming difficulties and winning a reputation as a time saver is shown in the following:

A broken condenser-head casting was sent to the pattern shop with an order for a pattern within a time-limit requirement that seemed impossible to meet. When this head parted company with the condenser, three of the nuts held, causing a section to be broken out of the head as shown at *A*, Fig. 3. The entire outside surface of this casting called for finish, as did the flange joint. A new pattern was out of the question, so here again a genius for extricating oneself from difficulty was required.

There was in the storeroom a stock of used leather belting of varying grades and thicknesses, and a quantity of this being secured, strips were shellacked to the outer surface of the broken casting in radiating lines as shown at *B*.

A piece of belting was similarly secured to the periphery of the flange and the broken segment filled in with plaster of paris. A thin wood disk provided finish for the outside of the boss, and a ring of wood veneer performed the same office for the surface of the joint. A stock core provided for the hole which was required through the boss.

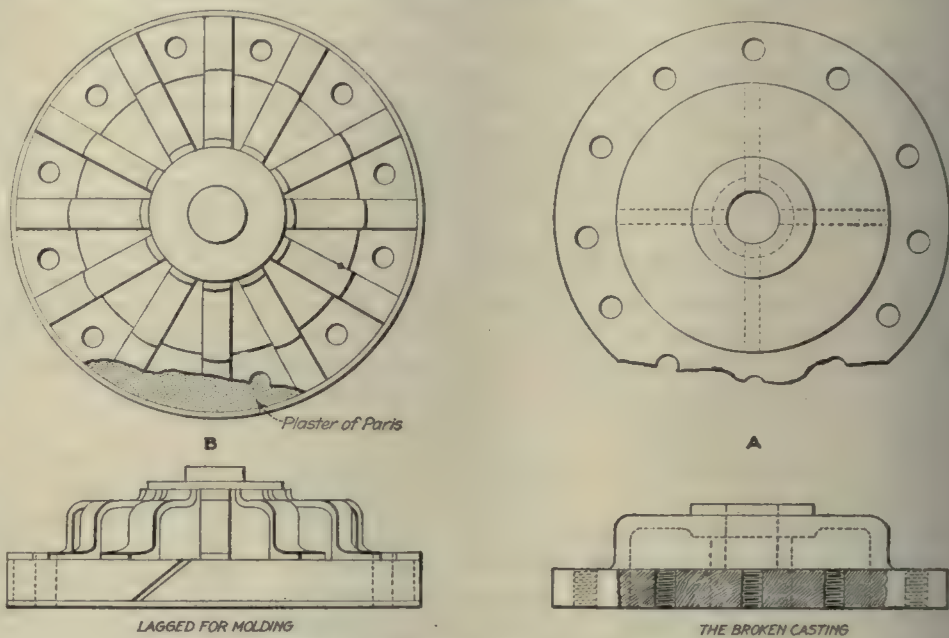


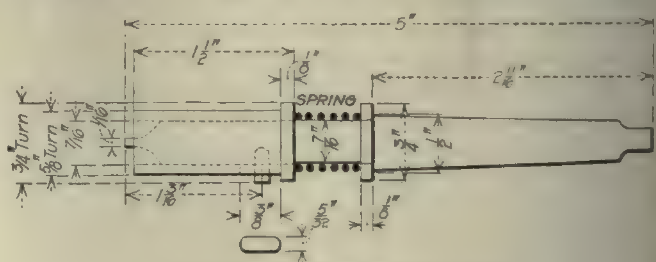
FIG. 3. BROKEN CONDENSER HEAD LAGGED FOR MOLDING

The resulting mold of course required considerable hand work in finishing out and smoothing up; but when poured, it furnished an excellent casting.

Compressed-Air Operated Screwdriver

By George M. Dick

In the shipping of munition most of the covers are fastened on the boxes by means of wood screws. The operation of driving in the screw occupies a large percentage of the time taken to pack a box, and also considerable strength, if done by hand.



AIR-OPERATED SCREWDRIVER

For some time past we have been using the screwdriver shown in the illustration. It is made with a Morse taper shank, and is used in a No. 4 "Little David" Canadian Ingersoll-Rand drill. A bushing on the stem acts as a guide on the head of the screw.

VI. The Receiver—V

The illustrations presented show unusual profiling cuts, spline-milling tools for an angular slot and special grinding and reaming appliances. The grinding apparatus finishes the end of the receiver to correspond to a height gage under which the work is tested in vertical position, and the reaming tools accomplish the difficult task of forming the tapered sloping wings for the cartridge guide in the top of the receiver.

FOLLOWING the performance of the operations already illustrated there are a considerable number of additional profiling cuts to be made at various points on the receiver, and several of these are illustrated herewith.

The first operation to be shown in the present views is represented by Fig. 54 and illustrates the process of profiling the ejection opening which is cut through the body of the receiver and into the main hole from the right-hand side of the forging. It is accomplished in the fixture for holding the receiver swung over at the necessary angle for the profiling cut, this fixture having at the right two form plates for the guide pins. The lower plate of the two contains the guide slot for the profiling of the right-hand side of the ejection opening, which is seen under operation in the illustration. The opposite side of the slot is profiled out with the guide pin working in the slot of the upper plate, which is here represented swung out of position at the back of the pin. This supplementary guide plate is pivoted on a stud near the rear end of the lower former, and when swung around into operative position it is fixed in correct location for controlling the work movement by means of the knurled-head plug, which is slipped through the aligning holes at the front end of both form plates.

Two receivers are seen on the table in front of the fixture, the one at the right with the ejection opening roughed out with an ordinary milling cutter, while the other one has its opening profiled to finished dimensions.

The fixture which holds the receiver for this operation has an index plate at the rear, with notched openings for the locking lever shown at the left, so that the receiver may be adjusted into two different positions about its axis for the profiling of the opposite sides of the slot.

Another profiling operation is illustrated by Fig. 55, which shows the method of milling out the inside of the platform ledge and the forming of the small lugs for the reception of the feed cover. In this fixture the front half of the platform surface is faced practically all over, the two receivers in the foreground showing clearly the appearance of the platform before and after profiling.

In connection with the finishing of broad surfaces, such as the top of the receiver shown, an unusual type of finishing cutter is sometimes applied, which has in place of the conventional end-mill teeth a number of V-grooves cut parallel straight across the end of the mill, forming a series of straight file-shaped teeth. This type of cutter acts as a rotary file for smoothing up the surface after the regular end mill has been used, and is intended to remove only a very small amount of metal.

The gaging fixture shown to the right in Fig. 55 is used in connection with the inspection of receivers after the platforms have been profiled to form the holding lugs along the inner surface of the ledge, as seen to the left in this view. The same fixture also gages the height of the flat surface profiled across the platform. The interesting feature of the gage is the provision for testing the positions of the small interior lugs referred

to and the adjoining surfaces of the wall or ledge along which these lugs are formed.

The gage plugs for checking these locations are milled off across their lower ends, forming a flat surface whose thin edges serve as the gage proper. The tops of the plugs are provided with small knurled extensions by means of which the gage members are rotated with the fingers to bring the narrow lower edges into contact with the work at the points that require gaging. The plugs thus constitute rotary-feeler gages which, when turned around in their sockets, must come into light contact with the surfaces under inspection.

While considering the type of tool in which the gaging members are rotated by the fingers, it will be of interest to show one more example embodying unusual features. In Fig. 56 a fixture is illustrated for gaging the position and width of the charging-handle clearance slot profiled in the side of the receiver in an earlier operation. The upper ends of the pins are flush with the top surfaces of the heads which carry them; that is, the upper ends must be flush when the bottom projections are swung into the slot in the work. In this way the slot width and its position in the receiver are accurately checked.

In the profiling operations so far illustrated the re-

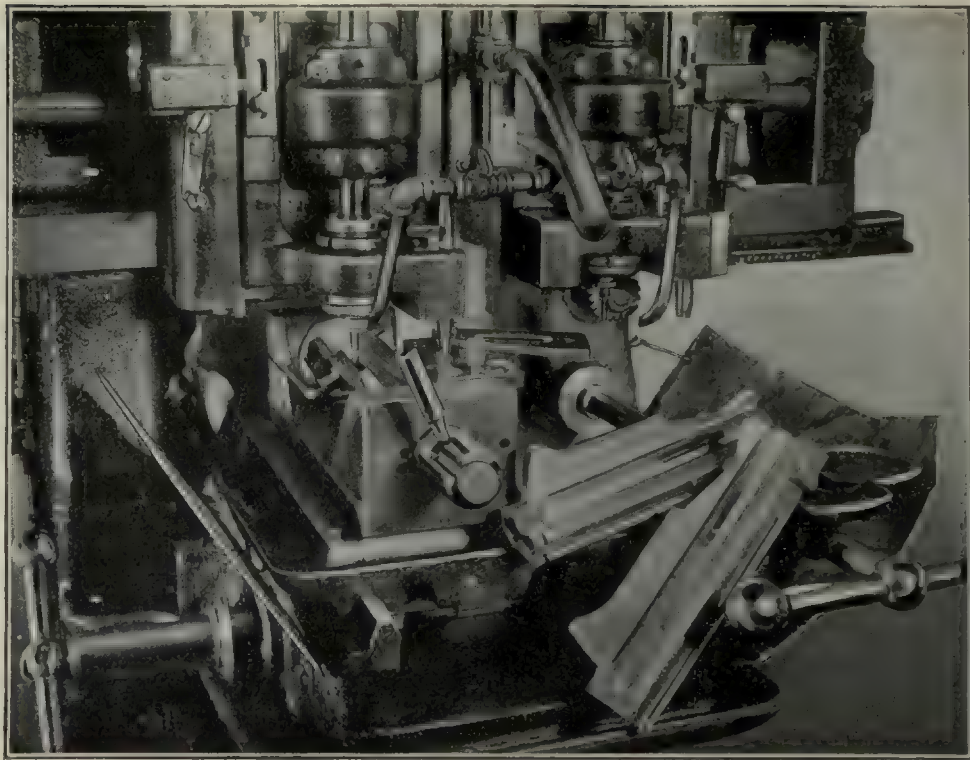


FIG. 54. PROFILING EJECTOR OPENING IN THE RECEIVER

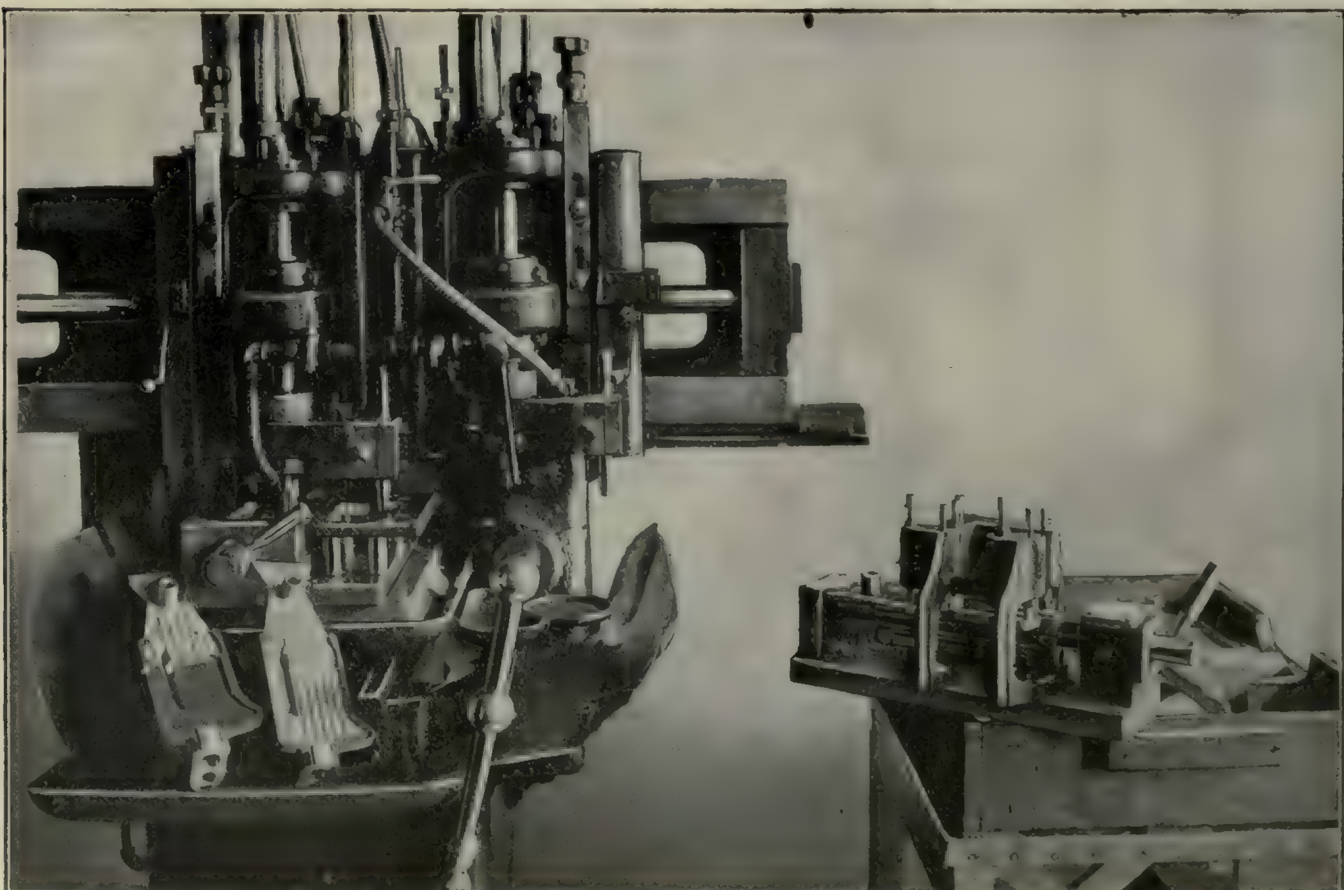


FIG. 55. PROFILING TOP AND INNER EDGES OF PLATFORM

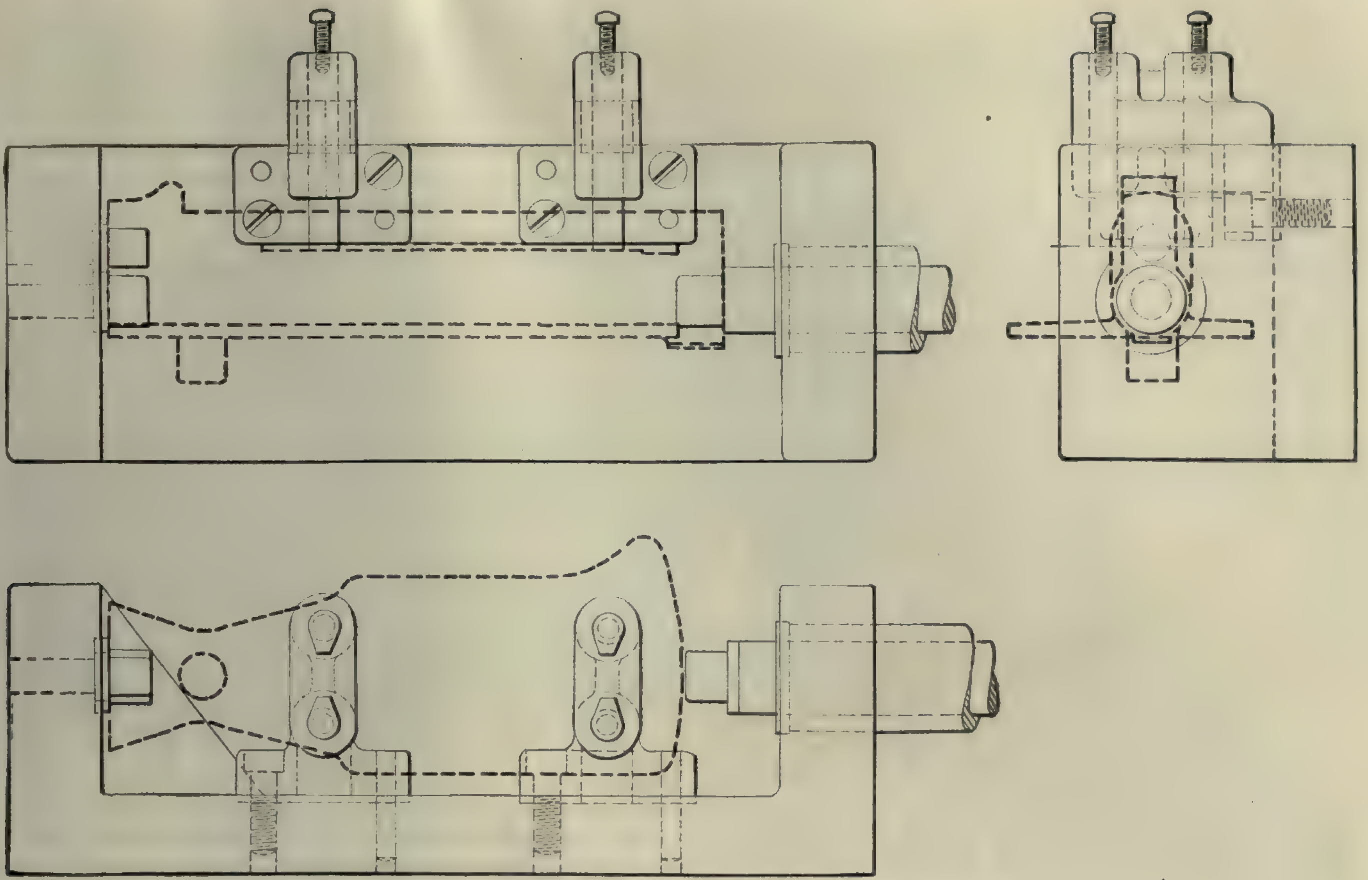


FIG. 56. GAGE FOR CHARGING-HANDLE CLEARANCE SLOT

ceiver has been held in horizontal fixtures on the table of the machine. There are, however, a number of profiling cuts that have to be made with the receiver supported vertically, and one operation of this character is illustrated in Fig. 57, which shows the work set up for the recutting of the extractor, clearance cut on the inside and at the side of bolt bore in the receiver.

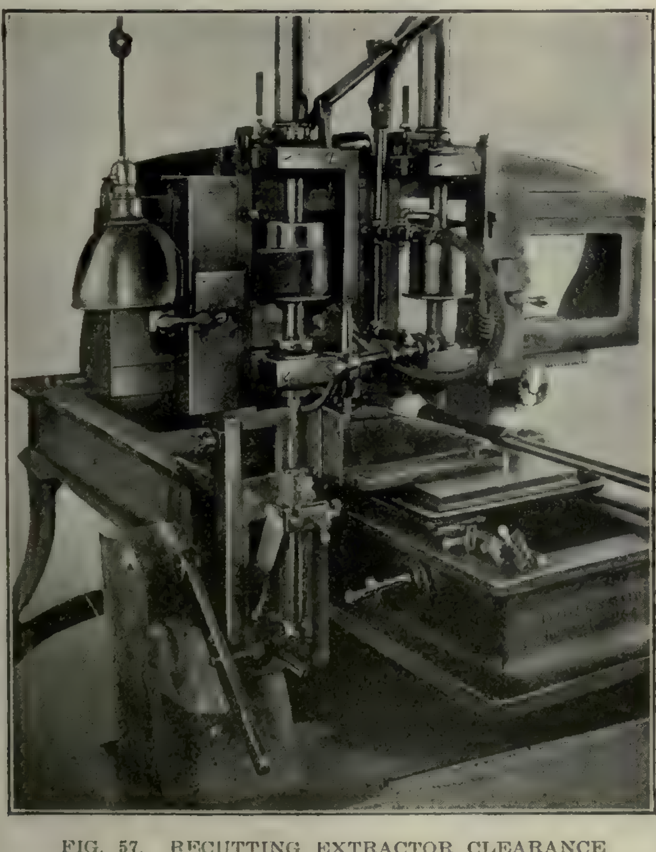


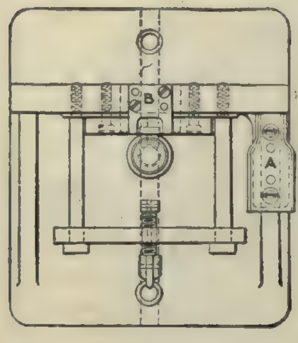
FIG. 57. RECUTTING EXTRACTOR CLEARANCE

The clearance cut is made with a profiling tool resembling a taper reamer, which is sunk into the metal at the side of the bore to produce a clearance pocket of the desired form and depth. This tool is clearly seen in the illustration, where the carrying fixture for the receiver is shown at the lower end of its guide, so that the top of the receiver stands clear of the cutting tool. The work-holding fixture is adjusted vertically in the guide at the side of the fixture base by means of the lever at the left-hand side, this lever having a pivot connection at the rear and a slot in the middle which receives an offset stud in the sliding fixture for the purpose of elevating the latter to the proper height for the forming of the clearance cut. When the slide with the receiver has been lifted into operative position it is locked for the taking of the cut by means of a plug which is slipped back into a fixed bushing in the rear of the vertical guide.

Securing the Fixture

The base for the fixture body, which is planed at right angles to the vertical guide referred to is secured to the profiling-machine table in the usual manner. The top of this baseplate is planed off and shouldered, as indicated, for the attachment of the form plate, which in conjunction with the guide pin in the spindle head controls the movement of the profiling cutter inside the bore of the receiver.

Another vertical fixture which holds the work upright on the profiler is shown in Fig. 58. This is used in profiling the rounded shoulder shape at the rear end of



the receiver, the shape of this contour being indicated by the outline of the form plate *A*. The receiver is located at the bottom on the shouldered plug which fits the counterbore at the front end of the receiver, while the upper end of the work is positioned by the lug at the back of the receiver platform which en-

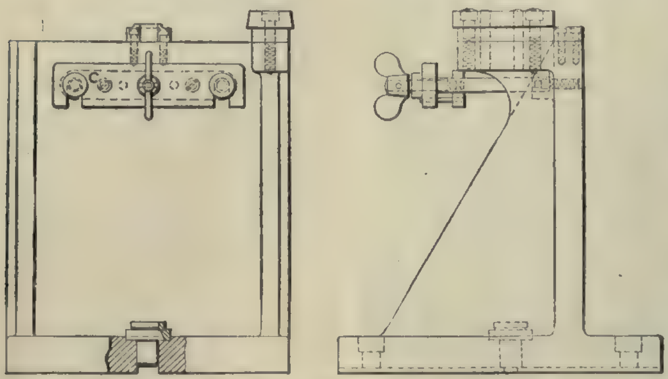


FIG. 58. FIXTURE FOR PROFILING END OF RECEIVER

ters the opening in plate *B*. The receiver is held in this upper locating plate by the thumbscrew in slotted strap *C*.

An awkward slotting operation which is accomplished on a spline-milling machine is represented in Fig. 59, which shows all details of the fixtures for holding the work on the table of the machine. This operation is the spline-milling of the ejector-clearance front slot. As will be seen from the plan and end views, which show the receiver and slot distinctly, the latter is at an angle to the bore of the receiver and also to the top surface of the work. The small slot must be cut by passing the shank of the spline-milling cutter through the ejection opening already profiled in the opposite side of the receiver wall.

The slot to be cut is seen at *D*, Fig. 59, and the spline-milling cutter at *E*. The holding fixture consists of two heads *F* and *G*, the former carrying locating plugs *H* and *I*, and the latter the shouldered clamp plug *J*, which is mounted and operated in the same manner as in the case of numerous other fixtures already illustrated.

Milling, Profiling, Polishing and Grinding Operations

Following the above operations there are a number of milling, profiling and polishing operations to be done before the receiver is ready for the grinding of the face end. This operation, No. 104, is accomplished in the manner illustrated in Fig. 60. The reeciver is here mounted on an arbor in the engine lathe, and a special outer support is fitted to the inner shears of the lathe. The grinding attachment is secured to an adjustable head on the carriage cross-slide, and the wheel spindle is swung crosswise to the centers to bring the edge of the wheel into contact with the work.

The grinding operation is carried along in conjunction with a gaging process for checking the over-all length of the receiver. The gaging device is shown at the right of the grinding fixture. It is similar in form

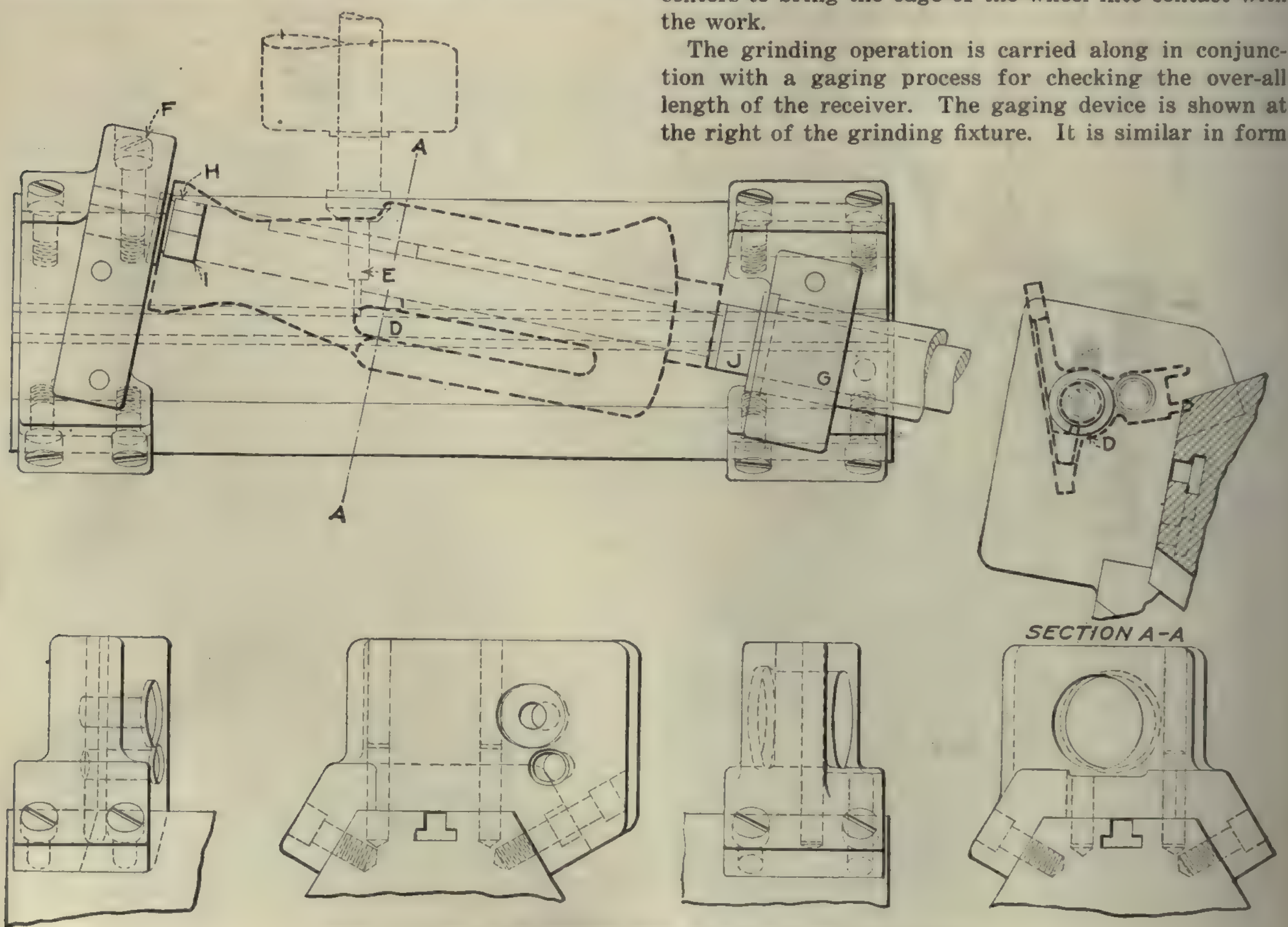


FIG. 59. EJECTOR CLEARANCE SLOT-MILLING FIXTURE

to the one used in connection with the original end-facing operation on the turret lathe. Its base carries an upright plug fitting the receiver bore and ground off at the top to form a height gage for the length of the work, the top of the plug being used as a setting point for the dial indicator, which is carried on an arm mounted at the upper end of the other post located on the fixture base.

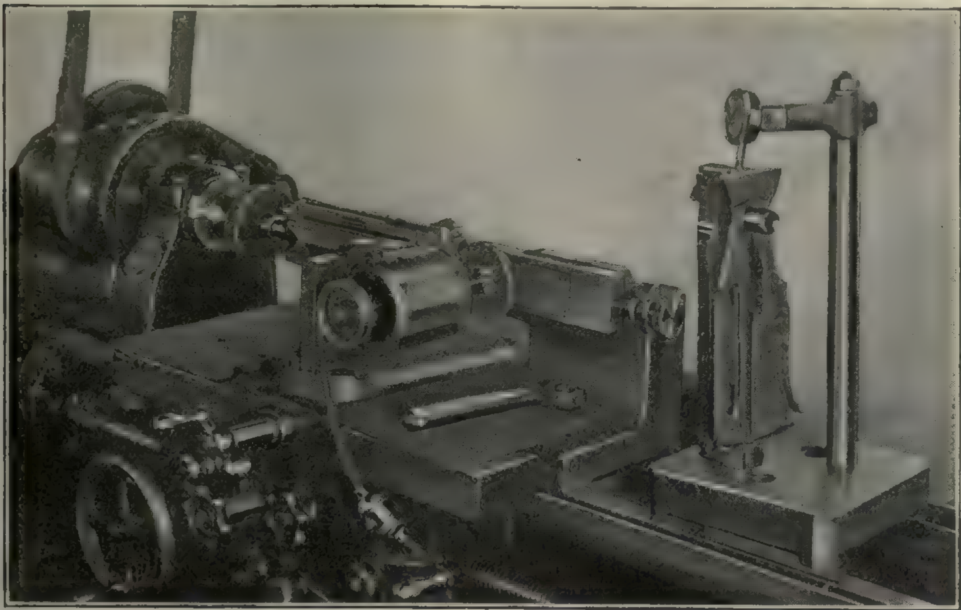


FIG. 60. GRINDING THE END OF THE RECEIVER

A receiver undergoing end-grinding operations may be placed over its plug on the gage and the dial indicator then applied to the top of the plug and the end of the work to determine how many thousandths must be ground off the receiver face. When the receiver is placed in the lathe and the grinding wheel brought into contact with the end surface a micrometer stop gage at the left side of the carriage may be set to limit the grinding operation in accordance with the readings previously noted on the dial indicator of the upright gage.

After this operation both holes in the receiver are again lapped and a number of other operations, mostly hand, are performed.

Machine Operations Performed on the Cartridge Guide Wings

Guide wings are placed at the sides of the slot on the top of the receiver, through which the cartridges from the magazine are guided down into the gun. The wings slope downward at an angle toward the front of receiver, and the opening between them tapers slightly with the greater width of opening toward the front. The narrow edges along these wings are machined to the required form and degree of taper in the drilling-machine fixture shown in Fig. 61. The fixture is mounted on a sloping base which tilts the fixture backward to the necessary angle for the machining of the wings for the cartridge guide.

The tool used in making the cut is in the form of a taper reamer with a long shank, which fits in the guide bushings as shown. The lower end of the reamer has a small pilot which enters another bushing near the lower end of the fixture. The cutting part of the reamer thus supported above and below is fed downward with the drilling-machine spindle into the cut. Means of adjusting the bushing-carrying head are indicated in the illustration. Fig. 62 illustrates a fixture for hand reaming these cartridge-guide wings and shows more clearly the application of the finishing tool. The large end of the reamer is attached to the long shank by a threaded tip on the latter, which fits a tapped hole in the reamer body, and has a threaded portion on this diameter for stop and lock nuts which limit the depth to which the tool is to be operated. The tool is operated by the knurled disk attached to the outer end of the shank, and when run down to depth the stop collar prevents further end movement by coming in contact with the bent arm of the steel stop bracket *B* which is secured by screws to the back edge of the reamer guide illustrated at *C*. The drawing of the fixture, Fig. 62, illustrates fully the method of holding the receiver in position, and the front elevation shows the manner in which the tapered

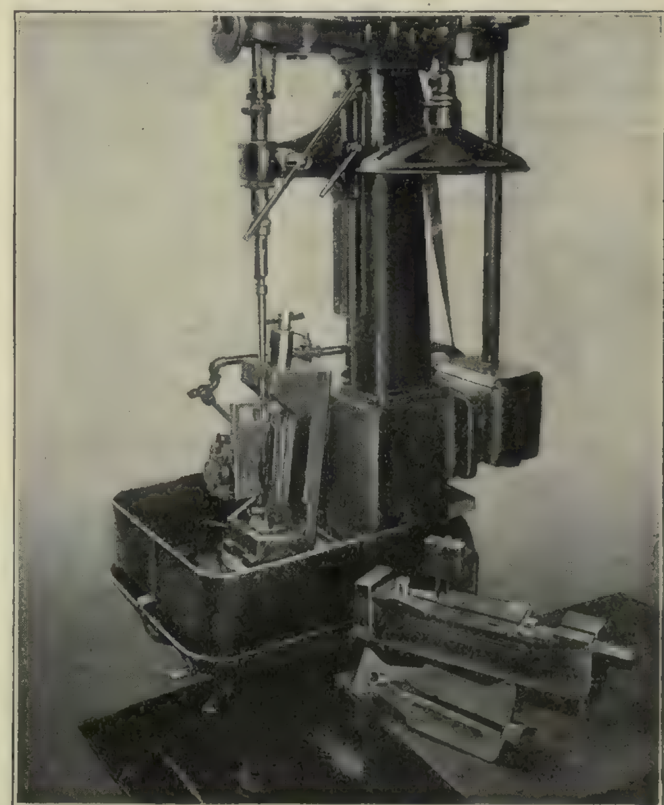


FIG. 61. REAMING CARTRIDGE-GUIDE WINGS

reamer passes down into contact with the edges of the cartridge-guide wings when the tool is fed along with the hand knob. The shape of the opening between these wings and the clearance cut in front of them may be seen in the plan view of the fixture, where the outline of

the top of the receiver is clearly represented by the dotted line.

The accuracy of the cartridge guide wings finished in the taper-reaming process is tested by the application of the flush pins in the gage shown to the right in Fig. 61, the lower ends of these pins having suitable outlines and dimensions for testing both the position and depth at each end of the wings.

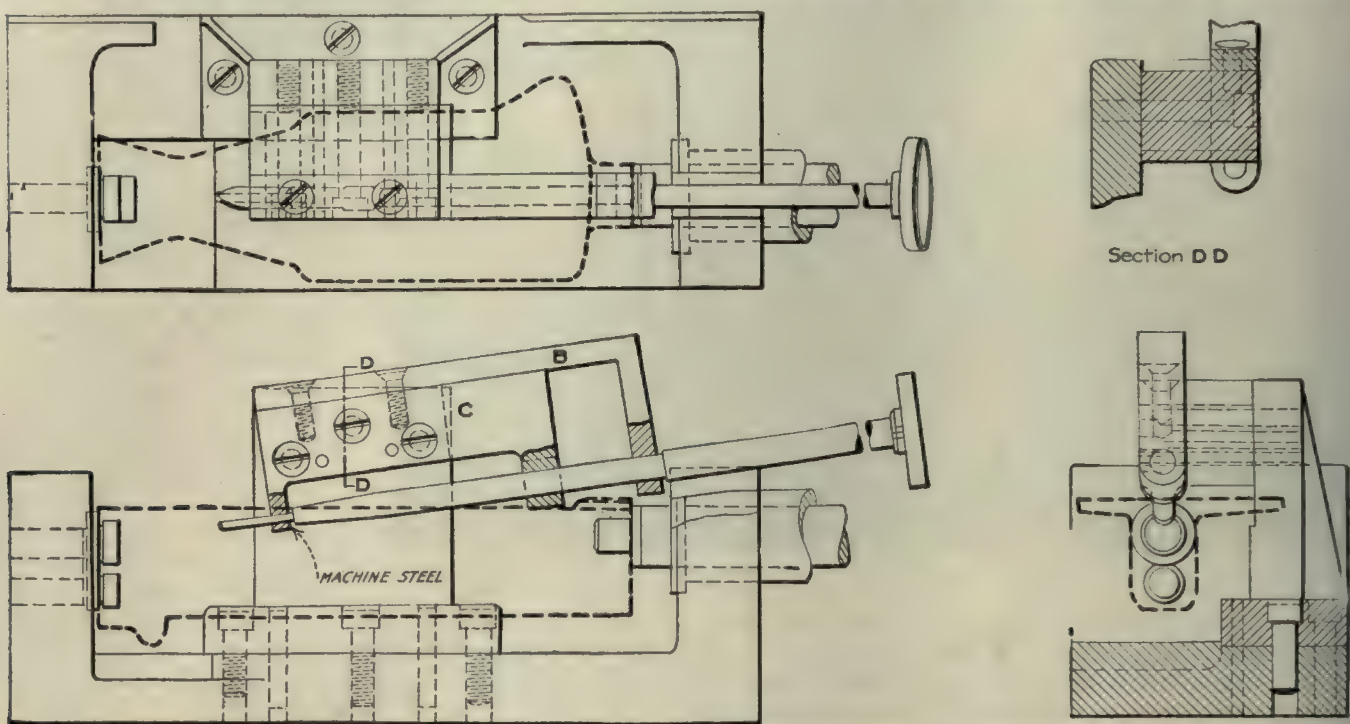


FIG. 62. HAND REAMING FIXTURE FOR CARTRIDGE GUIDE WINGS

A Nation-Wide Americanization Plan

The Americanization conference recently held in the Interior Department at the call of Secretary Lane adopted the following resolutions:

1. The adoption of the policy that the federal Government should coöperate with state and, through the states, with the local communities in carrying on an extensive, intensive and immediate program of Americanization through education, especially for non English-speaking foreign-born adults.

2. That the industries employing large numbers of non-English-speaking foreign-born persons should coöperate with local communities and with the state and federal governments in carrying out this proposition.

3. That adequate appropriations should be provided by Congress to be expended through appropriate governmental agencies for the foregoing purpose.

4. That in all schools where elementary subjects are taught they should be taught in the English language only.

This conference was attended by 18 state governors, representatives of the State Councils of Defense, and representatives of industrial concerns. The following committee was appointed to present a program to Congress: Governor Stewart of Montana, Governor Manning of South Carolina, Governor Milliken of Maine, Levy Mayer of Chicago, Harold T. Clark of Cleveland, Arthur T. Somers of New York City, Hale Holden of Chicago, Samuel Gompers of Washington and Robert Newton Lynch of San Francisco.

This is the beginning of what can and should become a movement of great importance. But it must not be forgotten such a vital question cannot be successfully handled perfunctorily. It is not a matter of passing resolutions and then letting things go on as before.

There is great need for a real Americanization movement all over the land, but it is a bigger problem than is realized. It is a human problem and must be handled in a humanly way by men and women whose personality is peculiarly fitted for this work. It must not be delegated to those who lack sympathy with those among whom they will labor and who hold race prejudices of any kind.

Americanization is more than the teaching of English and learning the Constitution. It is the inculcation of American ideals and ideas. And this can only be done by showing the foreigner that they are real, not sham.

We must all help if Americanization is to become real. In our daily contact with the foreign born we must show that we mean what we say; that this is the land of the free and the brave; the haven for the oppressed—not a place where oppression merely takes a different form. The foreign born must have a fair chance; must not be exploited by employer or fellow worker. He must be treated as a human being without patronage or hypocrisy.

The Americanization of our foreign born is a real problem and one which all of us must join in and settle. It will not be helped by personal abuse of Germany, by the burning of German books or by forbidding the teaching of the German language. It cannot be entirely delegated to even the most competent teachers.

There are a number of books on this subject and all interested should communicate with the National Americanization Committee, Engineering Building, New York.

Coöperation in Eliminating Accidents

By H. P. HEYNE
Safety Inspector United Alloy Steel Corporation, Canton, Ohio

The subject of teamwork and coöperation in respect to safety conditions and methods throughout the plant should receive every consideration, as they are necessary to efficiency and success. Without them there is failure both in safety and production.

THE fact was brought out by A. H. Young of the American Museum of Safety at the second annual New York State Industrial Congress that an army twice the size of that raised by the draft was maimed, crippled or killed in industrial accidents during the year 1916, the approximate figures being 1,500,000 seriously injured and 22,000 killed.

It should be the aim of every individual to assist in reducing these figures in the future by directing his efforts toward accident prevention, every employee doing his share to bring about this desirable result. Men should be taught the safe and correct way to perform their work and should use their initiative to do the right thing without being told. Shop safely committees should be appointed, the members of which should be prompted to direct their thoughts along lines of safety so that by their example and influence others will be induced to follow in the same channel. Every person appointed on these committees should remember that it is a duty which they owe to themselves, their fellow employees and to their employers to note and report all places and practices that may be dangerous to life or limb.

Industrial Lighting

A potent factor for safety in a plant is proper illumination, and all places about the plant and yards should be provided with sufficient light. An important adjunct to factory illumination is proper interior painting. Ceilings should be painted white or whitewashed, and so should the walls to within six feet of the floor. The lower six feet may be painted black, as if the entire wall were painted white the lower part would soon present a dirty appearance.

Do not keep out the sunlight by dusty or unclean windows. The sun is the best factory lamp known.

The New Man

Have the foreman keep after the new man, for most of the accidents happen to those who have not yet become familiar with the workings of the department and the hazards to be avoided.

The record of accidents occurring in the United Alloy Steel Corporation, based on length of service, is shown in the subjoined table:

PERCENTAGE OF ACCIDENTS IN RELATION TO TERM OF SERVICE

Employed less than 6 months	66.7
Employed from 6 months to 1 year	16.6
Employed from 1 year to 2 years	8.3
Employed from 2 years to 3 years	5.6
Employed from 3 years to 5 years	1.4
Employed over 5 years	1.4
	100.0

There should be a place for everything and everything kept in its place. If this were practised methodically there would be fewer accidents. The foreman should exercise close supervision in this respect, as many injuries occur from tripping and falling over misplaced material. For this reason workmen should not be permitted to throw tools or material upon the floor. It requires but a few minutes to see that everything is put in its proper place, and the acquirement of this practice tends greatly to lower the accidental percentage of the department.

Patrolmen

Educate the patrolmen along safety lines, as they are in a position to observe dangerous places and habits. Have them render a daily report covering the situation thoroughly. The form here suggested is intended to be executed as a daily report by the police department, the members of which are thus converted into safety investigators, and through them many danger points will be brought out.

PATROLMAN'S DAILY REPORT

Date.....................

No.	Points Observed	Day	Night	Remarks
1.	Defective floors and stairs	......	......	......
2.	Unnecessary lights burning	......	......	......
3.	Lights not burning	......	......	......
4.	Leaking pipes	......	......	......
5.	Electric wires down	......	......	......
6.	Uncovered manholes	......	......	......
7.	Unguarded excavations	......	......	......
8.	Unsafe piling	......	......	......
9.	Improper load of materials for inter-mill	......	......	......
10.	Protruding nails in boards	......	......	......
11.	Improper track clearances	......	......	......
12.	Fires	......	......	......
13.	Doors or windows open	......	......	......
14.	Crawling under cars	......	......	......
15.	Sleeping	......	......	......
16.	Intoxicated	......	......	......
17.	Stealing	......	......	......
18.	Carelessness or recklessness	......	......	......
19.	Fooling and fighting	......	......	......
20.	Violation of safety rules	......	......	......
21.	Not using safety devices	......	......	......
22.	Fire equipment out of order	......	......	......
23.	Stretcher boxes	......	......	......

Signed.....................

Educate and Interest the Workmen

In order to make the safety movement more interesting to the men, the safety engineer, with the assistance of the departmental superintendent, should conduct safety conferences in each department at least once every six weeks. This will bring the men in close touch with the safety-educational feature.

Recall the number of recommendations submitted by the committees and the ones that were approved; also the reason for passing up the remainder. Cite recent accidents in the department; also the means which should be adopted to avoid their recurrence. Ask the members for their comments up on the accidents and their suggestions for preventive measures. Appoint two or three persons to serve on a committee for a month to investigate dangerous and unsafe practices, giving them authority to approach workmen in their department who may be discharging their duties in such manner as to increase risk of injury. These men will feel that a responsibility rests upon them and that they are considered a part of the organization, thus promoting a spirit of friendliness and coöperation.

Conduct courts of inquiry on accidents by having the injured man, his foreman, the department safety team and witnesses present. After discussing the accident render a full written report, which is to be read to all members of the investigating committee, placing the blame for the accident upon the person or equipment at fault and recommending disciplinary measures for any infraction of safety rules. This method of investigating the cause of accidents has a psychological effect on the men, and you may hear them remark, "Do the work safe, for they will haul us all in the office if anyone gets hurt." The men do not like to be "entertained" in the office on such matters, and this will tend to make them exercise greater care in their work.

Defective Tools

Injuries through the use of defective tools are numerous, and the number can be reduced by encouraging the workman to turn in all unsafe tools for repairs. The foreman should make a periodical inspection of tools that are given out to the men, and the workmen should be taught to observe the condition of tools used in their daily work.

In summing up the accidents you will not infrequently find that lack of care on the part of the injured or of a fellow employee is the cause of the injury. It must not be forgotten that mechanical safeguards are essential, but also that accidents may be greatly minimized by coöperation between foremen and employees in following safe and sane methods. It is necessary to put the men through a course of safety training and to continually hammer home "safety first."

Forging Wire-Cable Sockets

By J. V. Hunter

On page 914, Vol. 46, the writer described the method of forging sockets for securing the ends of wire cables, calling attention to the original method of forging solid from the bar, the taper hole being afterward drilled and bored in a lathe, and to the later and more economical method of cutting out the blank from flat stock, rolling it up into form, and welding it upon a taper mandrel. The cable sockets thus described were comparatively small, but the socket illustrated in Fig. 1 shows that the same method can be applied to large work, the socket shown being 26 in. long and is for a 1½-in. cable.

This was forged in two pieces from a flat bar, one piece as rough forged being shown at *A*. It will be noticed that a rib has been formed along a portion of the outside of the socket to provide additional strength. This rib would be very difficult to form if the socket were to be forged from the solid, as in the old way.

In scarfing the edges for the closing welds around the taper mandrel it is better to make the joints as shown at *B* rather than to scarf both joints in the same direction. The completed socket is shown at *C*.

We recently had a considerable number of these forgings to make, and we developed still another method, as shown in Fig. 2. The piece is first shaped as at *A*, the bar being split at the end and the arms drawn out as shown, no effort being made to secure a symmetrical shape at this stage, as the dies used in later operations attend to this.

The forging is next placed under the hammer and a medium-sized hot punch driven about half way through the body, as shown at *B*. It is then transferred to the die shown at *C*, and a tapered punch,

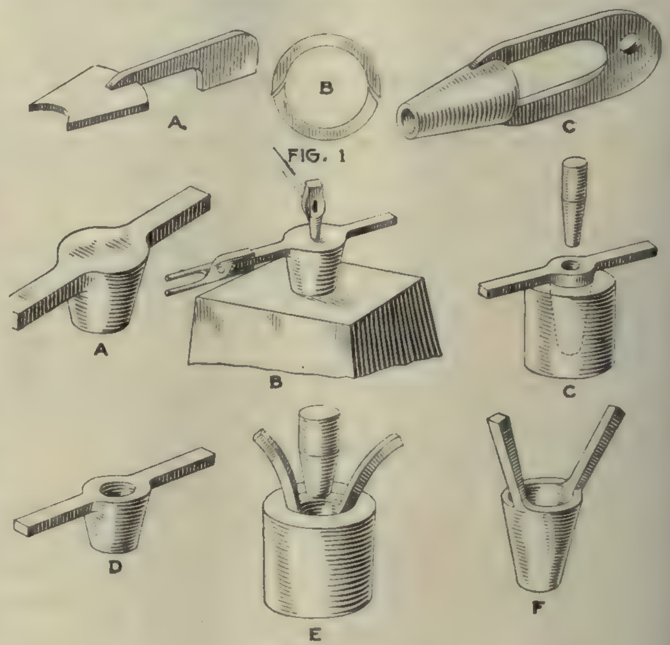


FIG. 2

FIGS. 1 AND 2. WIRE CABLE SOCKETS
Fig. 1—A built-up socket. Fig. 2—Socket forged from bar.

rounded at the end and not too sharp, is driven through. This tends to draw the body of the forging into the die so that the piece takes the form shown at *D*. This operation is then repeated with the larger punch and die *E*, in which the forging is drawn down into the die, bringing the arms up into the shape shown in the illustration at *F*.

There remains merely to bend the arms into shape and weld them together. Reheating between operations is of course necessary, but if the quantity required warranted the expenditure for the necessary dies the two drawing operations could be performed in a bulldozer and probably in one heat.

Why Tracing Cloth Sometimes Wrinkles Under the Eraser

By M. L. Turner

Most draftsmen have observed that when erasures are made on tracing cloth it sometimes wrinkles and it sometimes does not. Very few, however, understand the reason for this and do not know how to guard against it. The following explains: In weaving the cloth the strands which run lengthwise in the finished product are always held taut, while the threads which lie crosswise are drawn less tightly. Therefore if the eraser is always moved in a direction parallel with the tight threads wrinkling will not occur, but if the erasure is made across them the cloth will wrinkle. A simple verification of the fact that the lengthwise strands are tight and the crosswise strands are loose is this: Tracing cloth when torn lengthwise will tear in a straight line, while if it is torn crosswise the result will be jagged and irregular.

The Penetration of Carbon

BY HOWARD ENSAW

Carbonized mild steel is used to a great extent in the manufacture of automobile and other parts which are likely to be subjected to rough usage. The strength and ability to withstand hard knocks depend to a very considerable degree on the thoroughness with which the carbonizing process is conducted.

MANY automobile manufacturers have at one time or another passed through a period of unfortunate breakages, or have found that for a certain period the parts turned out of their hardening shops were not sufficiently hard to enable the rubbing surfaces to stand up against the pressure to which they were subjected.

So many factors govern the success of hardening that often this succession of bad work has been actually overcome without those interested realizing what was the weak point in their system of treatment. As the question is one that can create a bad reputation for the product of any firm it is well to study the influential factors minutely.

Introduction of Carbon

The matter to which these notes are primarily directed is the introduction of carbon into the case of the article to be hardened. In the first place the chances of success are increased by selecting as few brands of steel as practicable to cover the requirements of each component of the mechanism. The hardener is then able to become accustomed to the characteristics of that particular material, and after determining the most suitable treatment for it no further experimenting beyond the usual check-test pieces is necessary.

Although a certain make of material may vary in composition from time to time the products of a manufacturer of good steel can be generally relied upon, and it is better to deal directly with him than with others.

In most cases the casehardening steels can be chosen from the following: (1) Casehardening mild steel of 0.10 per cent. carbon; (2) casehardening mild steel of 0.15 per cent. carbon; (3) casehardening nickel steel of 2 per cent. nickel; (4) casehardening nickel steel of 5 per cent. nickel. After having chosen a suitable steel it is best to have the sample analyzed by three metallurgists and also to have test pieces machined and pulled.

To prepare samples for analysis place a sheet of paper on the table of a drilling machine, and with a ⅜-in. diameter drill, machine a few holes about ⅜ in. deep in various parts of the sample bar, collecting about three ounces of fine drillings free from dust. This can be placed in a bottle and dispatched to the metallurgist with instructions to search for carbon, silicon, manganese, sulphur, phosphorus and nickel. The results of the different tests should be carefully tabulated, and as there would most probably be some variation an average should be made as a fair basis of each element present, and the following tables may be used with confidence when deciding if the material is reliable enough to be used:

TABLE I. CASEHARDENING MILD STEEL OF 0.10 PER CENT. CARBON

Carbon	0.08 to 0.14 per cent.
Silicon	not over 0.20 per cent.
Manganese	not over 0.06 per cent.
Sulphur	not over 0.04 per cent.
Phosphorus	not over 0.04 per cent.

A pull on a test bar ground to ¼ sq.in. in area should register at least six tons, being equal to 24 tons per sq.in.

TABLE II. CASEHARDENING MILD STEEL OF 0.15 PER CENT. CARBON

Carbon	0.12 to 0.20 per cent.
Silicon	not over 0.20 per cent.
Manganese	0.65 to 1 per cent.
Sulphur	not over 0.07 per cent.
Phosphorus	not over 0.07 per cent.

Tensile breaking strength should be 25 to 33 tons per sq.in.

TABLE III. CASEHARDENING NICKEL STEEL OF 2 PER CENT. NICKEL

Carbon	0.10 to 0.15 per cent.
Silicon	not over 0.30 per cent.
Manganese	0.25 to 0.50 per cent.
Sulphur	not over 0.05 per cent.
Phosphorus	not over 0.05 per cent.
Nickel	2 to 2.50 per cent.

Tensile breaking strength 25 to 35 tons per sq.in.

TABLE IV. CASEHARDENING NICKEL STEEL OF 5 PER CENT. NICKEL

Carbon	not over 0.15 per cent.
Silicon	not over 0.20 per cent.
Manganese	not over 0.04 per cent.
Sulphur	not over 0.05 per cent
Phosphorus	not over 0.05 per cent.
Nickel	4.75 to 5.75 per cent.

Tensile breaking strength 25 to 40 tons per sq.in.

Having determined what is required we now proceed to inquire into the question of carburizing, which is of vital importance.

Hardening shops are, for some reason beyond the writer's understanding, generally laid out in a most unsuitable manner, with dangerous ventilating arrangements and bad lighting. The illustration, Fig. 1, was taken under difficulties in a fairly good shop which though, as will be seen, undergoing alterations at the time will serve to give an idea of the kind of plant necessary to deal with large quantities of work.

Using Illuminating Gas

The choice of a carburizing furnace depends greatly on the facilities available in the locality where the shop is situated and the nature and quantity of the work to be done. The furnaces can be heated with producer gas in most cases, but when space is of value illuminating gas from a separate source of supply has some compensations. When the latter is used it is well to install a governor if the pressure is likely to fluctuate, particularly where the shop is at a high altitude or at a distance from the gas supply.

Many furnaces are coke fired, and although greater care is required in maintaining a uniform temperature good results have been obtained. The use of electricity as a means of reaching the requisite temperature is receiving some attention, and no doubt it would make the control of temperature comparatively simple. However, the cost when applied to large quantities of work will prevent this method from becoming popular. It is believed that the results obtainable with the electric furnace would surpass any others; but the apparatus, as far as can be seen, is apt to burn out very quickly;

besides the necessity for frequent rewiring makes it impracticable at present.

The most elementary medium of carburization is pure carbon, but the rate of carburization induced by this material is very low, and other components are necessary to accelerate the process. Many mixtures have been marketed, each possessing its individual merits, and as the prices vary considerably it is difficult to decide which is the most advantageous.

Absorption from actual contact with solid carbon is decidedly slow, and it is necessary to employ a compound from which gases are liberated, and the steel will absorb the carbon from the gases much more readily.

Both bone and leather charcoal are more readily volatilized than wood charcoal, and although the high sulphur content of the leather is objectionable as being injurious to the steel, as also is the high phosphorus content of the bone charcoal, they are both preferable to the wood charcoal.

By mixing bone charcoal with barium carbonate in the proportions of 60 per cent. of the former to 40 per cent. of the latter a very reliable compound is obtained.

The temperature to which this compound is subjected causes the liberation of barium monoxide by contact with the charcoal with which it is surrounded.

Many more elaborate explanations may be given of the actions and reactions taking place, but the above is a satisfactory guide to indicate that it is not the actual compound which causes carburization, but the gases released from the compound.

Until the temperature of the muffle reaches about 300 deg. C. carburization does not take place to any useful extent, and consequently it is advisable to avoid the use of any compound from which the carburizing gases are liberated much before that temperature is reached.

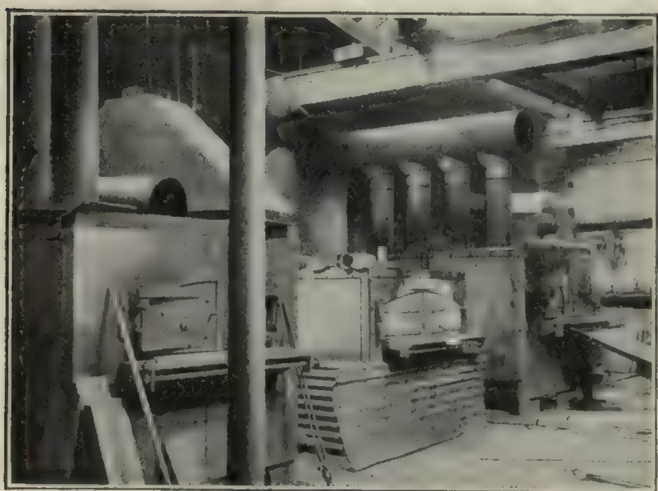


FIG. 1. A HARDENING SHOP

In the case of steel containing nickel slightly higher temperatures may be used and are really necessary if the same rate of carbon penetration is to be obtained, as the presence of nickel resists the penetration.

At higher temperatures the rate of penetration is higher, but not exactly in proportion to the temperature, and the rate is also influenced by the nature of the material and the efficiency of the compound employed.

The so-called saturation point of mild steel is reached when the case contains 0.90 per cent. of carbon, but this amount is frequently exceeded. Should it be required to ascertain the amount of carbon in a sample at varying depths below the skin this can be done by turning off a small amount after carburizing and analyzing the turnings. This can be repeated several

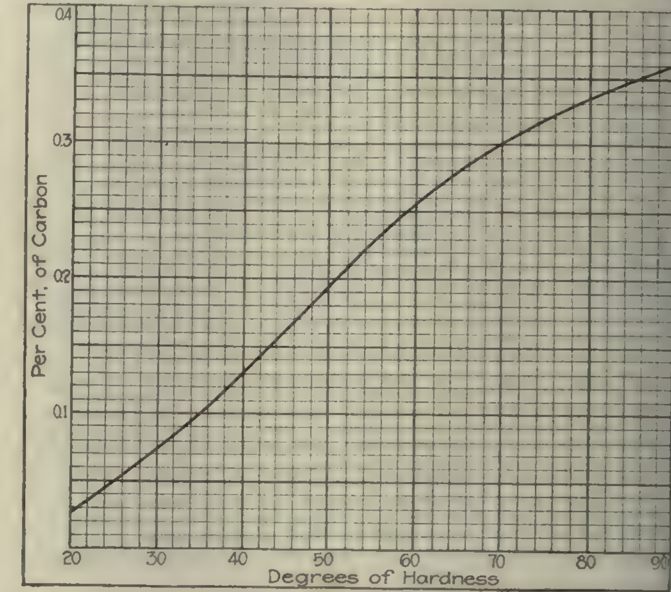


FIG. 2. CHART SHOWING PENETRATION OF CARBON

times, and it will probably be found that the proportion of carbon decreases as the test piece is reduced in diameter unless decarburization has taken place.

The chart, Fig. 2, is also a good guide.

In order to use the chart it is necessary to harden the sample we desire to test as we would harden a piece of tool steel, and then test by scleroscope. By locating on the chart the point on the horizontal axis which represents the hardness of the sample the curve enables one to determine the approximate amount of carbon present in the case.

Should the hardness lack uniformity the soft places can be identified by etching. To accomplish this the sample should be polished after quenching and then washed with a weak solution of nitric acid in alcohol, whereupon the harder points will show up darker than the softer areas.

The selection of suitable boxes for carburizing is worthy of a little consideration, and there can be no doubt that in certain cases results are spoiled and considerable expense caused by using unsuitable containers.

As far as initial expense goes cast-iron boxes are probably the most expedient, but although they will withstand the necessary temperatures they are liable to split and crack, and when they get out of shape there is much difficulty in straightening them.

The most suitable material in most cases is steel boiler plate ⅜ or ½ in. thick, which can be made with welded joints and will last well.

The sizes of the boxes employed depend to a great extent on the nature of the work being done, but care should be exercised to avoid putting too much in one box, as smaller ones permit the heat to penetrate more quickly, and one test piece is sufficient to give a good indication of what has taken place. If it should be

necessary to use larger boxes it is advisable to put in three or four test pieces in different positions to ascertain if the penetration of carbon has been satisfactory in all parts of the box, as it is quite possible that the temperature of the muffle is not the same at all points, and a record shown by one test piece would not then be applicable to all the parts contained in the box. It has been found that the rate of carbon penetration increases with the gas pressure around the articles being carburized, and it is therefore necessary to be careful in sealing up the boxes after packing. When the articles are placed within and each entirely surrounded by compound so that the compound reaches to within 1 in. of the top of the box a layer of clay should be run around the inside of the box on top of the compound. The lid, which should be a good fit in the box, is then to be pressed on top of this, and another layer of clay run just below the rim of the box on top of the cover.

A Satisfactory Mixture

A mixture of fire clay and sand will be found very satisfactory for closing up the boxes, and by observing the appearance of the work when taken out we can gage the suitability of the methods employed, for unless the boxes are carefully sealed the work is generally covered with dark scales, while if properly done the articles will be of a light gray.

By observing the above recommendations reliable results can be obtained, and we can expect uniform results after quenching.

Perpetual Inventory Board

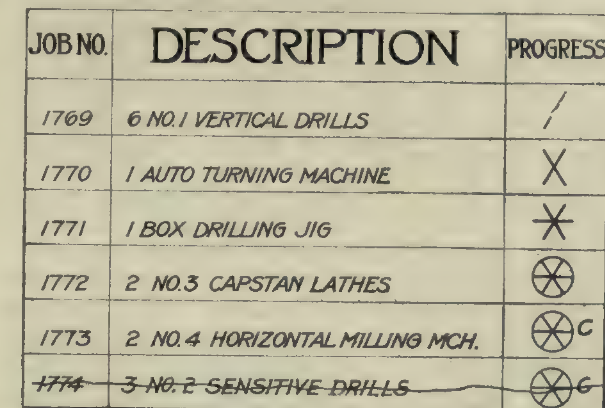
By Robert Shaw

The principle of the perpetual-inventory board described on page 733, Vol. 47, has been used by the writer for many purposes. This principle is easily applied to the progress toward completion of any machine or group of machines through the various departments of the shop, the pin being moved from hole to hole as the job moves from drawing office to shipment. To me the most useful recording points were: (a) In hand in drawing office; (b) issued to shop; (c) in hand in machine shop; (b) issued to erector; (e) completed. I have also used progressive symbols for the above purpose instead of a series of holes in a pin board, and like it better. The sheets can be fitted into frames and hung up on the office or shop wall, but I prefer to keep them in a binder on my desk, it being handier if called either to the telephone or to the manager's room to discuss the stage of progress. As orders are received they are added to the progress sheet, which is arranged as shown in the illustration, the symbols having the meaning respectively of the above headings.

It will be noticed that the symbol is altered for each progressive step by adding a single mark each time.

Some years ago when taking over a department making a range of hangers, blocks, pulleys and similar work I found great need for a visible telltale to show the status of many parts which were in heavy demand, the shortage of which at times caused shipments to be delayed. I took a board which had been used for time checks and gave each hook the reference number of one of the troublesome parts. The time checks being of brass, I had a number of them nickel-plated and others blacked, leaving the remainder in the original finish. A shortage of castings was shown by hanging a blacked check on the hook. Parts passing through the shop were represented by a brass check and parts in the finished stores by the plated check. The blacked checks were left in the original circular form, but the others were cut away in places, so that if all three checks were upon the hook at one time they could all be seen. This method quickly brought out our stocks into good order. We then introduced the method of stores control briefly described below, and for three years have had no complaint of shortage of castings or finished parts, and consequently no use for the shortage board. I am much better pleased to be able to prevent a shortage than to know how to record one when it is apparent.

The storeroom is divided into three sections, the first section being for castings and steel, the second for finished component parts, and the third for finished complete parts ready for immediate shipment. A separate card is used for each part in each section, each part having a reference number, and the complete part, if



PROGRESS SHEET

made up of more than one component, having a separate number. The method of procedure is as follows: The finished-stores department orders from the component-stores department the parts needed to maintain its required stock. The component-stores department controls the ordering of castings and raw material and the maintenance of manufacture. If the shop falls short of work for any class of machine or worker, the finished-stores department is asked for further orders. If its stocks are such that none can be placed, the matter is reported to the manager. The shipping office keeps a record of the finished-stores stock and the stock-control clerk there promptly advises the manager of any delay in replenishing. This check has proved sufficient for our purpose.

I have found the visible-control board useful many times for a variety of purposes when training men into methodical ways of working, but if your system is what it should be the board becomes unnecessary when the staff understands its duties.

I find a very satisfactory way of dealing with troublesome parts or careless assistants is to have a daily or weekly statement drawn from the stock cards and handed to me for inspection and signature. It is also advisable to occasionally take a personal look over the stock cards and compare them with the statement.

Sidelights

EDITED BY E. C. PORTFR

A new high-speed steel has been patented by a German company. The patent specification states that the steel shall contain carbon, 1.2 per cent.; manganese, 1.2 per cent.; silicon, from 0.1 to 0.3 per cent.; chromium, from 3 to 10 per cent., and cobalt, 1.5 per cent. This material is said by the inventors to be an improvement upon a similar steel, which they patented last year, containing molybdenum. In its manufacture the molybdenum is omitted and the percentage of manganese and chromium is increased.

* * *

The National War Savings Committee has issued the following: The lepers at Molokai, one of the Hawaiian Islands, have bought $3000 worth of thrift and war-savings stamps as their contribution toward the cost of winning the war. This inspiring example of patriotism from such an unexpected source thousands of miles from the battle front, and from people seemingly so far removed by the very nature of their unfortunate condition from all of its influences, has been brought to the attention of the National War Savings Committee by a letter written to a friend in Memphis, Tenn.

* * *

Women munition makers in Government plants will wear a distinctive uniform with an insignia to denote that the War Department recognizes them as an important part of the military organization. The safety features which characterize the uniform making it practicable for wear at work which involves danger either from the operation of machinery or the handling of explosive powders were designed by a committee of women workers at the Frankford arsenal and Mrs. Clara Tead of the Woman's Division of the Ordnance Department. The committee selected the style of the uniform and voted that it should be made of khaki.

* * *

President Wilson has approved an estimate of appropriations for $50,000,000 for the acquisition or establishment of plants suitable for concrete shipbuilding or "for the enlargement or extension of such plants as are now or may be hereafter acquired or established, and for the cost of constructing, purchasing, requisitioning or otherwise acquiring such concrete ships." The Shipping Board had already planned to construct three launching ways for three 3500-ton concrete vessels, and if these proved successful the board had then intended to go to the 7500-ton type, but with this large appropriation in sight rush work will be immediately begun at the projected plant in Wilmington, N. C.

* * *

Compared to the population and resources of the United States in the days of '63 the third, or Liberty, loan now being subscribed to is after all only a small amount that is being asked for. The Civil War cost the North $8,000,000,000, to say nothing of the unknown billions spent by the South. In the last year of their struggle the North raised the huge sum of $1,800,000,000, which was declared by the recorders of that time to be "such a triumph of financial strength as has never been paralleled." But in those years of strife there were only 30,000,000 people comprising the population, whereas today there are over 100,000,000, and the wealth of the country has increased tenfold. Add to these factors the improved facilities for creating wealth —themselves enormously multiplied in proportion—and it can readily be seen how not only this war loan but all others can and must be successful.

* * *

Relatives and friends of several soldiers in army camps have been victimized by swindlers who telegraphed or wrote for funds under soldiers' names. In each instance it was requested that money be sent by telegraph waiving identification, or by mail to general delivery, the customary explanation being that the soldier had been discharged and would have no way of securing identification nor of getting mail addressed to his company. The following is a typical telegram sent to the father of a soldier in a Southern camp: "Have been discharged. Coming home. Going to Atlanta through country tonight. Please wire me $60 at Atlanta so I may pay for uniform and come home direct. Waive identification, as I am not known in Atlanta. Wire cash quick, so I can get it tomorrow morning." Before being complied with, any request for money to be sent under such conditions should be verified by a letter or telegram to the commanding officer of the camp in which the man whose name is signed to the request is stationed.

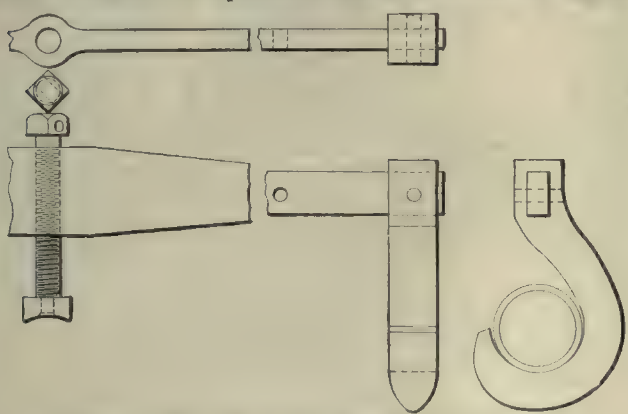
* * *

The War Savings Committee of Greater New York has announced the placing of an order for 1500 United States thrift banks. These banks are really thrift-stamp selling machines, which not only sell stamps for 25c. but also register every sale. The committee believes that the machine will greatly increase the sale of thrift stamps and facilitate their handling by merchants. These machines are meeting with great popularity everywhere. Frank Vanderlip, chairman of the National War Savings Committee, recently gave his approval to this latest invention to accelerate the sale of thrift stamps, and expressed the hope that the machines would be adopted all over the country. Following Mr. Vanderlip's approval the Treasury Department decided to put up the stamps in rolls of 100 each at a little less than 1c. a roll, in order to facilitate the feeding of the machine. The machines are ideal for factories on pay day, and in fact are meant for places where money changes hands and where people congregate. They do not eliminate personal solicitations, which are necessary if the War Savings Stamps campaign is to a success. Particulars regarding the machine will be furnished by the New York War Savings Committee, 51 Chambers St., New York.

Arch-Tube Straightener

By G. E. Baldwin

The sketch shown illustrates a device used in straightening arch tubes for locomotives. It consists of a wrought-steel bar 4 ft. long, tapering from 3½ in. at the center to 1½ in. at the ends, and is ⅞ in. thick. This bar is provided with a hook at each end and a setscrew in the middle. To operate it the tube is set on the end



DEVICE FOR STRAIGHTENING ARCH TUBES

hooks and is straightened by pressure brought to bear by the setscrew.

This device has been in use for some time on several railroads in this country, and has been found to be a very simple and effective method for straightening arch tubes

Cutter-Grinding Gage

By W. G. Groocock

On page 632, Vol. 47, under the above heading, Meydron Delmer credits me with describing a method of correcting incorrectly formed cutters by altering the angle of the cutting faces. I am afraid that Mr. Delmer did not read the article very closely, or he would not have fallen into such an error. I did not describe such a method; moreover, the fixture described by me was for grinding the whole of the form and was dependent for success on the cutting faces of the teeth being both radial and equally spaced.

While I have not described the method of correcting cutters suggested by Mr. Delmer, I have on many occasions been forced by circumstances to practice it in order to get cutters to work correctly; but while we ought to practice what we preach there is no earthly reason why we should preach what we practice, especially when the practice is a bad one.

Referring to the cutter-grinding gage described by Mr. Delmer I would like to suggest that to be really effective for examining a cutter, such gages should not only test the radial faces of the teeth but also the radial

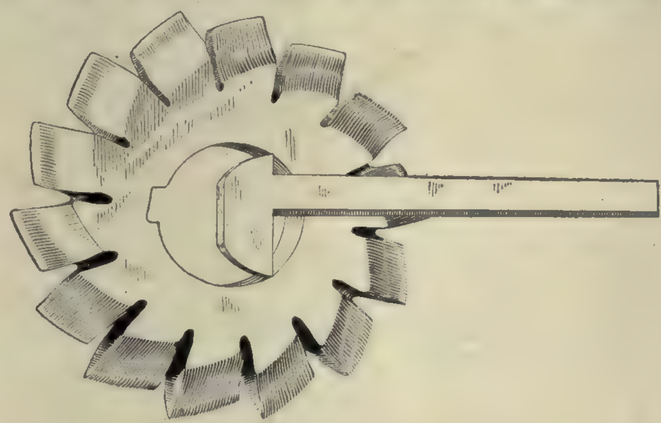


FIG. 1. CUTTER-GRINDING GAGE

height of the tips of the teeth. The gage described by him depends on vision, and when vision is uncontrolled within narrow limits, success depends largely on the skill of the observer. The best way to gage the face of the cutter teeth is to bring the gaging edge directly on the teeth, thus limiting the error of vision.

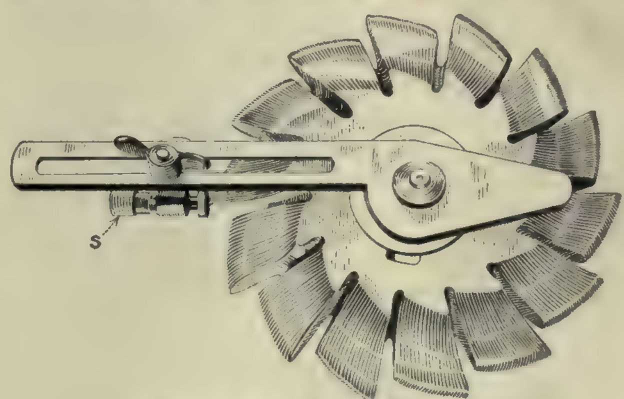
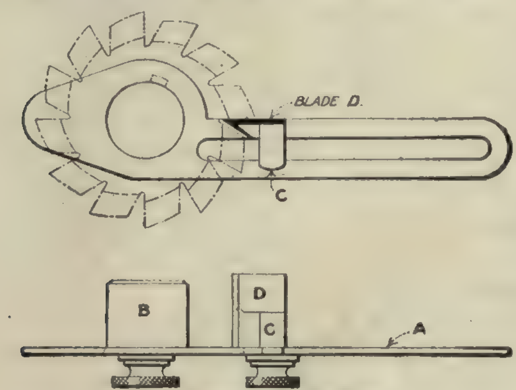


FIG. 2. THE GAGE IMPROVED

Drawing on our common enemy for inspiration, Figs. 1 and 2 show gages as made for testing cutters by J. E. Reinecker of Chemnitz. It will be seen that Fig. 1, which is taken from a catalog dated 1900, is practically the same as the one described by Mr. Delmer. The one shown in Fig. 2 is a distinct improvement on the first, because it will also test the height of each individual tooth by means of the micrometric screw *S*. Fig. 2 was taken from a catalog dated 1904.

Some years back, having made a gage similar to Fig. 2, I found it necessary to add a blade to test the face. For this purpose the micrometric screw was removed from the slot of the gage, and a blade was substituted that actually tested the face of the tooth, the idea being shown in Fig. 3. Here *A* is the plate, *B* the removable stud on which is placed the cutter to be examined, *C* the carrier on which is secured blade *D*, stud *B* can be changed to suit the bore of different sized cutters, and carrier *C* can be adjusted within the limits of the slot shown.

While examination of cutters after grinding may be necessary, there can be no doubt that the best way to insure that they are ground correctly is to give the grinder a gage to set the grinding wheel in correct relation to the stud carrying the cutter. Some special grind-



GAGE FOR TESTING FACE OF TOOTH
FIG. 3

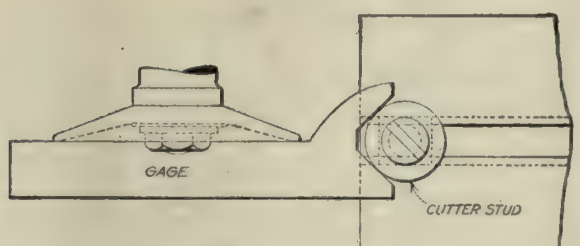


FIG. 4

FIGS. 3 AND 4. GAGE FOR TESTING FACE OF TOOTH AND A SIMPLE SETTING GAGE

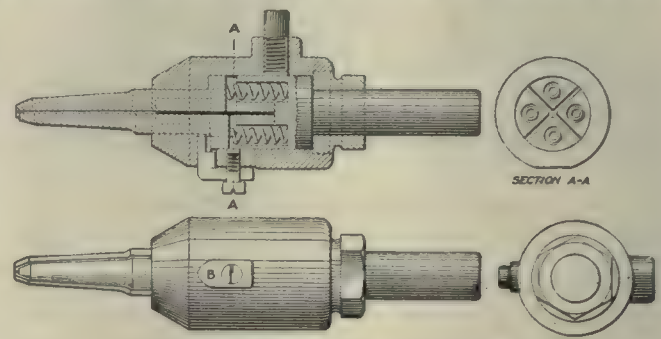
ing machines have such a gage. Usually, however, cutter grinders have no means of setting the stud central, and when such is the case then a gage should be made. A simple setting gage that will soon pay for itself is shown in Fig. 4, and needs no further explanation except to say that once the stud is aligned with the face of the wheel as shown, the table is raised to bring the cutter which is to be ground to center line of grinding spindle.

Machine Lap for Taper Holes

By John G. Rock

The illustration shows a machine lap to be used on cartridge dies in a slow-speed drilling machine. The lap is made of cast iron, finished all over and divided lengthwise into four sections with a $\frac{1}{16}$-in. slitting saw. The head has four drilled holes for helical springs; it is also slotted in a manner similar to the lap sections to receive a driver in the form of a cross made from $\frac{1}{16}$-in. cold-rolled steel, this driver extending downward between the sections of the lap for some distance.

The shell which incloses the working parts is made a running fit on the shank and is held from turning by a handle which in operation lies against the frame of the drilling machine. A hole is drilled in the side of the shell and the piece shown at *B* is fitted in, the inner end of the projecting part being beveled in such a manner that as the tool revolves the flanges at the



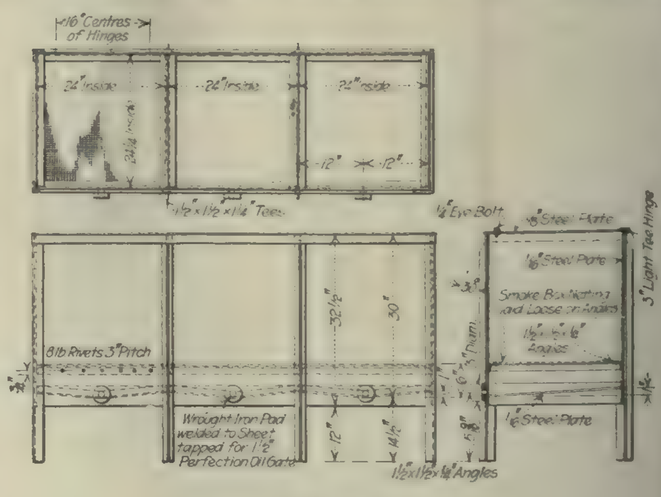
A MACHINE LAP FOR TAPER HOLES

top of the lap sections ride over it each in turn, the result being to lift slightly each lap section as it passes this point. This allows the lapping compound to work down continuously, and the tendency toward producing a high spot on the work at this point is counteracted by allowing the work to float slowly under the hand as the lapping proceeds. At all other points the lap sections are held down by the springs which allow sufficient flexibility to prevent the lap from seizing. A section taken through the body of the tool at *A*, *A* is shown in the line drawing.

Waste-Saturating Tank

By G. E. Baldwin

This drawing shows a tank for saturating waste with oil before it is used for packing car and tender journal boxes. The tank is composed of three compartments and is made of $\frac{1}{16}$-in. steel, having a hinged lid of $\frac{1}{8}$-in. steel at the top. Each compartment is provided with a



WASTE-SATURATING TANK

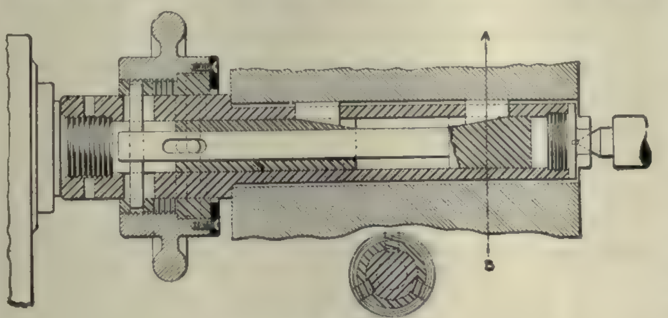
sheet of wire netting located about 6 in. above the bottom of the tank.

These tanks are standard for the New York, New Haven & Hartford R.R., being located at all shops and round houses.

Expanding Mandrel

By George M. Dick

The illustration shows an expanding mandrel which we use in the manufacture of coal-cutter cylinders. One end is threaded to fit the spindle of the lathe, the other is supported by the tailstock center. The jaws



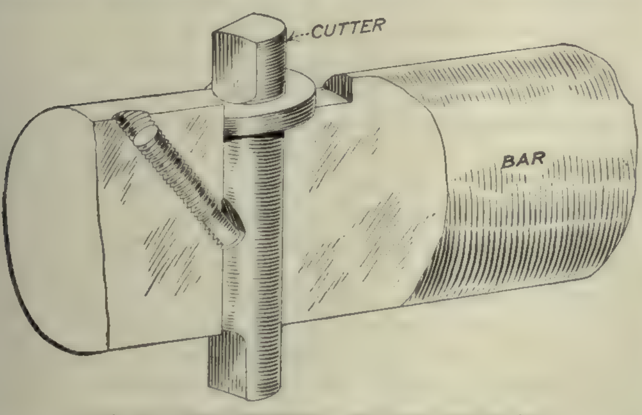
EXPANDING MANDREL

are expanded by means of the handwheel running on the threaded ring and drawing the expanders together. This means was found to be a big improvement over the old-style expanding arbor, which worked with a tapered plug driven into a split bushing. The new mandrel takes care of a variation in size, which was impossible on the old style, and the time saved paid its cost in a few weeks. We have since made a mandrel of the same type, but smaller, for turning leaf valve seats on a turret lathe, and it also has proved successful. One important point about these mandrels is that they are complete in themselves. They have no draw rods going through the spindle with handwheels at the rear, etc. They can be removed quickly from the machine like an ordinary chuck, which is a great advantage where various kinds of jobs are done on one lathe.

Method of Locating Cutters in Boring Bar

By T. A. H.

A method of locating multiple cutters in a boring bar where it is necessary to establish and maintain accurate relations both as to spacing and diameters is



LOCATING CUTTERS IN BORING BAR

shown in this sketch, and so far as the writer knows it is original with him.

The use of the round cutter with the flat-sided collar combines simplicity of construction, which is the principal advantage of the round cutter, with accuracy of location usually associated with the cutter of rectangular section that is milled out to seat on the sides of the bar.

After the holes are located and drilled in the bar, a flat is milled across the bar at right angles to the center line of each hole with one side of each slot so formed as to coincide with the leading side of the hole.

The body of the cutter is fitted to the hole and a flat is made on one side of the collar tangent to the circumference of the body of the cutter, as will be seen. The V-shaped notch in the side of the cutter furnishes a seat for the setscrew, which is tapped into the bar at an angle of about 30 deg. The sole duty of the setscrew is to hold the cutter to its seat, the location being determined by the collar.

The cutters are made in a short master bar having, in addition to the usual centers, offset or eccentric centers upon which the bar is swung for the purpose of relieving the cutters. The boring machine is thus kept in service continuously, and when a set of cutters becomes dull the operator takes them out and is given a new set.

Women in Machine Shops

There are many phases of the problem relating to the employment of women, as with men, which do not always appear on the surface. And, when we are seriously interested with the question of securing maximum production, as we are, we cannot afford to overlook any of them.

Remembering first of all that the main reason for bringing women into the machine shop is to maintain or to increase production and not to lower shop costs, there should be no question as to the principle of equal pay for equal work. Not only is this fundamentally just, but it has a direct bearing on the attitude of shop men toward the introduction of women, or dilution, as it is called in England. Every intelligent mechanic realizes that when any class of labor is hired at a lower wage for the same work, the standard is sure to be threatened soon or late.

With increased production for the main object, as well as the training of women to take the place of our depleted ranks of shop men, the dominant problems are, how to get women of the right sort, how to train them and how to keep them.

The class of women which can be secured depends upon the locality, the physical condition of the shops (which includes attractiveness as well as the bare sanitary and safety qualities), the kind of foremen and the power they exercise, the kind of work and the wages paid. Shop managers who deny rest rooms, red geraniums and similar foolishness, as they call it, who boast of treating the women just as they do the men, do not got the best class of women or the best results. Men as a class have worked so long in crowded, unclean and unattractive shops that they do not think as much about the little things to which women are so susceptible. And those who try to ignore this highly desirable quality are not good judges of human nature.

One shop manager who is giving the matter very careful consideration intends to have a training room

for women who have never worked in the shop and who are not familiar with machines. He believes that by giving them special attention in a comparatively small room, until they know how to handle the work to some extent, they will be less self-conscious when they are put on a machine in the regular manufacturing department. It is his belief that in this way he can get them into active production more readily, also it will tend to reduce accidents with their attendant delays, not forgetting the pain and suffering which are often involved. Both of these phases of the subject are well worthy of thought and investigation.

We are also learning that the productivity of a shop depends on many things which were formerly considered as being entirely aside from what we were pleased to call business. We paid little attention to the way in which the workers lived or how, and failed to see that it directly affected our production; but we are beginning to see how unsanitary houses prevent the worker from being physically fit, and it takes but a glance at the production chart to show the effect on the output of the shop.

The more steadily employees are at work, or more properly the less time that is lost by incapacity or voluntary idleness, the greater the output; consequently anything we can do to maintain the health of the workers, the better our production will be. Men who employ large numbers of women intimate that with women there is a greater percentage of idle time than with men—partially due to less physical endurance and partially to a less keen appreciation of the effect of this idle time upon the output of the plant. Both of these causes can probably be modified by paying greater attention to fatigue prevention and by impressing women workers that they are important factors in the output of the plant. It might even pay to offer some sort of a bonus as a reward for continuous attendance.

The question of fatigue is important for both men and women, as it has a greater effect on output than is often realized. Not only is this a direct effect, but it also increases accidents and sickness, and these things decrease the efficiency of the worker and seriously affect output. More money can be profitably invested in hoists, trucks and other handling devices than many realize. The less effort required in useless or needless lifting, carrying or handling, the more is available for useful work.

The question of clothing for women in the shop is receiving much attention and there is a decided tendency toward some form of the overall, with a cap for covering the hair, as an absolute necessity to prevent danger from moving belts and gears, even when the latter are carefully guarded. There is no question as to the desirability of a bifurcated garment in nearly all work, from the viewpoints of safety, cleanliness and modesty, even though the latter-day attributes of modesty do not agree with some of our older notions of propriety.

In some shops there seems to be a tendency toward the knee-length knickerbocker or bloomer, but in most cases the overall comes to or just above the ankle. In any case there seems likely to be a tendency toward more attractive designs, as there is no reason why the woman in the shop should not maintain her love of neatness and attractiveness, even when handling machines of various kinds.

One progressive superintendent is fitting up the gallery of his shop for women workers. Here they will be taught to handle machines of various kinds and here work will be done until they become proficient. This will give him a good chance to study the women and their work, because much of the success or failure of women in the machine shop depends on the personal element, as well as on their ability to perform various kinds of work.

When women become proficient along any line, they will be placed in the various departments as needed—the idea of complete separation only applying during the preliminary period of instruction.

This same superintendent feels, however, that the introduction of women into the machine shop must be considered in relation to its effect on industry after the war as well as at present. For his particular requirements he is drawing men from other lines, lines on which he believes that women can serve better, or more in keeping with their natural activities. He is taking clerks from dry-goods and similar stores; men who have never been mechanically inclined but who realize that there is more opportunity at present in the really essential industries than in selling neckties and fancy hose.

"We'll Stand Fast!"

By cable from our editor in Paris

IN the world crisis precipitated by the German onslaught in Picardy and Flanders the faith of France in her own armies and those of her allies remains absolutely unshaken. This is the clear-cut impression gained by the observer in Paris today. There is no panic here, as Teuton propagandists would have the world believe, nor are there discernible even the symptoms of general uneasiness.

Long-range shelling by day, bombing raids from the air by night and the threat of a German advance on the French capital, far from demoralizing the spirit of the civil population, have lifted it to new heights of determination and confidence. The daily news from the front is even more encouraging, and there are just beginning to drift back hints of the heroic part which the engineers of the Allied forces are playing in the greatest war dream of all time.

When the full story is told of how day after day they have been performing seemingly impossible feats in transporting reserve troops and material and in maintaining lines of communication it will form the grandest epic in the annals of engineering.

From the picture of public feeling here I will pick out a single detail. At the *pension de famille* where I stay lives the aged widow of a French general. Amid the bursting shells of the long-range gun, bombs dropped in the night and early rumors of an overwhelming German attack, her friends attempted to persuade the old lady to leave Paris. I saw her eyes flash, her bent shoulders straighten back and as she snapped "Resté ici!" she seemed to embody in those words the spirit of France—"We'll stand fast."

ROBERT K. TOMLIN.

Editorials

A Dangerous Coal Situation

THERE are grave possibilities of the whole governmental control of commodities being undermined unless the United States Railroad Administration is prevented from securing advantage to itself at the expense of the other departments and industry in general. In its attempt to make a good showing for the railroad administration, John Skelton Williams, director of the Division of Finance and Purchase, is endeavoring to break down for the benefit of the railways the prices fixed by the Fuel Administration, regardless of its effect on other industries and on the domestic supply.

Following the railroad custom of giving preference in the supplying of cars to the mines which made the best prices to them Mr. Williams is now attempting to do the same thing in order to secure fuel for the railways at a lower price.

The effect of this on those mines which will not or cannot meet the lower prices will be to deprive them of cars with which to supply their customers. This means that their mines will be idle, while those which granted the lower price will be running. It also means that the miners in the districts that are discriminated against will not be able to earn sufficient wages for their needs and that there will not be coal enough to supply a large number of industries and domestic users.

According to those who are familiar with the coal situation the question of the supply and price of coal is for the most part one of cars. The withholding of transportation facilities, it is said, was a deliberate plan of the railways four or five years ago to make it impossible for the mines to operate at their full capacity, and this had the effect of keeping up the price for coal.

What with the railroads taking 30 per cent. of the coal output and the mines that are supplying them being allotted a much greater proportion of the available cars the other industries and domestic users stand a small chance of getting coal if this discrimination is permitted.

Another point in connection with this which may well be considered: If the mines can afford to supply the railways with coal at 15 to 20 per cent. below the price fixed by the Fuel Administration, it is evident that they ought also to supply industrial and domestic users at the same price provided cars can be run regularly to the mines instead of only a few days a month. Is not an immediate increase in the number of cars, therefore, a most urgent matter?

One of the services which the Fuel Administration has rendered is the securing of accurate accounting of the cost of mining coal at various points. These accountings show very plainly how idleness at the mines, due to a lack of cars and other causes, increases the cost of production, for, as with other industries, certain expenses go on whether the mines operate or not and greatly increase the overhead cost per ton.

With these figures and the absolute knowledge that the practice proposed by Mr. Williams will result in discrimination in the coal industry it is the duty of manufacturers to protest against the move; besides if a similar practice is established in other lines it cannot help but bring about chaotic conditions to the country. No section of the Government should be allowed to cripple any industry, especially when it is done to make a showing for itself.

How "Cost-Plus" Hits the Machine-Tool Builder

THE machine-tool builder is between the devil and the deep blue sea. On the one hand his Government quotations are marked "price protested," in spite of the fact that his advances have been modesty itself in comparison with that for any other line of metal products. On the other hand, the shops with cost-plus contracts can and will if necessary pay double the normal wage to get the good men away from his shop.

This pilfering of man power affects the machine-tool shop more vitally than almost any other kind of business, for in most shops of the kind a higher grade man is needed than in the average one. The work often cannot be subdivided sufficiently to utilize the unskilled or one-operation man, as may be done in the larger manufacturing plants. The fact that man power has not yet been seriously reduced does not help the machine-tool builder materially if he cannot get the kind of men that can build his machines.

There is probably complete justification for the cost-plus form of contract in many cases; but unless there is some fair and definite understanding reached with regard to the payments for both labor and material, serious complications are bound to ensue and Congressional investigations will have full swing for many years.

With machine-tool and other necessary shops tied up or even handicapped by the ability of the cost-plus shops to pay any wage demanded (and in reality earning greater profits the more they make their costs) it will be impossible to insure a steady flow of all needed machinery, while any blocking of this supply pushes peace further into the background.

With the draft taking large numbers of useful men out of the machine-tool shops and with more to go in the next few months, the question of manning the shops is sure to be a serious one. In the interests of all concerned, concerted action should be taken by the manufacturers themselves, not only in cities and definite localities, but covering much larger areas. The new Federal Employment Service is to act along this line, but is bound to take time to get into complete running order.

At the present time each city has some sort of an employment bureau run by the employers of that locality. In one case the fund allotted by the Government for obtaining men in a shop with a cost-plus contract, was contributed to the employment fund for that city. This bureau canvassed the surrounding towns and secured a long list of possible employees who were likely to be

attracted by the higher wages which could be offered owing to the cost-plus contracts.

All this, however, is only adding to the output of certain plants or certain cities. The output of the country is probably lowered owing to the disorganization of the factories from which these skilled men have been withdrawn; and it is the output of the whole country which counts in our work of preparation.

The only solution of the pending difficulty seems to be the adoption of the clearing-house idea, by which labor can be put into contact with suitable jobs at the shortest notice. Also there must be some means devised of preventing the wholesale stealing of men which is being done at present in many places. Some forms of Government contracts attempt to prevent this by inserting a clause forbidding the employment of men who have worked for another contractor within sixty days, unless they have a release from the former employer. This is copied after the British practice, but has some drawbacks. It is a step in the right direction, and is worth considering, however.

Machine-tool builders must take an active part in this work both for the preservation of their own industry and in order to do their share in the great work which lies ahead of us.

Let All Serve in Some Way

THE getting of the right man in the right place is one of the great problems of any business, community or nation. If we could sort the round and square pegs and get them fitted into the right holes, we should have a wonderfully efficient nation.

The calling of the next draft quota gives us the opportunity to make a much more careful and scientific selection than occurred at the first call. It is suggested by those who have given the matter careful consideration, both from the standpoint of business, Government and the individual, that there should be no exemptions whatever: that every man called should be in Government service during the period of the war.

This does not mean that all the men called should go into the army, even should they be found physically fit, for some are undoubtedly of far more value to the country in other capacities. It might easily happen that a man would be sent back to his regular work, especially if he is in an important industry. But instead of exempting him permanently or temporarily, he could be assigned to the work for which he is best fitted, and become a Government employee to the extent that he could not change jobs at will but must stick to the one assigned, just as a sentry stays at his post. The question of remuneration can be settled in several ways, the main thing is to keep the man at the work for which he is best fitted or where he is most needed.

Men who have no special training or who may not be physically fit for the army could be assigned to other duties. The great army of farm labor which is sadly needed could be recruited in this way, and unless something of this kind is done there is sure to be a great shortage in this field during the coming season; for men will not work on a farm for $35 to $40 a month, when they can earn this in three or four days in a munition factory. But unless farm labor is supplied we shall be far below our needed production of farm products.

In the same way men can be assigned to other fields where labor is needed, and the fact that all serve in some capacity or other makes those who enter the army feel that they are not alone in rendering service to the country.

The Cost of Changing Executives

WE have been discussing labor turnover from its various angles, but in almost every case it has referred to the mechanic or machine operator and not to the foreman, superintendent or works manager. There are, however, many indications that the shifting of men in these positions has an even greater effect on the efficiency of the plant and its output than the frequent shifting which is going on farther down the line.

While the kind of labor required in management and superintendence can hardly be compared to that of repetition work, there is perhaps more similarity than might appear on the surface. For while the problems are constantly changing, the shop conditions remain much the same, and these may perhaps be likened to the machine and tool equipment which the manager must use to secure his output.

Salesmen and demonstrators of well-known machine-tool builders report such frequent changes of the entire executive staffs of large shops that it is becoming quite a serious problem. In too many cases it means that the advice and instruction previously given as to the use and operation of the various machines is entirely lost. This means a loss of production both to the shop owner and to the nation—a particularly serious item.

Some of this disorganization has of course been due to men being commandeered for service in the various Governmental departments. Much of it, however, is undoubtedly due to the failure of plant owners to thoroughly realize the low plane of efficiency which is sure to develop by constant changes in their executive staffs. In very many cases these changes, like those in the shop, are caused by the failure of the shop owner to appreciate the change in living conditions and the general increases made necessary in wages and salaries. In fact salaries have not kept pace with wages in many cases.

One of the grave dangers of the shifting of executives is that it usually involves a change of policy and often upsets previous shop routine and methods to such an extent as to more or less demoralize the workmen.

The selection or retention of shop executives is not as a rule a matter to be handled by an employment manager, although if he is a big enough man it may be advisable to call him into consultation even in the selection of a superintendent or works manager. For if the proper selection of a machine is important it is certainly more vital to have an equally intelligent selection of the executives of a plant.

There are many questions involved, including the all-important one of suitable renumeration, and here, as has been already stated, an entire revision of previous ideas as to salary may be absolutely necessary. The problem of shifting executives is even more serious than the large turnover of labor lower down the scale.

This is well worth the best thought of every shop owner, as it affects not only his welfare but the efficiency of the nation as a whole.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Wetmore Taps and Reamers

The Wetmore Mechanical Laboratory Co., Milwaukee, Wis., has recently placed on the market the special tools illustrated, which are for use in munitions work. Fig. 1 shows two different styles of taps which are used for threading operations in the fuse holes of shells. Fig. 2 shows an expanding reamer of the floating type to fit a 3-in. turret hole. This is for finish-sizing fuse holes on 155-mm. shells. The reamer is self-centering and the blades are set on a left-hand angle. The expansion is accomplished by means of two ground nuts, and the blades may be removed and replaced without taking the tool apart. Centers are provided for grinding with the blades in place if desired.

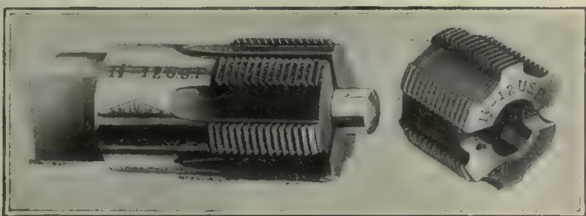


FIG. 1. TWO TAPS FOR SHELL WORK

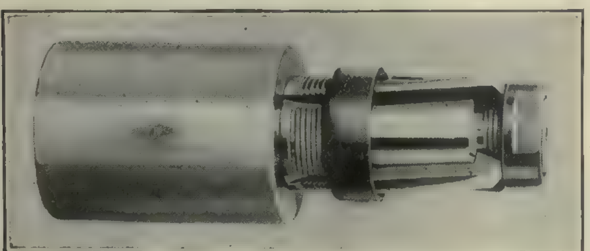
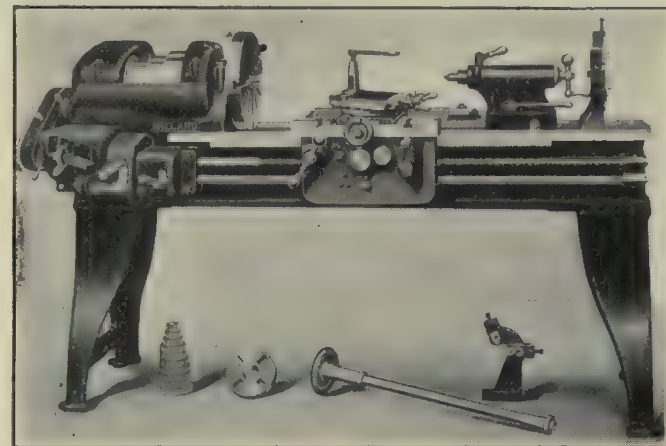


FIG. 2. EXPANDING FLOATING REAMER

Willard Improved Lathe

The Willard Machine Tool Co., Cincinnati, Ohio, has made a number of improvements in the Willard lathe since taking over the Willard Machine and Tool Co. A quick-change box has been incorporated, being bolted to the front of the bed. Its alignment is assured by means of tongues machined in the bed. One lever operating the tumbler gear gives 40 different feeds, while a second lever gives three gear ratios and reverse. Other feeds may be obtained by changing the gears at the end of the bed. A third lever at the right of the feed box is for disconnecting the lead screw. All gears in the feed box are of steel, and shafts are supported at both ends. A new headstock has been incorporated, which is claimed to be somewhat more rigid than the one previously used. It has a bearing of 21½ in. on the bed. The spindle is of 65-point carbon crucible steel and is ground to size. Reverse gears are of steel and the idlers are bronze bushed. The carriage has a bearing on the Vs of 18 in. and is 7½ in. wide. Taper gibs are used on all sliding surfaces and micrometer dials are used throughout.

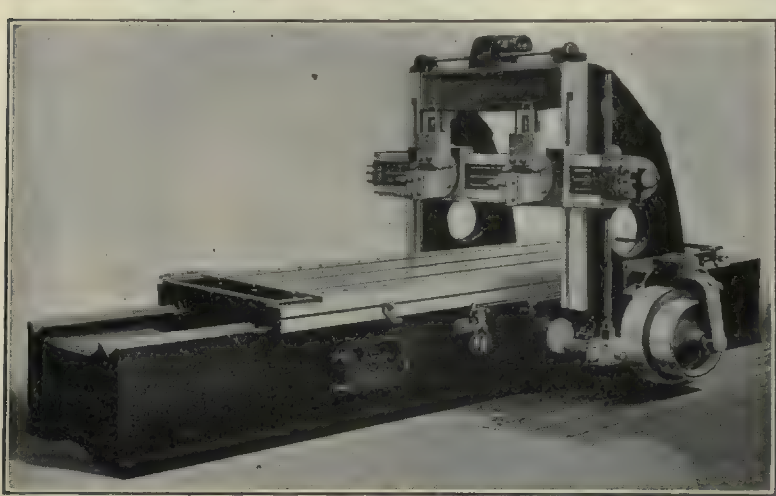


IMPROVED WILLARD LATHE

Liberty 36-In. Planing Machine

The planing machine illustrated is of the 36-in. size and is the product of the Liberty Machine Tool Co., Hamilton, Ohio. The bed extends to the floor and the top is closed in between the Vs, except through the gearing section, which is reinforced with girths. All gearing is placed inside the bed and is accessible from the top. Bearings are provided with bronze wearing surfaces and wick oiling is used. The housings are of box section, extend to the floor and are secured in place by means of taper plugs and bolts. Pads are provided in order that motor brackets can be attached at any time. The rail is of box section and is of sufficient length so that two heads may be used. The heads are made right and left in order that close work may be handled and have graduations for swiveling up to 90 deg. The down-feed screws are in tension while work

is being done. The feed is independently adjustable on either rail or side head. The feeds may be changed while the machine is in motion, and an index dial enables the operator to set the feed to the required amount. The elevating device is centrally located on the top brace

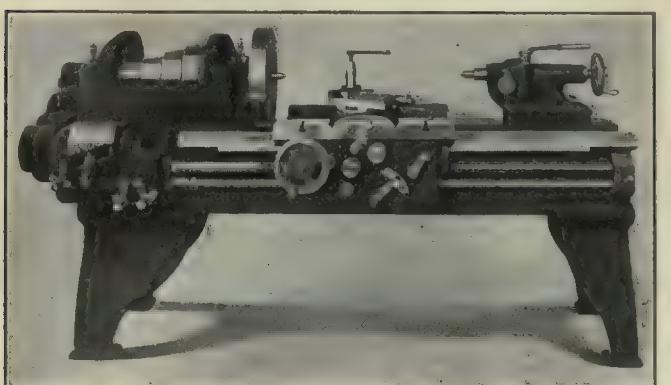


LIBERTY 36-IN. PLANING MACHINE

and is operated by a long handle at the side of the housing. The side heads have independently adjustable feed and micrometer index collars are supplied when ordered.

Hamilton 16-In. Engine Lathe

The 16-in. production lathe illustrated is one of the products of the Hamilton Machine Tool Co., Hamilton, Ohio. The machine is of the cone-head, quick-change-gear type. The bed is of semi-steel, having one V- and one flat-way in front and two Vs at the back. The headstock is of box construction and is equipped with single back gears and a four-step cone for a 3-in. belt. The locking device permits the cone and face gear to be connected or disconnected without the use of a wrench. Phosphor bronze is used for the spindle boxes and sight-feed oil cuts are provided. The spindle is hollow, of



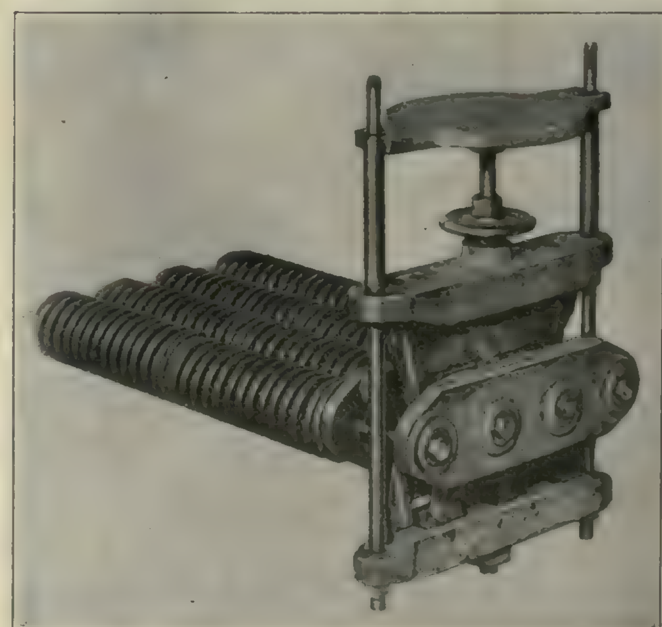
HAMILTON 16-IN. PRODUCTION LATHE

Swing over shears, 18$\frac{3}{4}$ in.; swing over compound rest, 11$\frac{3}{8}$ in.; length between centers with 6-ft. bed, 36 in.; front spindle bearing, 3$\frac{1}{8}$ x 5$\frac{1}{4}$ in.; rear spindle bearing, 2$\frac{1}{2}$ x 3$\frac{3}{4}$ in.; hole through spindle, 1$\frac{1}{2}$ in.; spindle nose threaded, 2$\frac{11}{16}$ x 6 U. S. S.; ratio of back gear, 10 to 1; tail spindle, 2$\frac{1}{16}$ in. diameter, 10-in. traverse; spindle speeds, 6 to 450 r. p. m.; threads cut 2 to 112, including 11$\frac{1}{2}$; revolutions of spindle for 1 in. of carriage travel, 7 to 392; length of carriage bearing on shears, 27 in.; size of tools, $\frac{5}{8}$ x 1 in.; capacity of steady rest, 5$\frac{1}{2}$ in.; weight with 6-ft. bed, 3480 lb.

chrome-nickel steel, ground to size, and the end thrust is carried on a ball bearing supported against the inside of the rear spindle box. Take-up is provided. The nose of the spindle is threaded at the end, the faceplate being so made as to fit both the cylindrical and threaded portions. The tailstock is secured by two clamping bolts. The spindle is of steel, is provided with a plug binder and is graduated in eighths of an inch. A micrometer dial is also provided for fine adjustments. Taper turning is accomplished by setting over the tailstock. The carriage is flat on top and is provided with T-slots. It bears on the bed for its entire length and shear oilers and wipers are used. The compound rest has taper gibs in both the top and bottom slides and the swivel is graduated in degrees. A chasing dial facilitates the cutting of threads, this being so arranged that it may be disengaged when not in use. The apron is of box construction, all shafts being supported at both ends in bronze bushings. The feeds are friction driven, and a mechanism is incorporated to prevent the feeding and screw-cutting mechanisms from being engaged at the same time. The feed along the bed is provided with an automatic knockout. The quick change gear box is at the front of the machine and hardened and ground steel gears are used throughout. Forty-eight different threads and feeds are available with the regular setup and the open-end lead screw enables any thread to be obtained by the use of extra gears. All bearings are bronze bushed. It is claimed that the machine is very convenient to operate, quick-action handles being provided on the tailstock screw, the apron handwheel and the cross-feed screw. Regular equipment consists of compound rest, double-friction countershaft, large and small faceplates, steady-rest, centers and wrenches.

King Pressure Toggle for Presses

The pressure toggle illustrated is for the purpose of regulating the pressure exerted on the work during the stroke of the press. The device may be so adjusted that

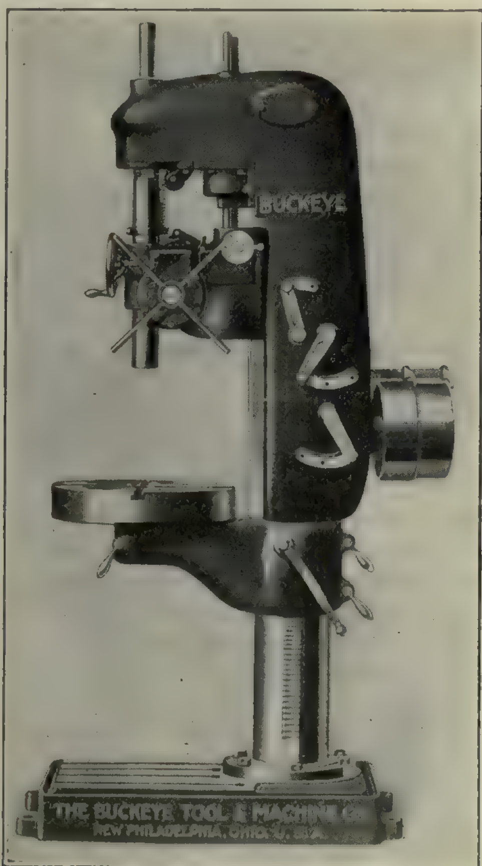


KING PRESSURE TOGGLE FOR PUNCH PRESSES

the pressure will remain constant during the entire stroke or so that the pressure will increase or decrease toward the latter end of the stroke. The device is attached to the bolster plate with two rods and is left stationary, while the plate supporting the drawing pins is moved up or down for adjustment to the length of the pins by means of the handwheel. After the adjustment it is secured in place by means of a locknut. Blanking or other push-through work may be done without removing the toggle by letting down the plate on which the pins from the drawing rest or by screwing out the rod that supports this plate and removing it. The toggle illustrated has a capacity of 10,000 lb., but it is also built in a 5000-lb. size. R. D. King, Monadnock Block, Chicago, Ill., is the manufacturer.

Buckeye Heavy-Duty Upright Drilling Machine

The Buckeye Tool and Machine Co., New Philadelphia, Ohio, is now manufacturing the heavy-duty upright drilling machine shown in the illustration. The machine is made in the 26-in. size, and it is claimed to be capable of driving high-speed drills at their maximum capacity. The machine is of the single-column type with a single



HEAVY-DUTY UPRIGHT DRILLING MACHINE

Height, 94 in.; drills to center of 27 in.; maximum distance spindle to base, 50 in.; maximum distance spindle to table, 33 in.; traverse of table on column, $18\frac{1}{2}$ in.: movement of head on column, 22 in.; movement of spindle in head, 12 in.; diameter of spindle, 2 to $2\frac{1}{2}$ in.; diameter of sleeve, $3\frac{3}{8}$ in.; diameter of column, 9 in.; slot in spindle nose, $\frac{3}{8}$, $\frac{1}{2}$ in.; diameter of table, 22 in.; feeds, six, 0.006 to 0.048 in. per spindle revolution; speeds, eighteen, 16 to 500 r.p.m.; size of pulleys, 12 x 4 in.; floor space, 30 x 40 in.; weight 2500 lb.; taper in spindle, Morse No. 4.

pulley drive, all gears, etc., being located in the upper part of the column. All gears are mounted on a sleeve and placed in the machine as a unit. They are held in place by a dead shaft and run in a bath of oil. The crown gear, tapping gears and feed gears are packed in grease. Eighteen speeds are obtained by means of three levers, and six rates of feed are provided for each spindle speed. The spindle is of high-carbon steel. The machine may be used as an upright milling machine by using the compound table, which can be supplied at any time. The spindle nose is slotted across the end to provide for driving boring and facing heads. An automatic trip is provided, which disengages the feed at any desired depth, a depth gage 12 in. long being placed on the front of the spindle sleeve. A tapping attachment is part of the regular equipment, and is obtained by using a Carlyle Johnson clutch. All bearings are Hyatt roller or bronze. The base is provided with an oil gutter around the edge, which is connected to a reservoir. A feature of the machine is that the table may be swung entirely around the column. Compound table and motor drive can be furnished as an extra.

Program of the A. S. M. E. Spring Meeting at Worcester

The following announcement regarding the convention to be held in Worcester, Mass., June 4 to 7, made by the committee on meetings and the Worcester local committee, evidences the intention of the committees to make this another war convention. Every member within reasonable distance of Worcester should make it his business to be present.

Tentative Program

Tuesday, June 4.—Afternoon (Hotel Bancroft)—Registering of members and guests at society headquarters. Evening (Hotel Bancroft)—Address of welcome, followed by reception and dance.

Wednesday, June 5, New England Day.—Morning (Worcester Polytechnic Institute)—Business meeting. First New England session, with opening address by Charles Washburn on the industries of Worcester; buffet lunch served at the institute. During the morning and afternoon sessions it is proposed also to discuss the textile industry in relation to the war; the shipbuilding industry; and the manufacture of small arms and gun carriages, with reference to these industries as developed in New England. Afternoon (Hotel Bancroft)—Second New England session; general session with technical papers; industrial safety and workmen's compensation session. Evening (Hotel Bancroft)—General war session. The general theme of this evening session will be How the Engineering Societies Can Assist in the Procurement Program of the Government. Some major topics to be discussed are: Ordnance and ships for the navy department; munitions for the army; aircraft material; merchant ships; training of labor, etc.

Thursday, June 6.—Morning (Worcester Polytechnic Institute)—General session with technical papers; fuel session; public relations session. Afternoon (Norton Co.'s plant)—Luncheon; inspection of the Norton Co.'s community housing and garden projects. Evening (Worcester Country Club)—Dinner; illustrated lecture.

Friday, June 7.—Morning—Automobile trip to Camp Devens via Clinton Dam; lunch at Camp Devens. Afternoon—Auto trip to Concord, Lexington and return via the Wayside Inn; afternoon tea at the Wayside Inn.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., April 27, 1918—It seems to be the fate of war that hardly any man ever finishes the work he begins. And yet we must not forget that the starter is just as necessary as the finisher. To Howard E. Coffin was given the vision to inaugurate a gigantic air program which involved great possibilities. Circumstances, many of them entirely beyond his control, made it impossible for him to carry them out. It is the old story of the new superintendent of the shop who makes a great record because he is given power to carry out new ideas which those above refused to grant the older man.

The changes which have been made, separating the Signal Corps from the production work, and with John D. Ryan at the head of the production end, is full of promise. Mr. Ryan's experience has not been in airplane lines, but it has been along the line of getting things done, and that is the crying need at the present time. Assurance has already been given for the production of several hundred airplanes of an approved type without further changes. In other words the decision has been made, and it should have been made before, that it is better to have a thousand airplanes which are serviceable, even if not perfection, than to delay day after day until the perfect machine was developed. Any engineer knows that the perfect machine of any kind never comes to light. There is always some little change which may improve it somewhat. And the man who waits for perfection never gets anywhere with production.

Where Some of the Money Has Gone

There is much speculation among our worthy Congressmen as to what has become of the immense appropriation. And there is little wonder. For when $700,000,000 is spent with only one fighting plane to show for it the uninitiated may well wonder where it has gone.

But we must not forget that several thousand training machines have been built; that much money has been spent in equipping shops to make the Liberty motor, and that much has gone for experiments and for changes of various kinds. Then, too, there are thousands of parts of Liberty motors in the various shops in different stages of completion. These do not show on production, but they do account for many thousands of dollars.

As to where some of the money has gone I can only speak for the mechanical expenditures, and not for all of those. But there has been a tremendous amount spent for machinery and fixtures—some at very exorbitant prices. Just where the blame lies is not easy to say, but much of it can be accounted for if we look into shops where planes and motors are built, especially the latter.

The change from 8-cylinder to 12-cylinder motors necessitated buying much new machinery which could only be had at high prices. It also meant the scrapping of a large number of tools, fixtures and gages. These changes in orders, together with the alterations which have been made in the motor, meant over a thousand changes in tools and fixtures to one concern alone. These changes cost real money in these days of high prices and will account for much of the expense in this shop.

Another great difficulty has been the time required to get tools, fixtures and gages at a fair cost. Just how much of this is due to lack of skill on the part of the workman, the greed for huge wages or huge profits, or both, or to a deliberate holding back due to disloyalty, will never be known. It is, of course, just possible that the lack of skilled men has made it necessary to employ those who either require an unusual length of time or else spoiled several pieces before getting a good one. There is no doubt, however, that thousands of dollars have been spent in excess of the normal cost of tools and fixtures. There should be a careful investigation of these costs and of the toolmaking firms which charged them.

I have seen a comparatively simple boring fixture which should not have cost over $350 that was billed at $1800. I have seen a small gage that should not have cost over $35 for which a bill of $416 was rendered. This is either rank profiteering, a failure to get proper men, or to know how to handle them after they are secured. If these concerns do not make excessive profits at these prices they are badly managed, and should be looked into in any case. There is a feeling in some quarters that the toolmakers are not doing a fair day's work, which if true is just as much profiteering as excessive charges by proprietors.

There are millions of dollars invested in machines, tools and fixtures and gages, not to mention steel forgings, aluminum castings and other parts of motors. The same is true of the wood and other parts of the planes. The motors are coming through in fair quantities, and this can be readily increased when some one in Washington can be induced to order 1000 or 10,000 motors and allow no changes or other interference from any source. Then we could get motors that would drive

battleplanes or bombing planes, even if they were not perfection in every way.

The question of heavy tools for ordnance is unsettled, but there seems to be some signs of life and it is hoped that a definite program will soon be announced. While it is not necessary to know the exact design of the gun, though this would be highly desirable if we are to have any in use this year, we could certainly know the approximate size of the machines needed. If it is a question of whether a 10- or a 12-ft. boring mill is needed, 12-ft. mills should be ordered at once, and many of them. A few extra boring mills of large size will be handy to have in the country either now or later.

How Some Orders Are Placed

One section of the Ordnance Department has suggested quite a machine program, but it does not include the heavy tools, which are difficult to secure. Instead it calls for a large number of small lathes to be made by a firm who has never before built lathes or who at least are unknown in this field. The same is true of a large order for turret lathes. When the established builders of standard machines are building machines for stock to keep their organization intact for future orders it seems unwise to encourage new firms to go into this field. The idea of ordering machines for future use is good, but the judgment displayed in placing them or in proposing to place them is open to question.

Speaking of machinery brings up the question of duplication of machines in the different Government shops. Each of the base shops in France has complete departments which duplicate each other. Toolroom equipment, equipment for repairing optical instruments and other special machinery were duplicated in each shop. The same thing occurs in this country and in the same locality at times. The Signal Corps, the Inspection Division and the Navy may all have identical equipment within a comparatively small radius. Perhaps some of this may be necessary, but in any case it should be carefully looked into by someone who has the necessary and experienced judgment to make the most advantageous decisions.

The epidemic of criticism of reserve officers in Washington has not yet run its course, and Congress is still wasting time talking about the slackers everywhere except at the capital. The funny part of the matter is that more than one of the young reserve officers in the draft age, it is said, has been appointed at the urgent request of some member of Congress.

As I have said before there are very few slackers among the hundreds of young officers now in Washington. Many of these are trying to get assignments "over there" and are bitterly disappointed because it has been decided that they are of more service to the country in their present positions. Then there are the many officers who have dropped several thousand dollars a year, and who are still not free from the income tax as are the Congressmen. The more I see of the reserve officers the more I am impressed with the good work they are doing, often under difficulties, and it ill becomes Congress and newspaper editors to criticise them in the manner in which it is being done. They are not all perfect or 100 per cent. efficient—my acquaintance with men of that particular kind is decidedly limited.

This defense of the reserve officer is not in any sense a reflection on the regular army officers, for while it sometimes happens that we view things from different angles and that their manufacturing experience is more limited than that of production engineers and works managers, there is not a harder working, more upright or more dependable set of men to be found anywhere. They are loyal to the core and deserve larger salaries to keep within speaking distance of the increasing cost of living in these strenuous days.

Large Rifle Production

It may not be amiss to call attention again to the fact that rifle production is now going on satisfactorily. According to the figures given out by the Ordnance Department we are making nearly 10,000 rifles a day of the Springfield 1903 model and the new 1917 model commonly though perhaps incorrectly known as the Enfield. This is said to be twice as great as the present production in Great Britain. Both of these rifles are using the same ammunition, the Springfield cartridge, and it is interesting to note that in international rifle competition the United States has always been the winner.

In 1912, in Ottawa, Canada, the Springfield rifle made world's records at 800, 900 and 1000 yards, which still stand. It has defeated the rifles of 15 nations, and it is encouraging to know that the Mauser has always been defeated in every competition. Reports from our training camps also show the excellent shooting qualities of the new 1917 model. It is certainly gratifying to know that our boys over there are equipped with the best shooting rifles produced anywhere. Another advantage is the freedom from jamming of the rimless cartridge and the rapidity with which the magazine can be loaded and fired. The rifle is said to have from 30 to 50 per cent. greater rapidity of fire than the German Mauser.

There seems to still be some confusion as to the reasons for rechambering the British rifles to take the Springfield cartridge. But, as we pointed out at the time, the change was desirable in every way.

Although the Small Arms Division disappeared with the reorganization of the Ordnance Department the work of keeping track of production is still in the hands of Col. John T. Thompson, who is keeping close account of the output and is watching it increase with much satisfaction. To Colonel Thompson also belongs the credit of establishing the corps of rifle demonstrators at the different cantonments. These men are not only excellent shots, but they also understand the rifle thoroughly, both from use and from its manufacture in the shops. These men instruct green boys in the use of the rifle and show them how to care for it, with the result that a great number of excellent shots are being developed at the various camps. And this will all count when the new army really gets down to business in all its strength in front of the enemy.

The navy has, as usual, made an excellent name for itself, or it might be more exact to say that it has maintained its past reputation. But there are several kinks still in the system that delay the fitting out of a flying boat or other navy airplane with proper equipment of instruments. The "coördinator" seems to be as little in evidence as in other branches of the service.

This is because the varied equipment for an instrument board is not in charge of one department, but of three. Clocks and compasses, for example, come under the Bureau of Navigation; tachometers and some of the other instruments are handled by the Bureau of Steam Engineering, while the remainder, such as altimeters and the like, come within the province of the Bureau of Construction and Repair. There may be perfectly logical reasons for dividing up the instruments in this way, but when a man begins to collect the instruments for equipping a machine it is not as convenient as it might be.

Requisitions are required on all three departments, and it takes time and patience to gather the whole outfit together. Some sort of a shopping card, such as used by the larger department stores, would expedite matters considerably.

Another feature which sometimes causes confusion and accounts for the lack of uniformity in naval airplane instrument boards is the working of the seniority ruling as it relates to the officers in charge of the different divisions. The ranking officer has first choice in the location of the instruments in his division, and in some cases the least important instruments get first place, while the only location left for the compass has been so close to magnetic metals as to render it very unreliable until the arrangement was changed. A little untangling would help greatly.

Personals

Ray P. Johnson, manager of the Warner Gear Co., Muncie, Ind., will soon sail for France to engage in Government construction work.

A. E. Ward, formerly with the Prest-O-Lite Co., has been appointed sales manager of the International Oxygen Co., 115 Broadway, New York.

J. R. Dunsford has resigned his position as sales agent of the American Steel Foundries to accept a similar position with the Wheeling Mold and Foundry Co., Wheeling, W. Va.

S. H. Widdecombe, formerly connected with the New York office of Lewis F. Schoemaker & Co., Philadephia, is now in charge of the Washington office of the company in the Munsey Building.

Herbert H. Evans has succeeded **W. R. Walton** as sales manager of the Coatesville Boiler Works, Coatesville, Penn., whose sales office for Pennsylvania and Maryland is in the Morris Building, Philadelphia.

C. J. Wolf is now associated with the American Steel Co., Park Building, Pittsburgh, Penn. Mr. Wolf was formerly manager of the New York branch office of the United Smelting and Aluminum Co., New Haven, Conn.

F. E. Norris, for 11 years superintendent of the Farrell and Sharon, Penn., plants of the Carnegie Steel Co., has resigned, and will go to France to superintend the erection of a steel plant for the Berliet Automobile Manufacturing Co.

Fred B. Crosby has resigned his position in the power and mining engineering department of the General Electric Co., Schenectady, N. Y., to become the electrical engineer of Morgan Construction Co., Worcester, Mass. Mr. Crosby has specialized in electrical equipment for steel work.

A. L. Cromlish, superintendent of the Carnegie Steel Co.'s blast furnace at Farrell, Penn., has been elected a director of the Colonial Trust Co., succeeding **W. H. Davis,** who resigned recently to assume the management of the American Sheet and Tin Plate Co.'s mill at Morgantown, W. Va.

Henry Brewer, for four years a member of the Engineering staff of the Beloit works of Fairbanks, Morse & Co., and in charge of the development of oil-engine design, has resigned and will become chief engineer of the combustion-engine department of the Worthington Pump and Machinery Corporation at Cudahy, Wis.

O. J. H. Hartsuff, for a number of years superintendent of the New Castle, Penn., works of the Carnegie Steel Co., has been appointed superintendent of the Farrell and Sharon, Penn., works. **George A. Rigby,** for some years master mechanic of the New Castle works, has been appointed assistant general superintendent of the New Castle plant.

Charles Philip Coleman has been elected president of the Worthington Pump and Machinery Corporation, 115 Broadway, New York. Mr. Coleman advances from the position of vice president held since May, 1916. Prior to that date he was receiver of the International Steam Pump Co. and associate companies, which have been reorganized into the present corporation.

C. R. Dooley, manager of the educational department of the Westinghouse Electric and Manufacturing Co., has been granted a leave of absence in order to accept an appointment by the Government as director of the vocational educational project for army needs now being developed by the War Department Committee on Educational and Special Training. He will be located in the War Department at Washington. During Mr. Dooley's absence from the Westinghouse Co. duties there will be assumed by **C. S. Coler,** who has been appointed acting manager of the educational department.

Business Items

The Electric Tool Repair and Maintenance Co., Chicago, Ill., has moved its office and shop from 31 North Jefferson St. to 23-27 South Jefferson Street.

The A. M. Stockman Advertising Agency, 20 Vesey St., will move on May 1, 1918, to new quarters in the Shoe and Leather Building, 271 Broadway, New York City.

The Krasberg Manufacturing Co., Chicago, Ill., has moved into its new factory on the lake, at 536 Lake Shore Drive, opposite the municipal pier.

The Smith Gas Engineering Co. has moved into its factory at Dayton, Ohio, where the main offices of the company will be located. The factory at Lexington will be operated as usual on certain classes of work. All correspondence in the future should be addressed to the Dayton office.

Charles E. McGill, designer and builder of tools, dies and machinery, 34 Commercial Ave., Binghamton, N. Y., has incorporated his business and will build a machine shop at Floral Ave. and the D., L. & W. R.R., Binghamton, for the manufacture of heavy machinery. **Harry E. Holford,** mechanical engineer and draftsman of the Fairbanks Co., is associated with Mr. McGill. The new concern will be in the market for additional equipment of all kinds.

The Ott Grinder Co.—Albert J. Ott and his son Conrad have sold their controlling interest in the Ott Grinder Co., Indianapolis, Ind. With this sale Messrs. Ott agreed not to manufacture small cylindrical grinding machines for five years, but are privileged to build large swing machines, which they probably will do in the near future. The purchasers of the Ott Grinder Co. will continue the manufacture of small plain and universal cylindrical grinding machines under the management of Russell Fortune.

The Westinghouse Electric and Manufacturing Co. announces that on Apr. 1, 1918, the Copeman Electric Stove Co. was merged into a new company to be known as the Westinghouse Electric Products Co., with headquarters and factory at Mansfield, Ohio. This factory will be devoted to the manufacture of heating appliances previously made at the Newark works of the Electric Co. and the Flint, Mich., works of the Copeman Electric Stove Co. The general operations of the Westinghouse Electric Products Co. will be directed by W. K. Dunlap, assistant to the vice president of the Westinghouse Electric and Manufacturing Co., as general manager.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City. The May meeting, at which the subject of labor turnover will be discussed, will be held on Tuesday, May 21. G. R. Woods of the Allied Machinery Co. of America will be chairman of the meeting.

American Society of Mechanical Engineers. Spring meeting at Worcester, Mass., June 4, 5, 6 and 7, with headquarters at the Hotel Bancroft.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The next convention and exhibit of the Georgia Retail Hardware Association will be held at Savannah, Ga., June 4, 5 and 6, 1918, with the Savannah Hotel as headquarters. Exhibits and convention sessions will be held in the new municipal auditorium on Barnard St. Walter Harlan, 44 Boulevard Circle, Atlanta, Ga., is secretary of the association.

The National Gas Engine Association will hold its eleventh annual meeting at the Hotel Sherman, Chicago, Ill., June 3 and 4. The headquarters of the association are at Lakemont, N. Y.

The spring convention of the National Machine Tool Builders' Association for 1918 will be held Thursday and Friday, May 16 and 17, at the Marlborough-Blenheim Hotel, Atlantic City, N. J. Charles L. Taylor of Hartford, Conn., is secretary.

A joint convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held at Cleveland, Ohio, May 15-17. Among the important subjects to come up for action will be Government control of fuel, transportation and shipping of materials and price fixing. The coöperation of labor in war activities will also be discussed at length.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Cleaning and Rinsing Machine for Metal Parts
Ideal Concrete Machinery Co., Cincinnati, Ohio

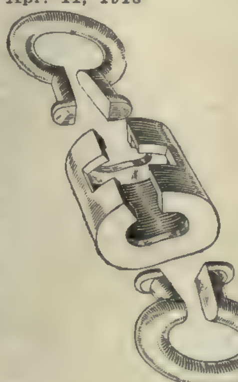
"American Machinist," Apr. 11, 1918

This is a batch process cleaning and rinsing machine, the outfit being especially adapted to removing grease and oil from stampings and drawn work which have heretofore been cleaned by dipping in soda kettles and by tumbling in sawdust. A feature of the machine is that the work can be automatically passed through the cleaning drum a number of times.

Grinding Stand, "Hummer" No. 271, Model F
Luther Grinder Manufacturing Co., 285-289 South Water St., Milwaukee, Wis.
"American Machinist," Apr. 11, 1918

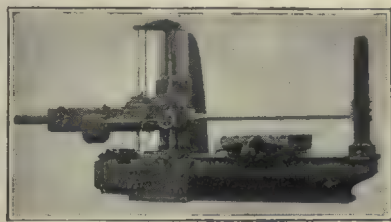
This company has recently made some improvements in its No. 271 "Hummer" grinding stand. The new model F is provided with a worm-gear drive instead of the cast bevel gears that were formerly employed. Ball bearings have also been incorporated to insure ease in running. The device is intended for use where it is not convenient to use power, the portable feature being of considerable advantage in some cases. As may be observed the device is driven by foot pedals, a seat being provided for the operator.

Link, Swivel Repair "One Minute"
Cleveland Galvanizing Works Co., Cleveland, Ohio
"American Machinist," Apr. 11, 1918



The device is made in three sizes, with either plain or waterproof finish, and may be used either as an ordinary repair link or as a swivel. Malleable iron is used, and the only tool necessary to apply it is a hammer, a pair of pliers or a vise. The ends of the pieces of chain to be joined are hooked into the two eyes whose flanged ends are then placed inside of the collar, which is hammered or squeezed together, preventing the separation of the eyes. The diameter of the eye in the three sizes is 3/16, ¼ and ⅜ in., while the over-all length is 1⅜, 1¾ and 2¼ in. respectively.

Boring, Milling, Drilling and Tapping Machine
Defiance Machine Works, Defiance, Ohio



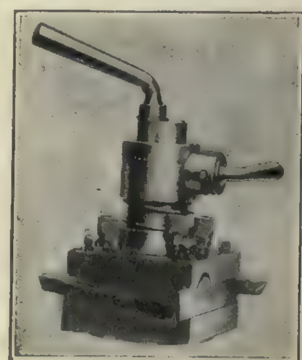
"American Machinist," Apr. 11, 1918

This is a combination machine for boring, milling, drilling and tapping, made in two sizes, Nos. 5 and 6. Maximum distances from top of platen to center of spindle, 25 and 37 in.; maximum distances from top of bed to center of spindle, 33½ and 47½ in.; number of speed changes, 10; number of feed changes common to all actuating screws and spindle, 12; weights, 12,000 and 25,000 lb.

Tote-Box Rack
New Britain Machine Co., New Britain, Conn.
"American Machinist," Apr. 18, 1918

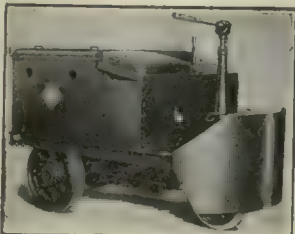
Rack for 6 x 10 x 5-in. boxes; Height of 6-box section, 3 ft. 11 in.; width of 6-box section, lower box to floor, 4 in.; height 11⅛ in.; depth from front to back, 18 in.; distance from lower box to floor, 4 in.; height of box space, 7 in.; width of box space, 10⅞ in. Rack for 20 x 12 x 6-in. boxes; height of 6-box section, 4 ft. 5 in.; width of 6-box section, 13⅛ in.; depth from front to back, 22¾ in.; distance from lower box to floor, 4 in.; height of box space, 8 in.; width of box space, 12⅞ in. Can be extended to any length or number of sections desired.

Toolpost, Turret
Craig & Coffman, 3714 Flora Ave., Kansas City, Mo.
"American Machinist," Apr. 11, 1918



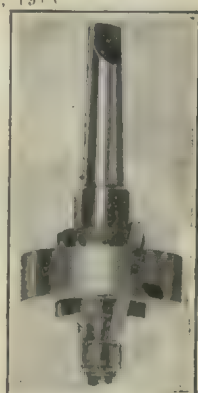
The device is made in two standard sizes, but can be had in larger sizes on special order. The larger size, No. 3½, is 3½ in. square and carries three ⅜-in. square cutters and one ¾-in. standard cutting-off plate. The No. 2½ toolpost is for bench lathes and is 2½ in. square, carrying three ¼-in. square cutters and one ½-in. cutting-off plate. The object of this tool is to place in a convenient manner the four essential lathe tools—roughing, finishing, threading and cutting off—as well as to make possible the rapid production of duplicate parts.

Tractor, Electric Type TA
Elwell-Parker Electric Co., Cleveland, Ohio.
"American Machinist," Apr. 25, 1918



The drive is single-worm reduction to the two wheels through a full floating axle, the steer being through the single front wheel by means of a hand-wheel or lever. Three speeds are provided in either direction, the maximum being 625 ft. per minute without load. A seat-actuated circuit-breaker is used. The tires are solid rubber of the press-on type, 20 x 3½ in. The frame is mounted on springs and is 70 in. long and 41 in. wide. The maximum drawbar pull is 850 lb. and the normal 300 lb. The battery used is a 30-cell Edison or a 16-cell lead-plate battery.

Facing and Counterboring Tool
Genesee Manufacturing Co., Rochester, N. Y.
"American Machinist," Apr. 25, 1918



For counterboring, facing and forming operations. The features claimed are that the chip space is not reduced by repeated sharpenings, and that no special jig or machine is necessary for grinding. In grinding, the blades may be tested with a square, and after being finished are replaced in their slots against the bushing, this automatically bringing each cutting edge into proper alignment. The blades are placed at an angle of 12 deg. for steel, malleable iron, etc., and radial for brass and other soft material. The tool is made with either two or three cutters. At present made in four sizes without outside diameters of from 2 to 4⅜ in. having facing capacities of from 1¼ to 3½ in. respectively. Shanks are Morse taper from No. 2 to No. 4.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Apr. 25, 1918	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$33.00
No. 2 Southern Foundry, Chicago......	33.00	33.00	.....
*Bessemer, Pittsburgh	36.15	37.25	38.95
*Basic, Pittsburgh	32.00	33.95	40.00
No. 2X, Philadelphia	34.25	33.75	40.00
*No. 2, Valley	33.00	33.95	38.00
No. 2 Southern Cincinnati	35.90	35.90	35.00
Basic, Eastern Pennsylvania	32.75	33.75	36.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Apr. 25, 1918	One Month Ago	One Year Ago	Apr. 25, 1918	One Year Ago	Apr. 25, 1918	One Year Ago
Structural shapes	$4.195	$4.195	$4.50	$4.20	$4.10	$4.20	$4.50
Soft steel bars	4.095	4.095	4.35	4.20	4.00	4.10	4.25
Soft steel bar shapes	4.095	4.095	4.35	4.20	4.00	4.10	4.25
Plates, ¼ to 1 in. thick	4.445	4.445	6.50	4.20	5.00	4.45	5.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Apr. 25, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.60
Warehouse, New York	4.70	4.25
Warehouse, Cleveland	4.10	4.00
Warehouse, Chicago	4.10	3.90

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Apr. 25, 1918	One Month Ago	One Year Ago	Apr. 25, 1918	One Year Ago	Apr. 25, 1918	One Year Ago
*No. 28 black	5.00	6.445	6.445	7.50	6.385	6.25	6.45	6.25
*No. 26 black	4.90	6.345	6.345	7.40	6.285	6.15	6.35	6.15
*Nos. 22 and 24 black	4.85	6.295	6.295	7.35	6.235	6.10	6.30	6.10
Nos. 18 and 26 black	4.80	6.245	6.245	7.30	6.185	6.05	6.25	6.05
No. 16 blue annealed	4.45	5.645	5.645	6.70	5.585	5.95	5.65	5.95
No. 14 blue annealed	4.35	5.545	5.545	6.60	5.485	5.85	5.55	5.85
No. 10 blue annealed	4.25	5.445	5.445	6.55	5.385	5.80	5.45	5.80
*No. 28 galvanized	6.25	7.695	7.695	6.50	7.635	5.75	7.70	5.75
No. 24 galvanized	5.80	7.245	7.245	9.00	7.335	8.00	7.40	8.00
*No. 26 galvanized	5.95	7.395	7.395	8.70	7.185	7.70	7.40	7.70

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Apr. 25, 1918	One Year Ago
New York	List plus 10%	List plus 25%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Apr. 25, 1918	One Year Ago
New York	$15.00	$9.50
Cleveland	15.00	7.00
Chicago	15.00	8.25

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

[illegible] ¼, [illegible]	21.00 @ 30.00
No. 8, [illegible] and No. 10	
⅛	
No. 12	
[illegible], No. 14 and [illegible]	
No. 18	
No. 20	

[1] Very scarce.

Cast-Iron Welding Rods

[illegible] by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

***Special Welding Wire**

⅛	33.00
[illegible]	30.00
[illegible]	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Apr. 25, 1918	Cleveland Apr. 25, 1918	Chicago Apr. 25, 1918
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel..	7.50	8.00	8.25
Spring steel (crucible analysis)	11.00	11.25	11.25
Coppered bessemer rods..	7.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel....	9.00	8.25	8.25
Floor plates	6.19½	6.00	6.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜..	44%	17%	¾ to 1½.....	33%	17%
½	48%	33½%			
¾ to 3......	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6......	47%	34½%	2½ to 4......	28%	15%
			4½ to 6......	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜..	40%	22½%	¾ to 1½.....	33%	18%
½	45%	32½%			
¾ to 1½.....	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4......	45%	33½%	2¼ to 4......	29%	17%
4½ to 6......	44%	32½%	4½ to 6......	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	42.8%	27.8%
3½ to 6 in. steel lap welded	18%	List	39%	25%	38.8%	18.8%

Malleable fittings. Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Apr. 25, 1918	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	34.00
Tin, in 5-ton lots	87.00	85.00	55.00
Lead	6.95	7.25	9.75
Spelter	7.00	7.75	10.75

*Government price.

ST. LOUIS

Lead	6.80	7.10	10.50
Spelter	6.75	7.75	10.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Apr. 25, 1918	One Month Ago	One Year Ago	Apr. 25, 1918	One Year Ago	Apr. 25, 1918	One Year Ago
Copper sheets, base	31.50-33.00	32.00	44.00	35.00	44.00	34.50	43.00
Copper wire (carload lots)	32.00	32.00	39.50	34.00	43.00	34.50	40.00
Brass sheets	30.75	30.75	45.50	30.00	43.00	30.00	43.50
Brass pipe base	36.50	36.50	47.50	41.00	52.00	40.00	47.50
Solder ½ and ½ (case lots)	62.00	62.00	33.88	49.50	33.50	50.00	34.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Apr. 25, 1918	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	29.50	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Apr. 25, 1918	One Year Ago	Apr. 25, 1918	One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	20.00	23.00	20.50	23.25
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Apr. 25, 1918	One Year Ago
New York	13.00	36.00
Chicago	12.50	37.00
Cleveland	15.50	35.00

Industrial Training for the War Maimed in Great Britain

By I. William Chubb

The general problem of the return of an army from war to ordinary industry has many phases, and nowhere is it more difficult of solving than in the case of men who are maimed or mutilated. The fact is being realized in all the countries actively engaged in the world war, and in Great Britain a fairly complete scheme of training men thus handicapped for the ordinary battle of life is in process of preparation and to an extent in actual operation. But some large proportion of it is on paper only.

UP TO the present it would appear that only about 7000 British maimed and disabled men all told have been restored to active occupation. Major Robert Mitchell, director of training at the British Ministry of Pensions, has informed the writer that at present about 2000 maimed men in Great Britain are in training, and that shortly there will be facilities for between 4000 and 5000 men. It is believed that if all the necessary machinery, material and otherwise, were available, accommodation could be readily provided for between 10,000 and 15,000 men. What this means in annual increase in British productive power will depend, of course, on the time of training, which necessarily will vary according to the physical and mental capacity of the individual and the particular activity he wishes to enter. The scheme as a national effort is quite new, and the government department concerned can hardly be blamed if everything is not absolutely ready yet or if some of the minor schemes, although intended to lead to permanent employment, are only of temporary value. Few people in Great Britain will question the national advantage of training such men. Burdened in any event by an enormous war debt and the changes it brings with it, to say nothing of heavy pension claims, the country after the war will need the maximum number of direct producers and the minimum of nonproducing consumers of wealth.

Clearly the problem is by no means simple even when the exact methods to be followed have been determined, for until the war is ended the total number of men to be provided for is a mere matter of estimate, while the course of the war itself determines day by day the number of individual cases that must be treated. How the number grows may be seen in the statement that up to the end of January, 1917, in Great Britain some 103,588 men, including warrant officers, noncommissioned officers and men, were officially returned as disabled through the war; by the end of April, 1917, the total of all ranks was 160,056, while by the end of September, 1917, the officers and men discharged from the army and navy were estimated unofficially at 225,000. These figures, the best at present available, are not exactly comparable with each other, but they

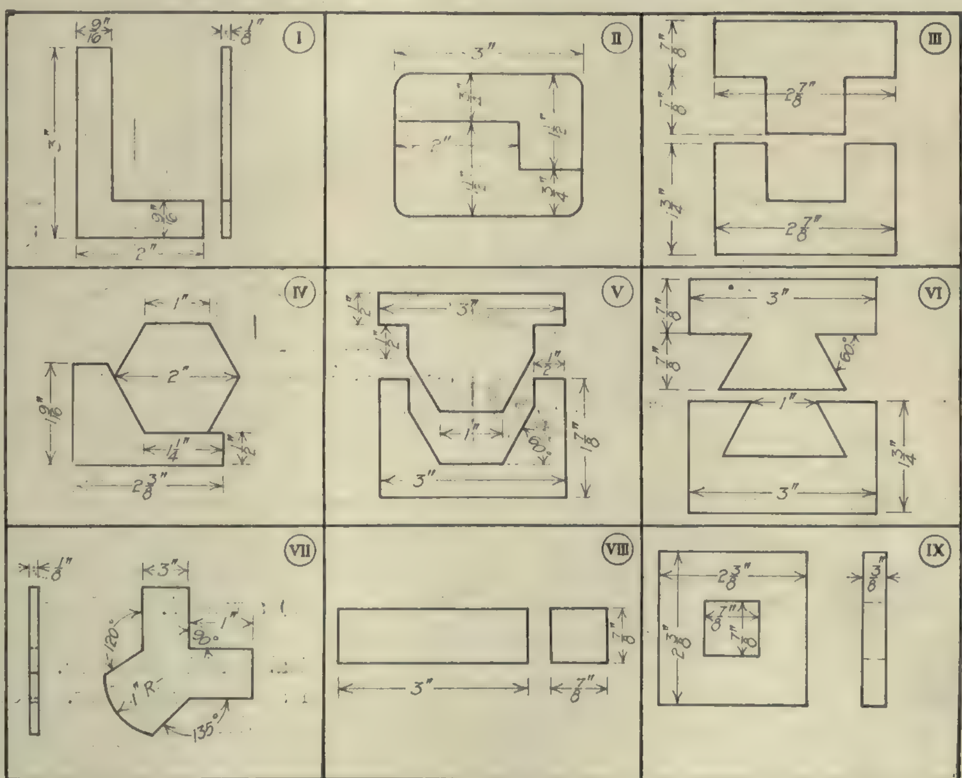


FIG. 1. ELEMENTARY COURSE IN BENCH WORK

at least show in a clear and general way a rapid increase. Analysis made of some cases prove that about 55 per cent. of the discharge of private soldiers is due to disease and 45 per cent. to wounds and injuries. Considering the total, injuries to the eyes account for a little more than 3 per cent.; injuries to the arms, about 10 per cent. (more than 8 of the 10 not requiring amputation); injuries to the hand not requiring amputation of whole hand, 6 per cent.; injury to leg, 15 per cent. (12 out of the 15 not requiring amputation), and injury to the head, nearly 5 per cent. Of diseases, chest troubles account for more than 12 per cent. (half of them being tubercular cases); heart troubles, 11 per cent.; rheumatism, 5 per cent., and nervous cases, nearly 5 per cent.; deafness (seldom total), 2½ per cent.; epilepsy and frostbite, 1 per cent. each, with insanity nearly the same, and paraplegic (paralytic) cases, about 1½ per cent. of the total. It is thought that the proportion of amputation cases will rise.

While the main efforts to restore wounded men to a self-supporting condition are and must be national and official, one or two are of a semi-private character, the most successful being in connection with the Lord Roberts' Memorial Workshops, some particulars of which are given below. As regards disabled soldiers generally, the process is as follows: The men are taken to large hospitals, and when they have received surgical and medical treatment they are usually sent to a convalescent hospital and finally are discharged with a pension. This pension varies both in accordance with the army rank and the actual disablement. Irrespective of any service pension, a disabled private soldier gets 27s. 6d. ($6.60) a week if the degree of his disablement is regarded as 100 per cent., pensions diminishing according to disablement to 5s. 6d. ($1.32) a week for privates with a 20-per-cent. loss. For anything lower a gratuity is granted.

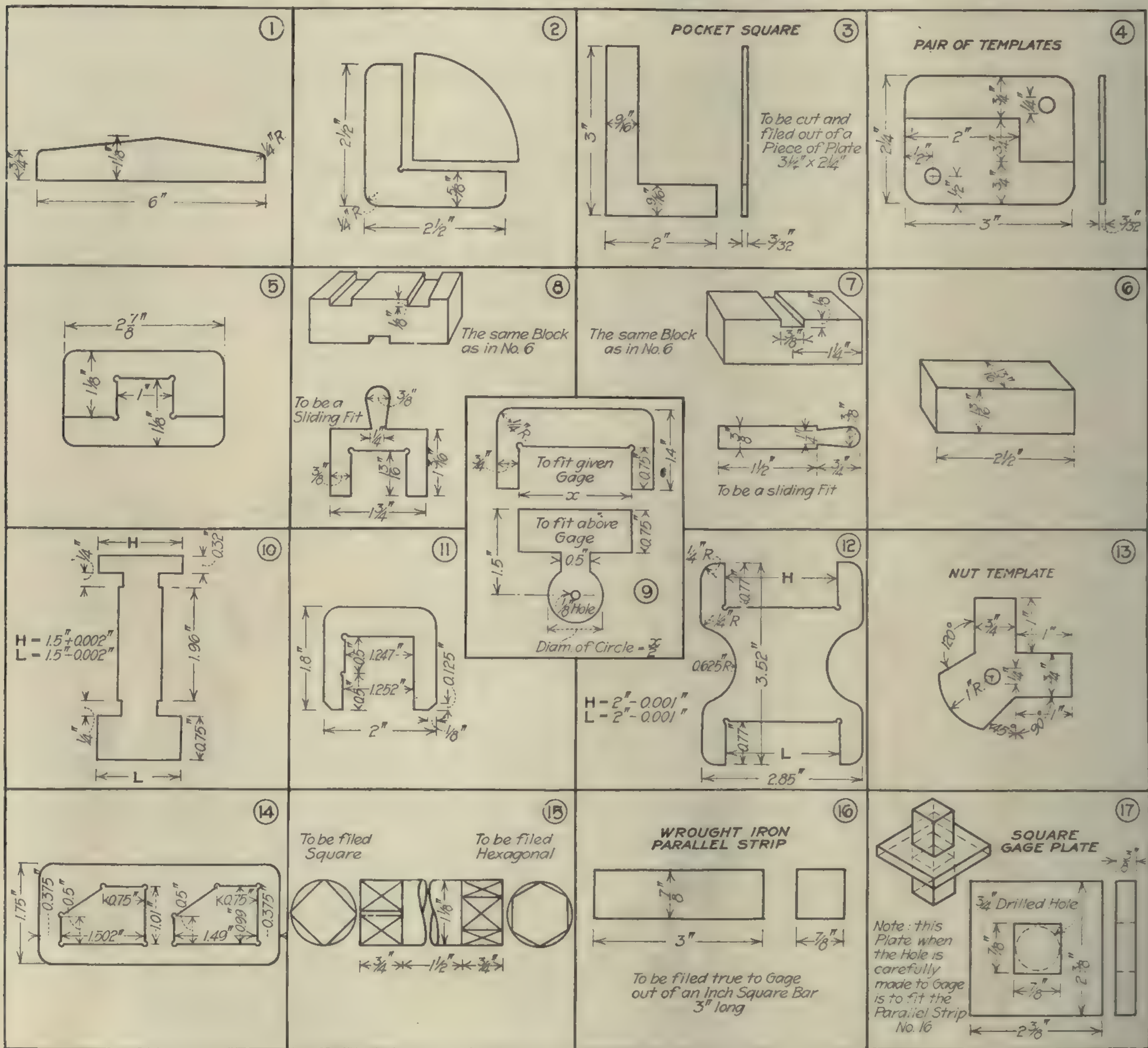


FIG. 2. ADVANCED COURSE IN BENCH WORK

The specific injuries regarded as constituting 100-per-cent. disablement include loss of two or more limbs, loss of an arm and an eye, loss of a leg and an eye, loss of both hands or of all fingers and thumbs, loss of both feet, loss of a hand and a foot, total loss of sight, total paralysis, insanity; wounds, injuries, or disease resulting permanent disability; wounds of or injuries to in-

ternal, thoracic or abdominal organs involving total permanent disability; wounds of or injuries to head or brain involving total permanent disability or Jacksonian epilepsy; very severe facial disfigurement, and advanced cases of incurable disease.

The full list is not given here, but it may be said that the loss of a leg at the hip or right arm at the shoulder or total loss of speech is regarded as an 80-per-cent. disablement, giving 22s. ($5.28) a week; total deafness, 70 per cent., with 19s. 3d. ($4.62) a week; loss of vision of one eye, amputation of leg below the knee, or of left arm below the elbow, 50 per cent., with 13s. 9d. ($3.30); loss of thumb or four fingers of right hand, 40 per cent., with 11s. ($2.64), and loss of two fingers on either hand, 20 per cent., with 5s. 6d. ($1.32). These rates are for privates, as stated, but a warrant officer may get 42s. 6d. ($10.20) a week for 100-per-cent. disablement down to 8s. 6d. ($2.04) a week for a 20-per-cent. disablement. Due account is, of course, taken of men who are left-handed. Widows get at least 13s. 9d. ($3.30) a week, and as regards children under 16 years of age the allowance varies according to the degree of disablement of the man, being 5s. ($1.20) a week for full disablement for a first child, 4s. 2d. ($1) for a second, 3s. 4d. (80c.) for a third, and 2s. 6d. (60c.) for each other child.

These pensions are payable in recognition of injuries, and once allowed are permanent. If a man returns to employment no deduction is made, whatever his earnings may amount to; neither is the employer encouraged to pay lower than the average wages because the man he employs is wounded. In one center at any rate, the experience has been that it is the wounded who offer themselves at lower wages and not the employer who takes advantage of their condition. The labor market at present, however, is abnormal.

Efforts Being Made to Train the Maimed

A man in the hospital is still in the army, but when discharged he returns to civil life. Consequently it is during the hospital period that attempts are made to interest him in his future and to direct him to a consideration of the training that will be necessary. No compulsion is ever exercised; if a man chooses merely to exist on his pension no one can stop him from doing so, but in various ways he is prevailed on to consider his future and in particular the means by which he can obtain training. Discharged from the hospital he comes into touch, through the nearest post office if need be, with one or other of the local committees which to the number of 300 or so have been formed throughout Great Britain.

Acting in concert with the Ministry of Pensions, these local committees form the real basis of the training scheme for a given district. Reports are made to them as to the number of disabled men in or coming to their district, and in accordance largely with the energy with which the committees work the men are given such training as may be necessary. The committees become responsible for pension allowances, medical attention and for technical training, their duty being to discover the natural or acquired bent of the men. The training is free and extends roughly from six months to one year, and here it is perhaps fair criticism to point out that the time allowed is insufficient, particularly as the man is in some respect or other disabled. Of course a large number of men recover almost completely, but a maimed man is necessarily of lower personal efficiency than an able-bodied one. The training must be for a definite useful purpose and in a direction that may fairly be regarded as leading to permanent employment at a minimum wage of between 30s. ($7.20) and 35s. ($8.40) a week.

No training is given unless there is a reasonable assurance of the man who submits himself to it being regularly employed, and the work is done in connection with the national system of employment exchanges. During the training the man is in receipt of a full pension, on the 100-per-cent., i. e., 27s. 6d. ($6.60), basis. In addition he has a grant of 5s. ($1.20) a week, which is not paid, however, until he has completed the course, the lump sum being then regarded as acceptable to him for the purchase of such small tools and implements as may be necessary for the industry he is entering. Any medical treatment required is continued, and if the man has to live away from home during the training period 13s. 9d. ($3.30) a week is paid to the wife, with the allowances on the full disablement basis for the children.

A great difficulty is to get the men to see the need for such training. Army service has never been regarded in Great Britain as a good preliminary to industrial life, and the wounded man, particularly if he has been a long time in the hospital is often found rather careless of the future and indisposed to any sustained exertion. Another difficulty is with men who before the war had never any definite line of work. The already-trained man when able will return to his own work, but where, by reason of the injury, this cannot be done it is often found possible to employ him in some related capacity. For instance, provided in other respects he is suitable, a producer readily becomes a salesman; in fact in some respects he possesses advantages over the usual run of that class. It is the dead-end worker who is most difficult to train.

Men Helped to Decide What to Do

In deciding on the actual trade to be entered both the man and the committee, helped possibly by a panel of employers and employed, will, of course, be guided by the particular disability. Some preliminary training is given in workshops attached to hospitals, as at Roehampton and Brighton, where three or four hours daily may thus be spent and where interested officials give all the advice that can be offered. At the centers the man must complete the training before he gets the 5s. ($1.20) a week lump-sum bonus, and generally, as at the Polytechnic, Regent St., London, W., to which we shall refer later, he is not sent away from training until he has actually obtained properly-paid employment.

The system is necessarily imperfect, but will improve with time. While, on the one hand, men will not always apply for training, on the other, complaint has been made that they have had to wait unduly long. Not only are buildings and equipment necessary, but a sufficient staff of fully qualified instructors is above all essential, and this has not yet been achieved. The general system by which the actual course of training is decided has also been criticised, as it may mean travel from one local committee to another, and there have been cases where men have been sent to a special technical examiner and then to a trade panel. The cost of travel is provided.

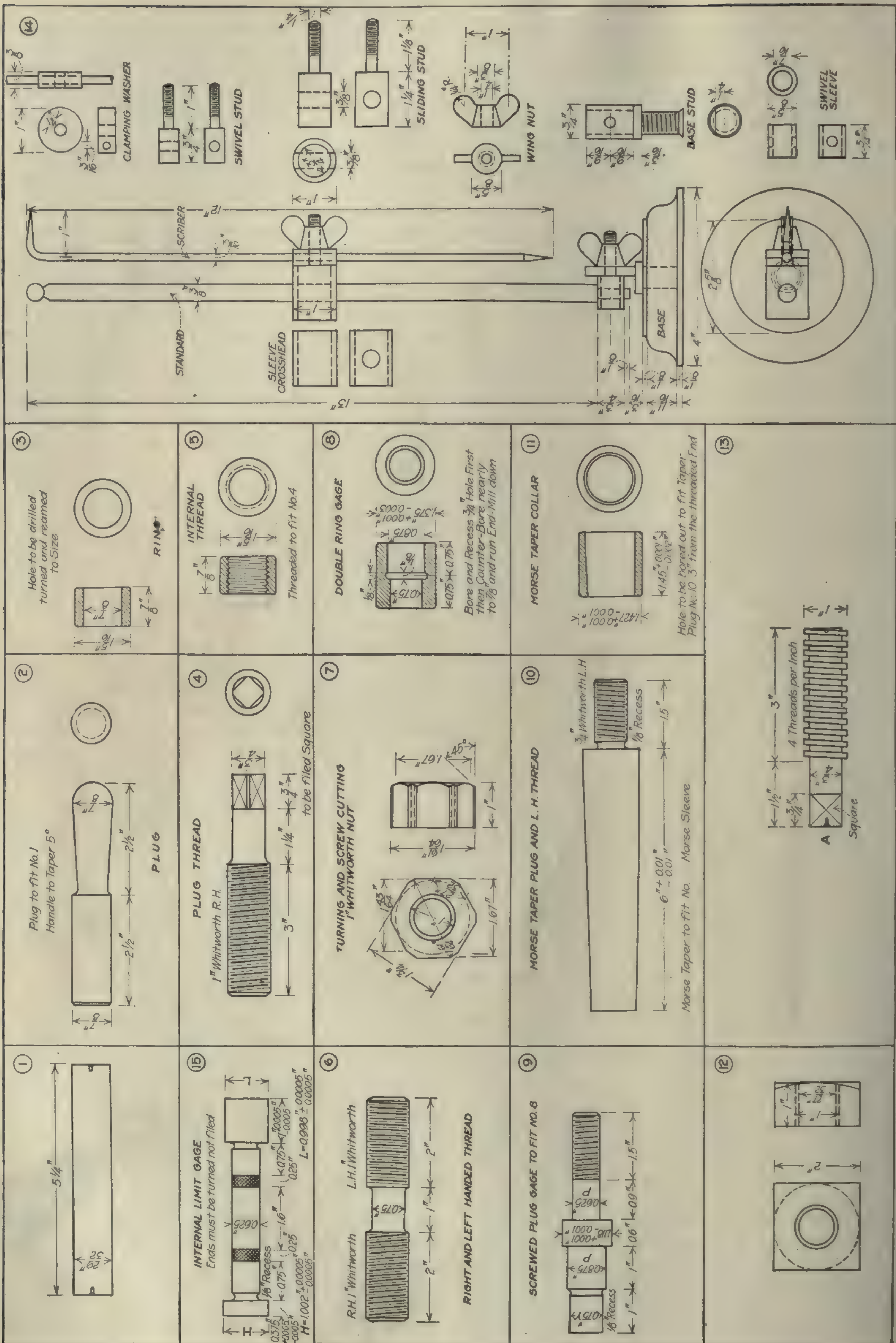


FIG. 3. COURSE IN LATHE WORK

No doubt defects of this kind will be minimized as time passes. The reason why a large number of the men do not apply is that they readily find employment even when untrained, the demand for men of all kinds in industry and commerce in Great Britain being larger than the supply, and ready money is always attractive, while foresight is uncommon.

The training of the disabled man is usually given in classes which are in existence or to be formed in nearly every technical institute in London and in about 80 provincial centers. Where possible he attends a course and the ordinary fees are paid by the pension authorities. In other cases the institution receives sums that are severely restricted to extra out-of-pocket expenses, the time of an instructor ordinarily engaged in such work not being considered. For example, take the case of the Polytechnic, Regent St., London, W. By the middle of January of this year this institution has trained and placed 366 men. Of these less than 3 per cent. failed to complete the course, and nearly all of them expressed their satisfaction with the work they had found, stating also that the training received was just what they desired.

The work here comes under eight headings: Engineering, two months; electrical, six months; cinema work, three months; tailoring, one year; architecture, one year; commercial, six months; photography, six months; and art, the last being a new departure, at present undeveloped. At the middle of January, the time of the visit of the writer, some 203 discharged sailors and soldiers were entered and working as students, and the various subdivisions are as follows: Engineering (under special scheme)—Fitting, 48; turning, 13. Electrical—General, 41; electrical testing (R. E.), 5; Cinema work, 16. Tailoring—Sewing, 21; cutting, 5. Architecture, 25. Commercial, 23. Photography, 5. Art, 1.

Special Course in Engineering

The engineering course, as at present conducted, is special. It is for a definite purpose, mainly for the production of gages, etc. The men will be found occupation, but it will be of a war character and therefore not necessarily permanent. Arrangements have consequently been made for them to return to the Polytechnic if necessary. A syllabus of the work follows which also shows the courses in grinding, milling and drilling when these are held.

Fitting—(Course from 8 to 10 weeks)—Marking out work (simple); various types of files and tools; how to use a file; filing a straight edge; fitting pair of square templets; filing a square block to dimensions; fitting male and female gages; fitting a single key to fit keyway; filing to a circle; making internal gage to external limit 0.0002 in.; filing to internal circle, special limit gage; filing internally to a pair of pentagons; marking out, from a circular bar, and filling square and hexagon ends; filing and fitting special tongue and fork joints; horseshoe limit gages.

Turning—(8 to 10 weeks)—Explanation of lathe; various tools used and names of same; marking out work, various methods; facing and centering work; turning work parallel to two dimensions; turning work both parallel and taper by hand; boring a parallel hole and square centering; uses of micrometer; limit gages and verniers explained; turning plug to fit parallel hole; explanation, calculating simple gears for screw cutting; fitting gears and cutting an even V-thread; boring and internal screw cutting to fit above; cutting from bar, left- and right-hand even thread; boring to a ring gage, two dimensions; turning a double plug gage with an odd left-hand thread one end; boring a taper ring gage to fit above plug gage; turning an internal limit gage to a limit of 0.002 in.; (this exercise includes knurling). All the above exercises require the men finding their own tools to suit their work.

Grinding—(8 to 10 weeks)—Explanation of machines; fitting of emery disks; parallel grinding to a limit of 0.001 in. external; parallel grinding to a limit of 0.001 in. internal; taper-grinding external and internal to a limit of 0.001 in.; grinding cylindrical gages to a limit of 0.005 in.; internal cylindrical ring gages to a limit of 0.005 in ; surface grinding special flat gages; surface grinding to special limit horseshoe gages; grinding parallel reamers; grinding taper reamers; grinding milling cutters, fluting and backing-off.

Milling—(3 weeks)—Explanation of machines; fitting milling cutters; squaring of work to machine bed; plain parallel milling; slot-milling; milling of tongues to suit above; mill gaging; milling special job with gang; explanation of dividing head; milling gear wheels; fluting taps and reamers.

Drilling—(3 weeks)—Explanation of machine; drilling with straight-shank drills; drilling with Morse-taper drills and fitting sleeves; radial drilling machines and drilling large holes; drawing over center chisel, center incorrectly marked; using various appliances on drilling machines, using self-feeding taps; jig drilling of work and cross drilling.

Part of the course for fitters is shown in Figs. 1 and 2 and the turning work in Fig. 3.

Leg cases are not uncommon on the engineering side. It is the man with his right arm missing who is the most severely handicapped for the future. Generally in engineering, after preliminary instruction and exercise, the men are put on production work as quickly as possible with a view to showing commercial requirements.

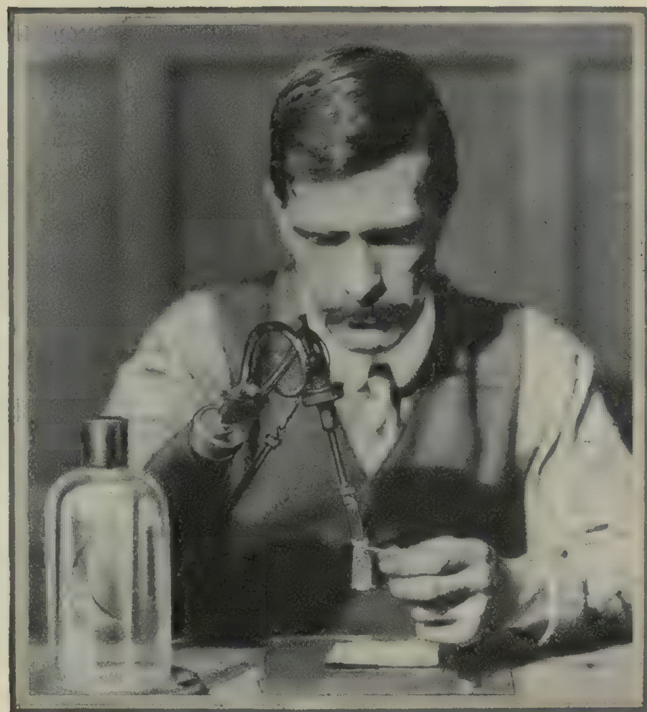


FIG. 5. WORKING WITH AN APOLOGY FOR A HAND

On the electrical side (a portion of which is shown in Fig. 4) the man first works on the theoretical side and on general electric problems, specializing later on some particular line. The work is done with a view to country-house lighting, telephone work, switchboard attendance, magneto repairs, cinema operating, etc. The extent of the training varies somewhat, but in the last branch the practical end of the trade is taught, with a little technical training in the electrical laboratory.

Then those who desire to become general electricians are given experience on more difficult work, such as on lamps of all kinds, radiators, control appliances, repairs and attendance, and, in fact, help to keep the institute itself in running order.

Elevator attendants would include men with an amputation of either leg or arm. After learning the elementary principles of motors, bells, indicators and wiring, they are taught how to clean the elevator-control gear, the safety gear, etc., with hints on faults, care of the electrical apparatus, general maintenance, and so on.

A telephone attendant employed at the Polytechnic

walks about without the aid of a stick, although both feet have been amputated. Switchboard attendants, often with an artificial arm, are trained in the elements of electricity, dynamos and motors, various kinds of switch gear, the principles of fuses, etc., the starting up of motor generators, the reading and connection of instruments and the principles of alternating currents, while a finishing course is given at certain substations in the district in order to show the actual use of the switchboard. In fact, where a firm requires such a man they may have him trained during the last fortnight or so of his course on their own switchboard. The man with a missing right arm is badly handicapped, but such a man, trained at the Polytechnic, is shown in Fig. 5, and is steadily occupied at instrument repairing at the present time.

The training in magneto work occupies three months and is regarded as suitable for men with single or double leg amputation, but generally the Polytechnic authorities require that men entering this course be previously assured of employment in the line. The work includes the theory of the magneto, the taking apart and assembling of apparatus, simple repairs on the lathe, drilling machine, etc., fitting and adjusting ball and other bearings, making templets, jigs, etc.

FIG. 4. ELECTRICAL TESTING

FIG. 6. OPERATING MOTION-PICTURE MACHINE

As to cinema work (Fig. 6), the demonstration, operation and management of films is under the control of a representative of a local firm, and if it is known that the maimed man is going to a place where petrol or gas engines are employed to run the generator, special training will be given. Elevator attendants, by the way, are certified by a firm of elevator manufacturers before being passed out of the shops.

Other work in this line is in electrical testing, repair and inspection for the army-signalling section, mainly as related to wireless telegraphy, the Polytechnic having a 1½-kw. wireless set for training purposes. Here again the men can come back for further training, as the work is regarded as special. Work being done by disabled men at the coppersmithing bench is shown in Fig. 7.

The tailoring instruction, which hardly comes within our special purview, is very detailed and carefully graded, for it is recognized that at least 12 months is required for instruction. In fact, if a man becomes qualified as a trousers maker in this space of time he will be doing as much as could be expected. With special preparation he can also receive instruction in coat making and also be trained in ladies' tailoring. Each class in these trades consists of not more than 10 students, and workshop accommodation is provided. Apart from the ordinary daily supervision and examination of work by the class director, periodical inspections and examinations are made by an advisory committee, including representatives of employers' and workmen's associations. The sewing course is restricted generally to men who have both hands, and all must go through this course before they can take up cutting, because it enables them to understand the building-up of a garment. For cutting, however, the men cannot sit.

In architecture the main idea is to turn out clerks and draftsmen, men who have previously worked in some capacity in the building trades supplementing here their previous practical experience. Engineering draftsmen are also being trained along similar lines, one instance being that of a locomotive driver who was offered employment in the draughting room of his company if he would qualify himself by attending the course provided for this purpose.

To give an idea of the curriculum, the time-table for the day school in architecture is submitted:

Subjects and Hours per Week—Building construction (structural and sanitary engineering), lecture, 3 hours; builders' quantities, lecture, 1 hour; geometry, lecture and drawing, 3½ hours; mathematics, lecture, 2 hours; art drawing, drawing, 2 hours; land surveying, lecture, 1 hour; draughtsmanship, studio work, 21 hours.

Monday—9:30 to 1, geometry; 2 to 4, constructional drawing; 6:30 to 7:30, builders' quantities; 7:30 to 8:30, engineering (structural).

Tuesday—9:30 to 1, constructional drawing; 2 to 4, constructional drawing.

Wednesday—9:30 to 1, constructional drawing; 2 to 4, constructional drawing; 6:30 to 7:30, individual tuition, constructional drawing; 7.30 to 8.30, engineering (structural).

Thursday—9:30 to 1, constructional drawing; 2 to 4, art.

Friday—9:30 to 1, constructional drawing; 2 to 4 practical mathematics; 6:30 to 7:30, land survey and leveling; 7.30 to 8:30, engineering (sanitary).

The classes, as will be seen, are held in the evening. These, however, are not obligatory for the disabled men, the day course being held to be sufficient. The evening classes form part of the ordinary work of the institute. Here, as in other cases, the wounded men take their places beside the ordinary day or evening students. This is a course followed wherever possible, as it helps a man to occupy his ordinary position in the world.

The commercial classes are for leg cases mostly, but

they contain some one-armed men. The work period is from 10 to 12:30 in the morning and from 1:30 to 4:30 in the afternoon. It includes English and commercial correspondence, commercial arithmetic, commercial geography, bookkeeping, business routine and commercial practice. Neither shorthand nor typewriting forms part of this course, the omission of these subjects being intentional, as it is thought that whatever present conditions may be there will be no shortage in these occupations after the war. One thing is recognized nevertheless, and that is a systematic course by which men can be taught to write with their left hand.

FIGS. 7 TO 10. SOME OF THE VARIOUS KINDS OF WORK PERFORMED

Fig. 7—Coppersmithing. Fig. 8—Substation operator with false arm. Fig. 9—Tinsmith work. Fig. 10—Operating a drilling machine with an artificial arm and hand

In photography two courses have been arranged, one leading up to the making, development, printing, etc., of negatives, with special lessons in studio work, and the other dealing with retouching, black- and white-chalk finishing in brush and wash work, or with the airograph and the coloring of prints by various methods.

The Polytechnic students have no difficulty in obtaining and keeping situations in the ouside world, and a record is kept of discharged disabled men, fitted with artificial limbs at Roehampton, and of others who, after a course of instruction at Regent St., W., have been placed in permanent situations. This record is the best testimony to the work accomplished. The first case is that of a man who, coming from the Royal Engineers with shrapnel injuries to his hand and with his right arm partly paralyzed, was given electrical training and is now engaged on maintenance work for a municipal electricity-supply organization at a wage of £2 5s. ($10.80) a week to start. Those taking electrical training started at 35s. ($8.40) a week; munition workers began at wages of from £2 17s. 6d. ($13.80) to £3 10s. ($16.80) a week; other men are earning sums anywhere up to £5 ($24.00) a week; a fitter at a Manchester engineering shop who was disabled by a high amputation of his right leg and other disabled men received 46s. ($11.04) a week to begin with; many men are working on the lathe at similar rates; coppersmiths with injured and amputated legs received 45s. ($10.80) a week plus their subsistence allowance of 17s. 6d. ($4.20); a number of other lathe hands received £2 ($9.60) a week to start; a man with curvature of the spine is employed on grinding machines at £2 10s. ($12.00); fitters at airplane works earn 10d. ($0.20) and 1s. ($0.24) an hour, and so on.

A glance at the list should encourage any disabled man to undergo one of the courses provided, even if only for the acquisition of the knowledge and skill. A man with a false right arm, in charge of an electrical sub-

station, is shown in Fig. 8. A tinsmith, now engaged in a colliery in the maintenance of lamps, appears in Fig. 9, and a man on a drilling machine (the artificial arm is of an old type) is illustrated in Fig. 10, all of them being Polytechnic trained

The Lord Roberts Memorial Workshops are of a somewhat different character and form no part of the state scheme. Their purpose is both to train men and to provide them definitely with employment. Except that the man must be a discharged wounded soldier, no other qualification is required. No red tape has to be cut or unwound; the man makes personal application, and in more than one instance, after being told the rules and regulations, has within half an hour been engaged for a job which might be permanent. After the course of training, the man if he chooses can pass out to some other employment, but most of them stay, there being now approximately 750 men working, while the total admitted is about 1100.

The factory is run as closely as possible on modern lines, the work being highly subdivided and various fitments devised to compensate for a man's disability. Every endeavor is made to find the work that will suit the man. Figs. 11, 12 and 13 illustrate various sections of the factory.

The ultimate aim is to provide places for 5000 of the disabled. The organization was started in a relatively small way in 1904, but at the outbreak of the war it was seen that its scope and opportunities had largely increased, and workshops were therefore opened in Fulham, London, S. W., with the object of making toys. In about nine months 80 different kinds of these articles had been produced in quantities and 100 disabled men were engaged in the work. It was then seen that for various reasons provincial branches would have to be opened, and in all there are some 11 factories, each self-contained, and all, so far as possible, coördinated.

The London branch is concerned now with toys, household articles, baskets, cardboard boxes and furniture. So that the last section may be entered more quickly, a new three-story factory has been begun, and furniture of all kinds from the commercial to the most artistic type will be produced. Belfast branch is for general woodwork; Birmingham for metal work; Bradford mainly for printing (it supplies all the labels, show-cards, etc., for the various branches); Brighton for games; Colchester for poultry appliances; Edinburgh for brushmaking; Liverpool for household utilities; Newcastle for tinware; Nottingham for baskets, brushes and cane articles, and Plymouth for joinery. The practice is, where possible, to buy an existing works with its goodwill and thus make a start.

FIG. 13. ONE-ARMED MEN OPERATING WOOD PLANER

The work is in no sense charitable, and the organization must pay its way. In London a man starts at £1 ($4.80) a week, is quickly raised to 22s. 6d. ($5.40), and then automatically at the end of another three months receives 25s. ($6.00) a week. Afterward his wages will depend on himself. All who receive more than 25s. ($6.00) a week, and most do, also receive an extra war bonus of 3s. ($0.72) a week. In London it is found to be of advantage to employ girls and women relations of the men on work that the men do not care to do, such as the dressing of dolls. Thus at Fulham, in addition to about 260 men, are about 50 women, making a total with the office staff, etc., of say 330.

As stated before, the workshops are intended to be self-supporting, and any profit that may be made is directly or indirectly divided among the workers, who are consulted as to the means to be adopted. The work-

FIG. 11. THE CABINET SHOP

FIG. 12. THE JOINER SHOP

shops receive grants from the memorial fund in aid of equipment and to form a certain amount of working capital, and on this grant no interest is charged, the idea being partly to balance the handicap under which the workshop starts in having to take disabled men who are generally untrained. In certain respects the workshops are greatly handicapped, as they take one-armed men, who are usually the least able of the maimed.

The balance sheet for last year is not yet available. In 1916, dealing chiefly with wholesale firms, the London workshops had a turnover of £48,000 ($230,400), and the profit on this, amounting to £960 ($4608), was expended in the purchase of a house near by, which is to be fitted up as a small hospital where disabled men can receive massage and such other treatment as may be necessary without having to give up their time to attend the regular hospitals.

The new factory building will also have a canteen.

Military Trade Schools at Washington (D. C.) Barracks

The necessity for speed in the repair and demolition of various structures used in the present conflict has made new demands on the process of oxyacetylene welding and cutting. Before the war this process had already become of general application in all branches of industry because of its great speed and still greater convenience. War has seized upon it as a means of solving important structural problems. Bridges damaged by shell fire may be repaired by the use of this process, or removal expedited to make room for a new structure. The ease and speed with which heavy members may be cut and a bridge rendered useless to the enemy has also made the oxyacetylene torch a very efficient weapon of defense.

The uses to which oxyacetylene may be applied are infinite, and one of them is the repair of stationary machinery. Cylinder heads may be mended, crankshafts restored and boiler tubes patched without being removed from their places. The most notable example of this process was the repair of the engines in the German steamships which the German crews tried to destroy before the United States took possession of the vessels. With an oxyacetylene torch, captured guns which cannot be moved may be rendered useless in a few minutes and an auto truck that has to be abandoned may be turned into a pile of junk in the same time.

The process of oxyacetylene welding and cutting is of such value in the present struggle that it has led to a demand for operators and equipment and it is for the purpose of supplying the workmen that a course in oxyacetylene welding and cutting is to be opened at the Military Trade Schools, Washington Barracks, District of Columbia, on May 1, 1918.

The course has been carefully worked out and designed to fit men to cope with all military problems involving cutting and welding in the field. Sixty men from the First Replacement Regiment of Engineers will take up the study. They will be taught metallurgy in connection with the welding of cast iron, steel, malleable iron, aluminum, copper and other metals. A study will be made of the gases, metals, fluxes, torches, valves, regulators, storage tanks, generators, etc.; also the effect of variations from the neutral flame, and of precautions to be taken with the equipment. The necessity of preheating and retarded cooling for large work will be taught. Thorough instruction in the danger of back firing in the torches and the precautions necessary for the protection of the eyes will be given. A selection of special tips and gas mixtures for various classes of work and the tricks of the trade incident to welding intricate parts of automobiles, tractors and tanks will be demonstrated.

Practical welding will be done on light and heavy work of sheet iron, steel, cast iron, malleable iron, brass, bronzes, aluminum, etc. The men will clean, chamfer, line up and preheat (when necessary) the metals which they are to weld. There are ample facilities for testing welds and thus correcting faulty work.

Besides the School of Oxyacetylene Welding and Cutting there are now in operation at Washington Barracks, schools of photography, lithography, reproduction, blacksmithing, horseshoeing, auto repairing, internal-combustion and gas-engine work, machinery (both bench and machine work), carpentry, surveying and drafting. The intention is to train all replacement troops in these schools until every man becomes proficient in some trade. It is expected shortly to begin the organization of schools in masonry, electric light and motor installation, and in rigging and moving heavy loads.

The schools are organized for the First Replacement Regiment of Engineers at Washington Barracks, District of Columbia. They are part of a three-months' training course through which selected men chosen from the national army or by enlistment are sent. The first month is spent in learning infantry drill, manual of arms and the many details of a soldier's life. The second month is spent at Fort Foote in rifle practice, engineer drill, bridge building and general construction. The fort is an old Civil War post overlooking the Potomac River 10 miles below Washington.

The third month is spent at Washington Barracks in the trade schools. Intensive study is demanded during this period to give the recruit the self-confidence and power to perform the skilled service required of the engineers.

Accident to Chain Hoist

By B. C. Hecker

An accident which happened in the shop recently prompts me to offer a suggestion for safety. The upper hook on a chain hoist straightened out because of overload, allowing the hoist to become literally a "chain falls." The fact that the hoist was overloaded and that the hook did not break exonerated the makers, but did not help the man below. Both upper and lower hooks appeared of the same dimensions.

The suggestion I offer is this: The upper hook should be the strongest member in the line from hook to hook, it being in an obscure position when in use and having to take the weight of the hoist and the pull of the hand chain besides the load. Allowing other conditions to be the same, if the upper hook were made 10 or 15 per cent. stronger it would make the lower hook the weakest member in the line, and that hook could be watched for signs of overload.

Chicago Meeting of the Chamber of Commerce of the United States

The meetings of the Chamber of Commerce of the United States are never without interest. Composed of men who head the industries and who from this point of vantage are able to sense the actual conditions all over the country much quicker than others, the two addresses here given will explain what is needed to promote a better understanding between the business element and those whose labor is equally important.

A MEETING of the Chamber of Commerce of the United States was held recently in Chicago. Among the addresses delivered was one by the president of the body, R. Goodwyn Rhett, and one by Edward A. Filene, both of which are here reproduced. Mr. Rhett's remarks were as follows:

"I want to talk to you about the typical business man of America, the business man with high ideals and high purposes, for which he is finding in this Chamber of Commerce of the United States the opportunity to give fitting expression. I want to talk to you about the part he has played in the making of America, about the part he is now playing in the saving of America, and about the part he is going to play in the building up of America to a still nobler estate and a still higher place among the nations of the earth.

"The resources of the country itself as it now stands are great indeed, but the present extent of this country and the present development of those resources are due to the genius, the enterprise and the energy of the people, and the opportunity for their exercise under its form of government. The development of the resources of America has been very largely due to the leadership of the business man who had the vision and the courage to follow that vision to realization. But if the development of these resources were the sole achievement of its people I would find little pride in the part which the business man of whom I speak has played in it. It is not alone the material growth and expansion of America of which we are proud, but also its spiritual development into the great champion of human liberty in its broadest and highest sense.

"When the President sounded his clarion call on Apr. 2, 1917, in which he set forth the reasons for which we must fight, it sent a thrill through the business men of the country and through every true and loyal citizen of every class or calling, because it rang true, because it struck a note which harmonized with his own ideals and principles and proclaimed a purpose which was deeply rooted in their own souls.

We Must Adjust Living Conditions

"But it is not enough for the business man to turn his genius to the saving of America from the menace of German militarism. There is another equally important part for him to play in preserving America from the foes that threaten her from within. Unrest has arisen by reason of the distribution of the great wealth which has come to the people of this country through industry and commerce, and the comforts and enjoyment it has brought its possessors are not to be questioned. But that this unrest must be reckoned with and adjusted if industry and commerce are to go on under private initiative and private leadership and management is also perfectly plain, and it is a part of business to find a solution for it. Otherwise the extremists will find ears for their strange doctrines, and willing arms to aid them in their strange experiments in governments. The Bolsheviki will appear in America as well as in Russia to paralyze business and turn us over to the tryanny of the mob.

"There are just as noble characters in the ranks of labor as in the ranks of any other class and condition of men. There are among them those who have for years been trying to raise the condition of labor to a higher level. Has not the time come when those in business, who believe in coöperation for the common welfare, may seek kindred spirits in the ranks of labor and lend a helping hand, thus uniting the element necessary to carry forward our great democracy to a still higher estate and suppressing those restless spirits of discontent who, by appealing to the brute in man, would bring about a revolution?

Our Moral Senses Dulled

"For years there has existed in this country a condition of law that, in my judgment, accounts for much of the trouble between business, and especially big business, and the people in general, as well as between capital and labor. Congress therefore enacted the Sherman Act, which made it unlawful to enter into contracts, combinations and conspiracies to restrain commerce among the states and with foreign nations. Under that law it became a question of the survival of the fittest. For fifteen years the moral sense of business men was so twisted and distorted that it will take another generation to restore it to full health and vigor, although the United States Supreme Court five years ago reversed its decision on both points and adopted the interpretation of the common law.

"Men are still afraid to coöperate. Lawyers are still diffident about advising clients that they can reply upon the reversing decisions in the Standard Oil Co. and the American Tobacco Co.'s cases. Moreover the legal representatives of the Government cannot yet fully accept these decisions as final. And yet they undoubtedly saved this country from a revolution.

"Under the old interpretation, man's sense of moral right and wrong had become dulled and was becoming duller with the years. The greed for wealth, the acquisition of which threw crooked paths in the moral world, straight though they had been made in the legal world, was rapidly creating a plutocracy as mighty and as menacing to the great mass of the people as any autocracy or aristocracy of history. Meanwhile the spirit of coöperation in all the relationships of life was instinctively present in the breast of man, and it began to break forth everywhere, seeking to escape the pro-

vision of the Sherman Act as at first interpreted. The labor union, the farmer's grange, etc., were all struggling to find some way to escape its limitations and gather force to meet or match what in business was finding its culmination in the trusts.

The Spirit of Coöperation

"When the Supreme Court reversed itself in 1912, business men for the first time awakened to the wrong that had been done them as well as the country. They at once began to adjust themselves to the new conditions and to seek the means of coöperation in the spirit of the common law. This Chamber of Commerce has been the organ through which and by which this message of the new freedom for business has been transmitted to our local chambers and to our national trade associations, and then to the American business men and to the public. We have in season and out of season preached the doctrine of real coöperation, where men combine to benefit not only themselves but the public also. When we have all learned that lesson and taken it to heart suspicion between employer and employee will begin to disappear; conflict between capital and labor will cease; thoughts of coercion will change to plans of coöperation; the spirit of greed and gain will be transformed into a spirit of service, and contentment and happiness will find a wider and brighter sphere. We have thought of business and talked of business as a cold and callous thing. We have said to ourselves and to our neighbors so often, 'There is no sentiment in business,' that we have blinded our eyes to what business ought to be To me the highest mission of the chamber is to put a soul into business, to transform the cold clay into the sentient being, to transfuse into the marble statue the warm blood of the human being, which will make its face to shine, its eyes to glow, its hands to clasp, its heart to beat and its soul to vision. In that sentient, soulful business only may democracy find its safeguard and protection. When we have found out that what is not for the common good is not for the good of business; when we have transmitted that creed to our fellow citizens and made them understand that it is our creed, and that it should be and must be the creed of labor, of agriculture, of the citizenship of all America, we shall have advanced the happiness and contentment of our people a hundredfold and we shall have placed democracy upon a broader and surer foundation and mounted infinitely higher in the scale of civilization."

How We Can Help to Get Ships

The address of Edward A. Filene on the ship problem contains many points which tend to show us that a good share of the work of winning the war is up to us as individuals and business men as well as to the men we send to represent us at Washington. He said:

"The most urgent problem before American business men today is this: What can business men do through their organizations to help get ships enough to insure victory and to get them in time? The business men here assembled are not concerned primarily in making a theoretical analysis of what Government agencies have done, have left undone, might have done, or should do. Our chief concern is to catch some new source of power to put behind the shipping problem.

"In my judgment the American people are more responsible for delays in ship construction than is the Government. It should be clearly understood that even though the Government does its work perfectly, so far as its administrative functions go, still there will be delays until the people in general, and we business men in particular, accept and discharge our full share of the responsibility for getting out ships.

"Nothing shows our social shortsightedness more clearly than the difference between the way we treat our soldiers and our ship workers. Suppose we had assembled our soldiers, given them arms and ammunition, and stopped there. Suppose we had left every individual soldier to scramble for a place to live. Suppose we had given little or no thought to the problem of locally transporting our soldiers and their supplies. Suppose we had not given expert attention to the problem of sanitation where we massed our soldiers. Suppose we had never cheered our soldiers as they marched through the streets. Can we assume that they would have developed into the well-drilled and disciplined soldiers that they are?

"And can we expect a maximum of speed and efficiency from ship workers who, after a day of hard and gruelling work, must stand in the rain waiting for delayed and inadequate transportation? Can we expect maximum speed and efficiency from ship workers who must crowd into unsanitary and already overcrowded sleeping quarters?

Workmen Must Be Well Treated

"Frequently after waiting a long time in the rain, they are obliged to pack themselves like sardines, wet and tired, in a car, or, worse still, into trucks that bump them over bad roads into the city. Imagine these men passing a limousine that could carry seven workmen occupied by only one woman and her lap dog! Will that convince them that, as a nation, we mean what we say when we tell them that the very outcome of the war—the freedom of our nation and of the world—depends upon their work, while at the same time the transportation that they need is being wasted?

"The problem of a contented and effective working force in our shipyards will not be solved by rhetorical preachments to the ship workers in their luncheon hour, by flag raisings, or by brilliantly colored posters, valuable as all these are. It can only be solved by cleaning up the discouraging condition of bad housing, inadequate transportation, inadequate amusements, etc.

"What can the business men of the United States do, especially in these fields, to increase the speed of ship production? First, they can see to it that local business organizations in every community where ships or ship parts are being made shall make it their urgent business to organize themselves to aid effectively shipbuilding. For them this will mean the working out of a clearly defined program to fit the specific needs of their community. This must not be a blanket offer to help, but a carefully organized service. Business men can organize their expert knowledge and specialized abilities and put them at the disposal of the shipbuilder in a way that will relieve him of the necessity of taking care of such questions as housing, transportation and power, to which he is now giving attention that should be devoted to the actual building

of ships. Such organized assistance would permit the shipbuilder to sit in conference with the business group say once a week, thus holding the necessary executive position by being relieved of many distracting affairs. Organized business can make it impossible that private plants shall have better skilled workmen than the shipyards, just as the organized business of Rochester has seen to it that the demands of the munition plants have first call on all the labor of the city.

Organizing Business Back of Shipbuilding

"Another way in which we can help is to organize the community behind shipbuilding as definitely as we organized the business forces back of shipbuilding. Pending the time when entirely adequate housing and transportation facilities have been supplied we can ask and help the community to do such things as these: (1) Carry workmen to and from their work; the car lines in many communities are unable to meet the extra demand required of them, though some communities have relieved the situation by changing the local business schedule by opening stores and offices a half hour later so that the rush of workmen will not come at the same time. (2) Make a survey of the private automobiles of the community, and with proper leadership virtually requisition the services of owners of private automobiles to carry men to and from their work to the best advantage of the nation. Can anyone imagine workmen so treated striking before submitting their differences to the Government for arbitration? (3) Take shipyard workers into private homes until other accommodations are ready, regardless of the inconvenience that might arise. The Government has just appropriated $50,000,000 to build houses, but they will not be ready in less than six months, and we cannot wait. Care, of course, must be taken to make the proper choice of the right man for the right home, the plan being applied in the light of moral, social and sanitary conceptions. (4) Adopt a definite policy of recognition of the ship worker. This might be done in such ways as providing that ship workers wearing official badges be admitted to motion-picture shows and other places of amusement at a reduced price. This is not merely a question of the difference in price, but the recognition by the community that it honors and appreciates the ship worker as an industrial soldier.

A Critical Situation That Must Be Faced and Faced Now

"While these are merely palliatives, we face a critical situation in which something must be done, and done now. Such a program will not only bridge over the present gap, but it will do much to awaken a public opinion which will hasten an adequate solution of the shipping problem. It is time for the frankest facing of facts. We are at the most critical period of the war. During the next few months we should send more and more troops to meet the stress of war. The full power of the United States is irresistible, and in this crisis it can and will be concentrated on ship production if we assume our full responsibility for carrying out the program here outlined. It is for the business men of America to help focus all the powers in their respective communities on shipbuilding, upon which the very outcome of the war itself depends."

Lapping Scored Cylinders

By Thomas B. Huling

The article on page 506 of the *American Machinist* on the subject of lapping scored cylinders describes a method similar to that used by the writer in lapping a four-cylinder motor. In this case the cylinders were much worn and badly scored, thus necessitating the removal of a lot of stock, especially since most of the wear was at the top, or explosion, end of the cylinder, while when finished the bore should be slightly tapered with the large end at the bottom.

Believing that these particular cylinders expanded about 0.018 in. more at the top than at the bottom an effort was made to taper them this amount. The old pistons were taper bored inside, taking out the pin bosses, and 1-in. holes were put through the heads. A taper plug with a center hole was fitted to this bore and six slots cut lengthwise through the skirt of each piston. An arbor was tightly fitted to the hole in the piston head and threaded back of the plug to provide a means of expanding the split piston, which had now become a lap. The end of the arbor was fitted to the spindle of the drilling machine.

With the casting mounted upon the table of the drilling machine and one of the cylinders lined up with the spindle the lap was put into place and run at a speed of about 450 r.p.m. The lap was always started at the bottom of the cylinder and worked up to the top. The lapping material was powdered glass, which we found superior to emery, as it does not tend to bed into the iron and so become a destructive agent when the engine is put into service. A small stream of water was kept flowing on the lap, which was continually supplied with the glass. About 12 qt. of the glass was used on the four cylinders.

The finish on these cylinders was not as good as a ground surface, but was better than could be produced by any other method. The engine was fitted with new pistons and rings, and the owner says that he gets 15 per cent. more mileage than when the engine was new.

I believe that gas-engine cylinders should be constructed so as to be round and parallel when hot. Sometime ago we sent a block of three badly worn cylinders to a concern which made a specialty of cylinder grinding, with instructions to grind them while oil heated to 275 deg. was circulating through the jackets.

This was done, and the cylinders when cold were neither round nor parallel, but when this engine was refitted with pistons and rings and put back into service it gave an increase of 20 per cent. in mileage per gallon and 25 per cent. more power.

Holding Small Taper-Shank Milling Cutters with Copper Sulphate

By D. E. Mapes

Trouble is often experienced from small end mills working loose in their collets. The usual way of making them hold is to clean the collet and shank and apply chalk, but as I had one that persisted in working loose despite this treatment I tried a few drops of copper sulphate and it never worked loose again. Care should be exercised, however, against overdoing this, as it might spoil the looks of the tool.

The Relining of Guns at the Watervliet Arsenal

Part Two

By E. A. Suverkrop

The operation of assembling the various parts of a gun depends for its success as much on correct methods of cooling as on correct methods of heating. If the cooling be not properly controlled, accurate machining and temperature regulation and handling in and out of the furnace and shrinking pit are of no avail.

IN THE usual method of assembling a hoop or jacket into a gun under manufacture, the gun is placed in the shrinkage pit muzzle up, and the jacket, or hoop, after being heated sufficiently to obtain the necessary clearance, is lowered into place. The hoop is then cooled at the shoulder by means of a water ring. This causes the hoop to contract at this point while it is still expanded at others. After a few minutes several more water rings are turned on at the shoulder and are gradually moved up away from the shoulder, thus cooling successive elements of the hoop, the one most distant from the shoulder being the last cooled. In this way shoulder contact is obtained, for the hoop is cooled at the shoulder and takes hold there, while the other parts are still expanded. By cooling progressively away from the shoulder, longitudinal strains are avoided as much as possible. This practice is the one still followed in assembling the double tubes of guns under construction. This same practice was followed when through liners were first assembled in built-up guns. A 6-in. Vickers-Maxim gun was the first one assembled in this way, and the liner was 0.158 in. off shoulder. Seven other guns were then assembled in the same manner. They consisted of two 12-in., one 10-in., three 6-in. and one 15-pounder, all with taper liners. The maximum amount off shoulder with these guns was 0.024 in. In this respect the results were highly satisfactory. These guns were afterward tested successfully at the proving ground and everything was considered normal.

However, the experience in relining three 12-in. navy guns, Mark V, caused a change in the system of assembling liners. These experiences were as follows: The first gun, No. 62, was heated to 700 deg. F. for several hours to insure the requisite expansion. It was then removed from the furnace and assembled over the liner, which rested on a mandrel in the shrinkage pit. The heated gun enveloped the liner and rested on the contact shoulder, which is located a little forward of the D hoop. Four water rings were used; the water was turned on at the contact shoulder and the rings were gradually moved toward the muzzle. After striking the hot metal the water ran down over the D1 hoop. Guns 65 and 66 were also assembled in practically the same manner.

When gun 62 was finished bored, chambered and rifled it was discovered that the D1 hoop was loose in two localities separated by about 120 deg. At one point a steel tape 0.007 in. thick was inserted under the D1 hoop for a distance of 28 in. The compression of the liner under D1 hoop was 0.005 in. less than prescribed. Guns 65 and 66 were found to be similarly affected. The C4 hoop of gun 62 was also found to be loose. All these hoops were removed, bored true, the shrinkage surfaces turned down, and the original shrinkage got by winding one layer of ⅛-in. square wire over the section covered by the hoops. The hoops were again shrunk on and the guns issued for service.

The above occurrences were at once investigated with a view to discovering the cause. It was thought probable that when the water was turned on to the exterior of the hot D1 hoop the cooling affected the outer hoop first and caused it to contract before the cooling had penetrated in the interior and while the interior was still hot and in an expanded state. The contraction of the D1 hoop against the expanded and strongly supported interior hoops caused the outer hoop to stretch.

Testing the Theory

In order to test this theory the manner of applying the water on the 12-in. guns was duplicated on an available section of a 10-in. gun which had become unserviceable on account of being cracked. The results of this experiment showed that in such cases the exterior of the gun was virtually cooled before the central portion had been affected by the cooling, and the condition of the outer hoops after the experiment amply verified this theory. Appendix B gives a more complete account of the case of the navy guns above referred to and of the experiments on the 10-in. gun.

In view of the defects discovered in the method of securing shoulder contact of liners by exterior cooling, no water was used in the next case—that of 12-in. navy, Mark V, No. 61. The liner was stood on a mandrel and the gun assembled on it as before. No provision was made to hold it on its shoulder, except the weight of the gun itself and a 59-ton weight placed on the muzzle. No water was used and the gun was left to cool of itself. After it was cool the measurements showed that the liner was off shoulder 0.68 in. and that, probably on account of gripping, the liner was

overcompressed throughout. The gun was then placed in the furnace, muzzle down, and heated to 500 deg. for several hours, after which the interior of the liner was flooded with cold water with the intention of causing the liner to drop to its shoulder. When the water was turned on, the liner dropped to its shoulder. The water was then turned off and the furnace was sealed. When the gun had cooled it was found that the liner was off shoulder 0.813 in. It is believed that this movement of the liner off shoulder was caused as follows:

As soon as the liner was in place the water was turned off. The thin section of the liner near the muzzle, being the first to expand, came in contact with the tube and gripped. As the liner gradually heated up it expanded, and being held near the muzzle by the gripping it expanded away from that point. The gun then cooled around the expanded liner and gripped it all over, holding it away from the shoulder.

A second attempt was made to drop this liner on its shoulder, but the attempt failed, though the gun was heated to 700 deg. before flooding the liner. It is probable that the failure was due to the presence of burrs that had been raised during the previous attempt.

In order to seat the liner a 700-ton hydraulic press was constructed, which was threaded like a breech block and which fitted in the breech recess of the gun, the piston fitting against the breech end of the liner. The gun was assembled in the furnace, muzzle down, and heated to 700 deg. for several hours. The burners were extinguished and the press was attached to the thread box and the liner was flooded. A pressure of 190 short tons was applied and was immediately followed by a pressure of 636 short tons. Three minutes after the water was turned on, the liner was forced to its shoulder. After ten minutes the pressure was reduced to 127 short tons, and 20 minutes after this the pressure was removed. When cold it was found that the liner was on shoulder and that the liner from the shoulder to the breech end had been compressed 0.162 in. The liner in all these attempts decreased over its total length 0.995 in. and the gun lengthened 0.175 in. The compression of the bore at the breech section of the gun was generally increased at all of the shoulders, the compression at the rear shoulder being 0.04 in.; at the second shoulder 0.0435 in., and at the forward shoulder 0.043 in.

Present Method of Assembling Liners in Built-Up Guns

The above experience demanded a radical change in the method of assembling liners in built-up guns. The method which was finally adopted has been in use here for several years and has given excellent satisfaction. Briefly it is as follows:

The gun is placed vertically in the furnace, muzzle down, and heated to the required degree. The liner is prepared with a water-inlet pipe entering the top and extending nearly to the bottom. An overflow pipe extends into the bore from a point just below the shoulder. When the water is turned on it enters through the inlet pipe, rapidly filling the liner to a point just below the shoulder where the water escapes through the outlet pipe. Before shrinking, the liner is filled with water to the level of the overflow pipe. When the gun is at the required temperature the burners are extinguished, the furnace opened and the liner lowered to its shoulder. The water circulating in the muzzle section of the liner keeps this part cool, and the breech end, which contains no water, expands rapidly and grips the gun while the cool muzzle portion is not in contact. The water is allowed to run for several hours, after which it is turned off. The gun is left in the furnace until cool. This method is very effective in securing shoulder contact.

One commercial firm in this country habitually makes use of a press in assembling liners. The liner is fixed in a vertical position on the plunger of a hydraulic press and the gun is lowered over it. It is then fastened down and pressure is applied. Water is circulated inside of the liner and the gun is left to cool.

This method is more complicated than the one employed here, obtains no better results, and has no advantages. On the contrary it has the disadvantage of possibly upsetting or buckling the metal between the shoulder and the breech end of the liner, thus causing too much compression in that section.

Results on 12-In. Guns

In the navy 12-in. (45 cal.) guns, the powder chamber is of the so-called bottle-mouth form, and the liner around the large part of the powder chamber is rather thin. In the proof firing of some of these relined guns, the breech section of the liner moved to the rear so much as to jam the mechanism. In the case of 12-in. (45 cal.) navy gun No. 10, the proof firing caused the liner to protrude both at the breech end and at the muzzle. The Navy Department explained this by the theory that the longitudinal component of the pressure on the bottle-neck portion of the chamber stretched the liner.[1] The officers at this arsenal do not agree with this theory, but advance the belief, which is shared by the writer, that the use of the press in assembling buckled the breech section of the liner and that the radial stress of firing restored the buckled portion and caused the breech end to protrude. The longitudinal stress in these liners, including friction, is in excess of the elastic limit of the material, so that the design was defective regardless of the actual causes of the failure.

In the case of the navy guns relined at this establishment the tube is lubricated, preparatory to assembling, with a mixture of graphite and oil. This is done to allow the parts to adjust themselves more readily when relative movement takes place in assembling. Graphite is not used on the army guns relined here. The Ordnance Department does not at present favor its use, the argument being that when graphite is used, relative movement of the parts in firing is more likely to occur.

All 14-in. guns, except model 1907, MI, are wire wrapped, and all except the models of 1907 and 1907, MI, are provided with double tubes. The outer tube is

[1]The theory herein expressed that heating and interior cooling of the wire-wrapped gun would destroy the liner does not appear to be based upon sufficient positive data. The example cited was a case where the ring at the rear of the tube which supports the wire slipped to the rear. This slipping could be prevented by leaving the breech bushing in place or, as in the general case, if the liner will not pass through the bushing a temporary bushing with enlarged bore may be assembled in the gun during the lining operations.

taper bored, and the inner tube, which is in reality a taper liner, is provided with a corresponding shrinkage surface. To assemble, the inner, or A, tube is placed vertically in the shrinkage pit, muzzle up. The outer, or B, tube is heated to the required temperature, removed from the furnace and lowered over the A tube. Water is applied outside the B tube at the shoulder. After the tube has cooled at this point the rings are moved gradually toward the muzzle. A sheet-metal shedder is used to prevent the water from coming in contact with the section between the shoulder and the breech.

After the tubes are assembled the wire and hoops are put in place. The addition of the wire and hoops not only superimposes a heavy compression over that already caused by the shrinkage between the A and B tubes, but also usually causes bends in the liners. A consideration of the above facts leads to the belief that an attempt to remove the A tube from a completed gun by heating and interior cooling would not be successful. Further, it is the belief of the writer that such an attempt would ruin the gun. This conclusion is based on a general consideration of the probable effects of such heating and cooling on a wire-wound construction, and is strengthened by the experience of this arsenal with 6-in. gun, model 1908, MII, No. 1. This gun, which was of wire-wound construction and provided with a Hadfield cast jacket, was sent to Watervliet to have the jacket removed for the purpose of making an examination of its condition and of the gun underneath its surface.

Methods and Results Attained in Removing Jackets

In the first attempt to remove the jacket the gun was suspended in the furnace by the jacket in order to utilize the weight of the gun to separate the parts when the shrink had been broken. The flames from the burners were played upon the jacket, which was moved up and down and turned constantly in order to obtain a uniform heat. The gun was removed from the furnace and the temperature, calculated from exterior measurements, was found to be 1000 deg. F. The gun was suspended from the jacket and the jacket was hammered to determine its looseness and, if possible, to start it. The jacket appeared to be free from contact with anything underneath it, but did not move. To further assist in the separation of the jacket from the wire, interior cooling was used, but without accomplishing the desired result.

After cooling, the star-gage measurements of the gun indicated a serious release of compression under the jacket, the diameter of the bore having increased an average of 0.005 in. Outside measurements indicated that ring A, which supports the breech end of the wire winding, had moved to the rear a distance of 0.555 in. relative to the tube. The moving of the A ring on the tube evidently resulted from the contraction of the tube due to the application of water while the wire winding and jacket were in an expanded condition.

A further attempt to remove the jacket was made, using a hydraulic press. The attempt was unsuccessful and the jacket was parted off in a planer. After the removal of the jacket and wire, the tube was found to be considerably warped in several directions so that it could not be used again. The gun was reassembled, using a new jacket, tube and wire.

It is said that this method is used in England. It is evident that if the method could be successfully applied it would have marked advantages, especially in the case of wire-wound guns. The gun, minus the liner, would be finished. The liner would then be driven in and secured. When relining became necessary the liner would be driven out and a new liner inserted. Assuming a gun with double tubes, similar to the 14-in. model 1910, the method would have the following advantages: (a) Heating the gun would be avoided; (b) the expensive operation of boring out the old liner would be dispensed with; (c) the time that the gun would be out of commission for relining would be reduced to a small fraction of what it is at present; sizes could be obtained from the records of the gun and the liner could be prepared before the receipt of the gun at the arsenal.

The following calculation was made by Capt. W. M. Wilhelm to determine the amount of shrinkage obtainable by ordinary methods:

Let X = the absolute shrinkage of the liner. The equation which expresses a relation between the absolute shrinkage and the pressure per square inch against the exterior of a liner is: P short tons = $3313357X$. Assuming a liner with a standard taper in a 12-in. gun, model 1888. If the coefficient of friction between graphited surfaces equals 0.1, an 800-short-ton hydraulic press will force the liner in to such an amount as to give an absolute shrinkage over all of 0.0024 in. If the liner be dropped home a distance of 290 in., which is the distance from the muzzle of the liner to the shoulder, the finished liner weighing approximately 9250 lb. and having a taper of 0.007 in. per inch should take up an absolute shrinkage over all of 0.0053 in.

A Chance for Stay-at-Homes to Help

The "Official Bulletin" for Apr. 9 contains the following:

"France has just established a new regime of bread consumption. From now on bread will be strictly rationed through all of France on the following basis: Children less than 3 years old, 3½ oz. a day; children from 3 to 13 years old, 7 oz.; persons from 13 to 60 years old, 10½ oz. (hard workers in this age class may receive 3½ oz. more); persons over 60 years old, 7 oz.

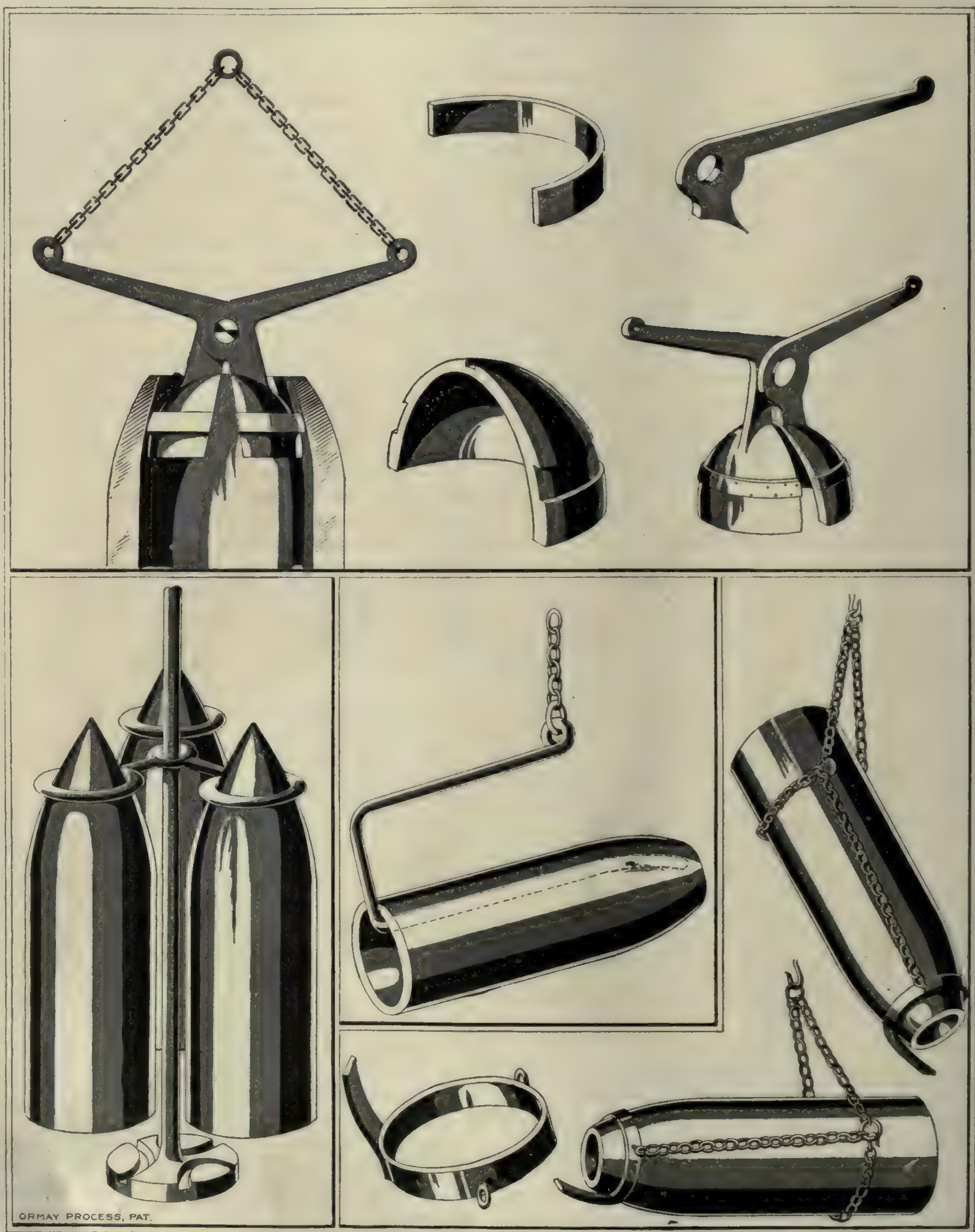
"This ration is about two-thirds of the bread allowance heretofore maintained. The fact that bread constitutes over one-half of the diet of the French nation and the further fact that the price of meat is such as practically to prohibit its use by a large part of the population make these figures highly significant of the extent to which the French people are going in their efforts to restrict food consumption."

Can any of us do less than to curtail our own bread consumption in the face of such facts?

France has not asked it—she is bearing the burden bravely. But we must not forget that it is *our* burden too. Let us all help gladly, quickly and generously. Not with money, but with self-denial in the eating of breadstuffs that more may go to the people of our sister republic. There is not one of us but can eat from 10 to 25 per cent. less without harm to himself.

From a Small-Shop Notebook

BY J. A. LUCAS



A NUMBER OF DIFFERENT SHELL-HANDLING DEVICES

A NUMBER OF DIFFERENT SHELL-HANDLING DEVICES

Machining the Stitch-Making Mechanism for Hosiery Machines

BY ROBERT MAWSON

The changes in wearing apparel influenced by the European war have necessitated alterations in some of the more essential working parts of the standard textile machines. One of the machines so influenced is the hosiery-knitting machine on which certain changes are necessary to adapt it for the coarser grades of yarn now in use. How some of the machining operations are performed on these interchangeable parts is described in this article.

THE European war has affected almost every part of the engineering industry, which is apparent by the radically changed designs on machine tools and methods. It is safe to say that more one-operation machines are now being used than ever before. The effects of the war have also been felt in the textile industry in the class of goods now being manufactured by machinery, since in this connection thicker yarn is now being used in order to afford warmer clothing for the men in the trenches. Among these is the hosiery-knitting machine known as the "Banner," manufactured by the Hemphill Manufacturing Co., Pawtucket, R. I., and shown in Fig. 1.

An advantage in this design of machine is that the lower portion is made standard, the only special part being the head. By this method the machines may be built and carried in stock and the only parts to be added are the head, depending on the size and gage of stitch ring, and the cylinder, with their respective attachments. Various sizes of these details are, however, kept in stock, so that almost any size of machine may be quickly assembled.

Two Sizes of Stitch Rings

Most readers will remember the old type of stockings made with four needles by hand and the yarn thick enough to wear through many launderings. Then through the advent of the knitting machine the quality gradually swung to the opposite extreme—from coarse gage to the very finest, which produced the invisible hose with the transparent effect. Now we find that the quality is going back again, most hosiery, especially men's, being made from thicker yarn and requiring a coarser gage stitch ring and cylinder mechanism.

In Fig. 2 are shown fine and coarse stitch rings; the one at *A* is $3\frac{3}{4}$ in. in diameter and 216 gage, and the one at *B* $4\frac{1}{2}$ in. in diameter and 54 gage. By the term gage is meant the number of strands of yarn in the hose in its circumference. The ring *A* was the one commonly used two or three years ago for the fashionable styles of hosiery, and that at *B* the one now used for soldiers' hose.

Referring again to Fig. 1 the yarn is carried on spools which fit on the pegs *C* shown on the reel at the upper part of the illustration. The strands of yarn are fed into the stitch ring and from there to the cylinder *A* shown immediately under it. The stitch ring and cylinder are revolved by the machine by means of a belt on the pulley *D*, which may be seen at the right of the machine.

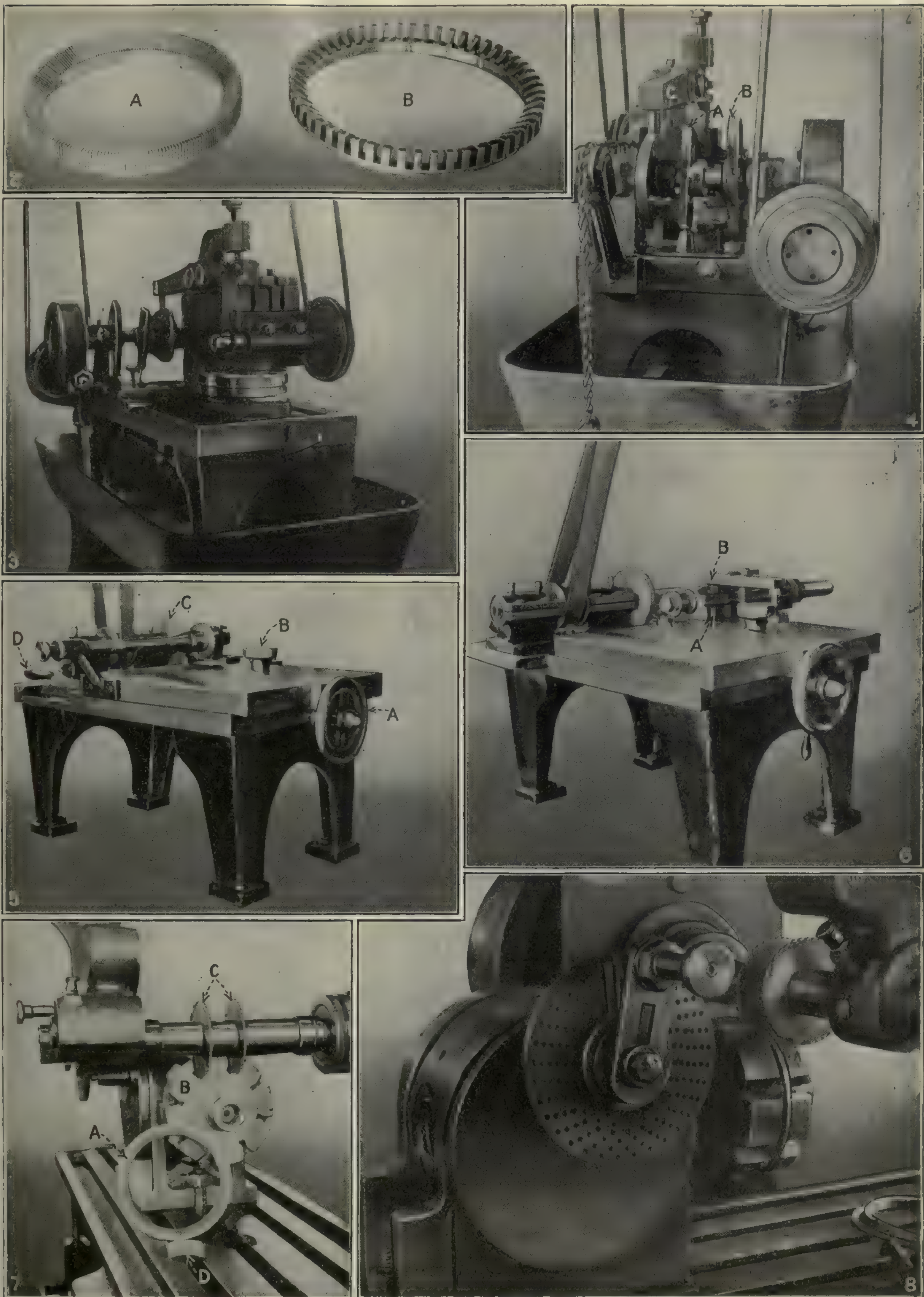
The needles which form the loops are raised and lowered by cam plates which are placed on the outside of the cylinder. These cams raise and lower the needles, permitting the strands of yarn to pass either over or under other revolving yarn strands to form stitches in a similar manner to the old-fashioned four-needle hand method.

The length of stocking, shape, position of heel and toe are controlled by cam plates at *B* driven by the chain which may be observed in front of the machine. The stocking as it is being made passes through the carrier, one being shown at *E* in process of manufacture. This briefly describes the operation of this type of knitting machine.

Fig. 3 shows one of the machines used when machining the slots in stitch rings. These parts are made from

FIG. 1. A HOSIERY-KNITTING MACHINE

brass castings and machined all over to size in previous operations. The ring is then placed on an expanding chuck which is operated by the lever shown in front of the machine. The cutter used is of the correct thickness desired to mill the slot in the ring, and is revolved by



FIGS. 2 TO 8. MACHINE OPERATIONS ON KNITTING-MACHINE PARTS

Fig. 2—Two sizes of stitch rings. Fig. 3—Slotting operation on the stitch ring. Fig. 4—Rear view of ring-slotting machine. Fig. 5—Grinding stitch-ring-slotting cutter. Fig. 6—Grinding the cylinder cutter. Fig. 7—Cutting latch openers. Fig. 8—Rear view cutting jig for latch openers

the round belt shown at the right of the illustration. In operation the cutter is fed down onto the work.

An interesting feature of the machine, which has been added by the Hemphill Co., is the indexing and feeding mechanism shown in the rear view of the machine, Fig. 4. Formerly these machines were made with single-motion cams, but these have been changed to double motion, thus increasing the production. The cam *A* is for indexing and locking the ring being machined, and the cam *B* is used for the feed. At the left of the cam *A* may be observed the cutter cam *C*, which is also double acting and controls the raising and lowering of the cutter onto the work. The head is held rigid to avoid the cutter chattering during the machining operation by means of the chain shown at the extreme left of the machine. The rods which operate the indexing and feeding of the work are under the machine, but the pins which are attached to them may be observed under the cams *A* and *B*. With this machine, and arranged as shown, a 3¾-in. ring with 220 slots may be machined in about 30 minutes.

Anyone who has had experience in grinding cutters realizes the trouble experienced in obtaining a tool that will cut on all the teeth. In most cases after the cutter has been ground it will be found that only part of the teeth perform the machining operation. Under these conditions the strain brought to bear on these teeth causes them to break or, at best, unsatisfactory results are obtained. The thinner the cutter, or as it more nearly approaches to the saw type, the more is this trouble experienced.

In Fig. 5 is shown a tool designed and built by this company to overcome this trouble and produce an evenly distributed cutting surface on the entire periphery of the tool. The spindle from the milling machine with the cutter assembled is removed to this machine and held between centers, as shown. The position for each tooth during the grinding operation is determined by a stop at the rear of the machine on the right hand side. The table feed is obtained by revolving the hand wheel *A*.

After the table has been adjusted it is locked by means of the knurled knob *B*. The revolving grinding wheel *C* is slid back and forth across the teeth of the cutter by means of the handle *D*.

A similar machine is used for grinding the cutter used for cutting the slots in the cylinder; one of these set up for this operation is shown in Fig. 6. The head with the cutter in position is removed from the cylinder slotting machine. The head is then located on the grinding machine by means of pairs of pins as at *A* between which it is slid. A clamp *B* is tightened onto the cutter head, thus holding it securely in position. The method of grinding is similar to that for the preceding job.

Making Latch Openers

The position of the heel and toe is obtained by cam plates on the chain, as noted. These plates as they are fed around come in contact with latch openers fastened on the outer periphery of the drum *B*, Fig. 1, as previously mentioned.

There is an interesting operation followed when making these latch openers, which are of tool steel and machined all over to the correct dimensions. In Fig. 7, at *A*, is shown one of the rings from which the latch openers are made. The ring is placed in the fixture *B* located by a machined projection which fits on the inside of the piece, and the outer plate is then fastened on by means of the nut. The two cutters *C*, one of which is 3½ in. in diameter and the other 3 in. in diameter by $\frac{3}{32}$ in. in thickness, are placed on the milling-machine arbor with the correct spacer in position. It will be observed in the section cut at *D* that the edge of one end of the latch opener is almost vertical; the other, owing to the ring being circular, is at an angle. This accounts for the two cutters being of different diameters. The table and fixture is fed across against the revolving cutters. After the machine table has been returned to its original position the index head is fed around and the fixture is in position for machining another latch opener. From one turned ring eight pieces are thus made. In Fig. 8 is a close-up view taken of the rear of the milling machine, in which the design of the holding fixture may be noted. The index head is of the conventional type.

Keep At It!

"Cincinnati Post," Apr. 13, 1918

The soldier works 24 hours a day, when necessary. In great emergencies a 24-hour day's work follows a 24-hour day's work. He is not paid for overtime. He is engaged in the most perilous pursuit the world knows.

To be a soldier he has sacrificed home, family, advancement, education, money gains—everything that those who stay at home hold dear. And he says to Uncle Sam: "All this I do willingly and freely, and I do more—I offer you my life to do with as you will."

We are not asked to work 24 hours a day. We are not asked to endure hardship. We are not asked to risk our lives.

All that is asked of us is that we remain steadily at our tasks, doing a full day's work every day and a full week's work every week.

Particularly is the request made of those men employed in factories manufacturing war munitions. For if work drags here, the war drags. And if the war drags too much—farewell, liberty; farewell, labor conditions as we know them in this country today.

The first thing the Germans did in the conquered Russian territory was to reduce wages from $2.10 a day to 30 cents a day, and to lengthen the workday from eight hours to 10 hours. This is a suggestion of what might happen in America if it fell under the lash of Prussian military autocracy.

The Ohio Council of National Defense has made a survey. The survey shows that an average of 10 per cent. of workers are regularly absent from their jobs. In some factories the absences run as high as 30 per cent.

These absences seriously interfere with war work.

Governor Cox is calling upon Ohio to remedy this condition.

The call will not be in vain.

No Ohioan wants to help Germany win the war.

Yet those of us who lay off do help Germany win the war.

With that straight in our minds, let us adopt this rule:

NO LAYOFFS FOR ANY CAUSE SHORT OF SERIOUS SICKNESS OR DEATH IN THE FAMILY.

Export-Trade Problems

By ROBERT S. ALTER
American Tool Works

Though the country is bending its energies to the successful prosecution of the war, our manufacturers ought to find time to mend their economic fences by securing all the foreign export trade there is to be had. Even the small neutral nations are making efforts to supply non-manufacturing countries with what they need, and the American machine-tool builder will do well to give this subject his most careful attention. This article is taken from an address delivered at the fifth National Foreign Trade Convention in Cincinnati, Ohio, Apr. 19, 1918.

THE export-trade problems of the past will likely not be identical with those of the future after this war has ceased. America should realize this, and we Americans, individually and collectively, should give the best of our thought in an endeavor to ascertain just what the requirements will be to develop and maintain that vast amount of foreign trade obtainable after the war and claimed by many to be within easy reach of us all.

As we are aware those countries which constitute not only our allies but our enemies have a degree of governmental assistance and support in their commercial activities that we in the past have not had the pleasure of enjoying. That this support is an absolute necessity for the future commercial welfare of our country is self-evident; and that individuals are giving the matter serious thought is manifested by the calling of this magnificent convention.

Commercial Coöperation

However, in these times, when we are face to face with the tremendous power of the governmental commercial coöperation wielded by so many foreign countries, and when we are face to face with the fact that this governmental aid will likely be steadily increased, the urgent need of the same system for us is instantly apparent if we are to be successful in the race for foreign business in the future.

The advantages obtainable through the operation of the Webb bill are too far reaching to permit of discussion at this time. George H. Charls, in his paper entitled "Organization of an Export Association Under the Webb Bill," presented in Group 4 last evening, has given the exporters of our country food for thought in making practical use of the opportunities afforded by this bill.

While we have a Department of Commerce which is making an honest effort to render service to American manufacturers in exporting their wares throughout the world, yet it is significant that to date there is not a single special organization to enter upon this work. Consequently, there is no agency to pool the findings of such an organization, which consolidated would give to us suggestions as to what policies to adopt in dealing with the peculiar competition that we shall have to face.

Permit me to interpolate here a word of congratulation for the magnificent work being done by the National Foreign Trade Council and the conventions which it has called. It is to be hoped that the honest, practical business sense as expressed here at this convention through the many interesting speeches and papers will have a far-reaching result.

The countries now at war are all facing enormous national debts which must and will be liquidated by every country involved unless they have no shame in going down in history as nations repudiating their obligations. These countries, therefore, have economic reasons why they as nations, and also as individuals must develop not only their home industries, but also their foreign trade. This will be accomplished in many ways; for example, by reducing imports wherever possible, and by the development of their home industries to such a degree that increased exports will be made possible on the basis of overproduction.

Many large plants now confined to the production of war material will be utilized for other purposes when peace comes. According to a recent consular report the Skoda gun plant of Pilsen, Bohemia, expects to control the farm-implement trade in Russia and the Balkans after the war, and has already made preparations for the conversion of its gun-making plant as soon as peace is declared. The report states that plants connected with the Skoda works already have quantities of machines which are to be shipped into Russia as soon as the border is opened.

It appears also that the Skoda works are counting on the neutralization of the Dardanelles and a resulting increase of traffic on the Danube, which has caused them to prepare to build motor boats for export to Turkey and Bulgaria. One part of the plant is to be converted into an automobile and airplane factory, while another part will continue in the manufacture of war materials.

I have visited this enormous plant on several occasions, and can realize fully what its output can accomplish in competing with the sales organizations of other countries in the territories mentioned.

Resources of This Country Will Make It a Factor

In 1865, when this country carried a national deficit of seven billions dollars, European countries took it for granted that we would have to go bankrupt. They did not know the resources and the inventive genius of the Yankees. "Necessity being the mother of invention," the brains behind our country got together, with the result that it was pointed out that there were 12 states out West rich in minerals of all kinds and susceptible to enormous development. The work began. Gold and silver, virtually the needed money, was dug from the ground in ever-increasing quantities. Transcontinental railroads were put through, which in turn developed the enormous agricultural possibilities of our Western plains. These in turn yielded harvests which brought additional funds to our coffers, and by our industry we eliminated the debt.

The national debts of our allies at the end of this year

will be colossal. It is estimated that Great Britain's national debt at that time will be fifty billion dollars, or practically one-half of the nation's wealth. Great Britain is not crushed under the weight of this obligation. She knows exactly what she is going to do to pay it, and she has already taken steps to carry out extensive developments in her various colonies. Development possibilities in Canada alone are so enormous that legislation has recently been passed whereby ten million Chinamen will be allowed to immigrate and will be employed in building railroads, cultivating the soil, and in other capacities, at the insignificant wage rate of 62½c. a day. This shows exactly what Great Britain intends to do in the way of future development.

Similar plans are under consideration with other countries and their colonies. Some are also planning the development of the vast agricultural and mineral possibilities of South America. However, we should not be alarmed over the possibility of this extensive program working against us provided we are willing to lend ourselves to the general scheme. It might be advantageous for us to coöperate in giving financial assistance to the work of reorganizing those countries which have been hard hit by the present conflict, thereby gaining their support in trade on a reciprocity basis. America is in an excellent position to render this assistance on account of the huge gold reserve which we have accumulated. This gold reserve will be immediately available upon cessation of hostilities and will give America the first opportunity to reap the benefits derived from this source. The extension of the American banking system, which is rapidly taking place, will offer great help in guiding and assisting credit extensions to countries needing same.

Coöperation with Our Allies Suggested

If the Allies can hold together after this war, the combination will form an organization consisting of practically three-fifths of the land of the world, three-fifths of the population and mineral resources, and a string of colonies extending around the world. With such coöperation German interests will find a worthy competitor.

The trade situation with neutral countries after the war will be quite unique, according to information I have collected on this subject. The export restrictions against them have made it difficult for neutrals to import the articles which they formerly secured from abroad. This has forced them to cultivate their own fields to obtain food, and to develop their own mineral resources to secure necessary raw materials for home requirements, as well as war orders, the latter being quite profitable.

This industrial development has increased the number and size of manufacturing establishments to a remarkable degree. When the war is over they will be better able to take care of themselves than formerly and be independent of outside assistance, and besides a market must be found by them for the overproduction. Neutrals therefore are looking more than ever to export possibilities for their own commodities and are coming to a broader understanding of their own capabilities of self-preservation and securing world trade.

Let us take the Scandinavian countries as an example. In the past they have been large importers of all kinds of material, particularly manufactured products. Denmark, Norway and Sweden have recently invested one billion kroner ($270,000,000) in factories which will complete directly with American firms not only in their own countries, but in the world at large. These factories are manufacturing chiefly such goods as emery wheels, twist drills, taps, dies, engine lathes, planers, shapers, chucks, files, hammers, axes, shovels, ball bearings, railway supplies, wood-working machinery, automobiles, harvesting machinery, shoe machinery, lumber machinery and many other kinds of commodities.

The Raw Material

The raw material for the manufacturing of these products is obtained largely from Sweden and Norway, and the production of these industries is arriving at such a high degree of efficiency that they can more than supply home consumption. An investigation of the conditions in these countries would lead to the belief that after the war the prices will be considerably lower than those prevailing at present, not only on account of the reduction in the cost of raw material but on account of constantly increasing efficiency of manufacturing organizations. For this reason, they are fully expecting to compete in a most energetic and intelligent way against American and European firms, who will feel their competition in Russia and Asia as well as the greater part of Europe. In addition, the Scandinavian countries have the advantage of being closer to the majority of these markets than the United States. The embargo against Scandinavian countries, while admittedly a war necessity, has nevertheless developed in those countries a new and determined competitor in foreign fields.

Scandinavian customers had a leaning toward American products, and it is regrettable that war conditions have forced us to curtail shipments to them. Tonnage has been available, because the Scandinavian countries are employing a considerable part of their large merchant marine for the war requirements of America and her allies, a certain amount of this tonnage being used for traffic between this and their countries.

Scandinavian Trade Should Not Be Neglected.

In recent months several boats have left for Scandinavian ports with passengers, but practically empty as far as cargo is concerned, although goods for Scandinavian countries have filled certain New York warehouses. I am advised that the Danish steamer "Helig Olav" will be allowed to sail shortly for Denmark with passengers, but otherwise practically empty. It is unfortunate that the various associations in Denmark, Sweden and Norway have not been able to fully satisfy our Government that American goods imported into those countries would not be reëxported to the enemy, as otherwise our products would have been established in these countries to a degree difficult to enjoy at any other time.

German activities in these countries are bound to militate against us under these circumstances, and the development of home industries there is creating a condition which unless very energetic steps are taken to retain our trade will make Scandinavia a competitor for our goods where formerly we had a customer.

I could go on at length and point out identical conditions in other neutral countries, particularly Spain, but time does not permit.

The uncertainty as to the volume of business which we will secure from Europe after the war brings up the old axiom, "Don't put all your eggs into one basket." The logical thing to do, it seems to me, is to go after new markets without the least delay. Now is the time to start our propaganda in virgin fields, as it takes time for the seed to grow, and still longer to reap the harvest. The crop from the fields which we have cultivated for years may not now yield its utmost, and for the safety of our export business—in fact, the safety to the proper balance of our individual businesses—may depend upon orders secured from new markets. This is another great problem in export trade, and to give advice which will cover the vast number of various industries would require special and exhaustive treatment.

The exporter must, first of all, consider the market in question from the standpoint of its buying ability for his particular commodity. Much money is wasted every year, and export campaigns do not bring fruit simply because the firms behind them neglect to study the markets.

The Climate and Altitude

The matter of climate and altitude should not be overlooked. For example, there is a good market for heavy overcoats in Mexico City because of its altitude and regardless of the fact that it is far south of us. Many centers of population in tropical countries are situated in altitudes which give them temperate atmospheric conditions.

The occupation of the people will indicate the needs of the community for raw material, machinery, tools, clothing, luxuries, etc., the latter depending greatly upon the degree of refinement of the population. Naturally, those people who can be compared with us in civilization, regardless of their geographical location, will be interested in buying commodities which we ourselves use and enjoy, such as automobiles, Victrolas, Pianolas, motor boats, photographic apparatus, etc. On the other hand, the peoples in savage and semi-savage countries may use cheap cotton cloth and a few simple utensils, but would hardly create a market for laundry machinery, much as they might need it.

Knowledge of these conditions based on study and observation is the only way to ascertain whether there is a market for a product. It is an interesting and fascinating study, and well worth the time of any business man who desires to expand the horizon from which he secures orders.

Familiarity with Commercial Law also Essential

Moreover, in going into new markets it is well to familiarize oneself as far as possible with the commercial laws effective in those countries. Because we have certain laws for doing business in our country is no indication that the same applies elsewhere. While the laws in approximately 50 independent foreign countries may differ (not to mention the colonies which may come under their jurisdiction having their own local regulations), and while at a glance the complexity of this subject might appear discouraging yet it is not hopeless.

Commercial law governing foreign transactions contains a degree of uniformity in fundamental principles throughout the world. Then again there is a certain amount of trust, confidence and business honor existing when one's negotiations are carried on with reputable people, regardless of where they are located. A firm wishing to maintain its reputation and credit will find it obligatory to follow established business practices rather than stoop to acts of cupidity. Commercial law has been largely built up by a long line of precedents previously established by merchants in dealing with each other.

There are two distinct legal groups involving civilized nations. The first includes the United States, England and some of her colonies, whose laws have not been reduced to fundamental codes, legislation coming under the head of common law, and based on decisions of the courts and precedents. The second group includes practically all other nations, and is what is called civil law, which is closely related to the old Roman law. The underlying principles of this civil law are frequently embodied in the form of written codes. What interests us most in civil-law countries is the section covering commercial codes, which makes quite a distinction between traders and commercial transactions, and nontraders and noncommercial transactions. Therefore, in drawing up agency contracts, in shipping goods on limited or indefinite consignment, in allowing expenditures to be made for propaganda, and in dealing with trademark and patent matters, in sending salesmen to work independently of any established agencies, and in extending credits, it is advisable to become familiar with the legal points covering each in the countries concerned.

I take this occasion to speak a word of caution about the use of the word "agent" in drawing up various documents. I have known cases where the use of this word by the manufacturer has placed him in a very embarrassing position when called upon to meet certain expenses charged to him by the party appointed as a sales agent.

The matter of regulating the selling price of your products in foreign countries deserves the most profound consideration. The fact must not be overlooked that the foreign salesman or dealer is in a large percentage of cases up against more competition than would be the case here in America.

European Competition Keen

Almost everything that America can supply can also be furnished by Europe, and therefore, in getting down to the final stages of a foreign deal, it is common experience to find that you are not only enjoying the competition of your American friends in your same line of business, but also the European manufacturers in the same class.

It is obvious, in view of the additional cost of transportation, duties, etc., on shipments from America, that foreign dealers, thinking only of their own pocketbooks, might easily and wilfully quote prohibitive prices on American products in order to sidetrack them, and thereby be able to handle a similar article of European production on a much more profitable basis by bringing the price up sufficiently under the American to secure the business. This increase in price and the low cost

of delivery of the European article would naturally make his margin of profit most acceptable. It therefore behooves us all to give this matter special attention, and the best place to secure the data is on the ground.

This brings me to one of my hobbies, namely, "If you want foreign business, go after it in person." Take the time. Become personally familiar with the markets and the agents who are handling your interests. How can any dealer enthuse over principals whom he has never met and with whom he has never had the slightest degree of social intercourse? Insurance agents write millions of dollars' worth of insurance on the strength of their personal acquaintance, often on an unequal basis with their competitors, but the personal contact and bonds of friendship get them the business. The same applies to the development of foreign trade from the standpoint of the individual firm which is expanding into this field.

The Commercial War to Follow

It would hardly be fair for me to close my remarks on foreign-trade problems without saying a word of encouragement. We should not allow these apparent difficulties to dampen the ardor of our activities, because we have before us examples of the wonderful success in export trade enjoyed by countries which we can now more easily call our neighbors than ever before. If their brains have enabled them to amass huge fortunes from this class of trade it would be an insult to the intelligence of American business men were it to be intimated that we are not at least the equal of these neighbors.

That the British manufacturers are afraid of our competition after the war is clearly set forth in a speech made by J. Judson on Mar. 8 last before the machine-tool builders of England. Mr. Judson said in part: "We are all out to win the war, but there is another war to come, viz., the commercial war, and I am sure that we cannot tackle the problem properly unless something is done to assist us against both American competition and probably German competition. It is going to be difficult for the British machine-tool makers to compete in the world's markets owing to the fact that our American rivals have amassed huge reserves during the war period, which reserves will enable them to successfully travel and advertise and do everything possible to secure the trade. To prove to you at once that our United States competitors will be better able to travel the world for trade than ourselves a few figures will assist."

He then introduced data on comparative prices of American and British machinery, and continued:

"It just shows us the surplus our friends will have to work with, enabling them to secure a maximum share of the world's trade. Our aim should be to see Great Britain self-contained in this industry. There must be no 'next time' of going thousands of miles for such essential commodities as machine tools and accessories which are the absolute basis of every article for defense, offense and peace-time necessities."

In Belgium there has been instituted a Comptoir National pour la Réprise de l'Activité Economique en Belgique, which intends not only to back Belgian firms in advancing the necessary money for purchasing the reëquipment of their plants but at the same time to carry a large stock of material and to place orders as soon as circumstances permit. This company has been definitely formed and is backed by the government. It is intimated that before long manufacturers in the United States will hear from them as to their methods of purchasing and acquiring material.

In Scandinavian countries there is still hope, as evidenced by a letter which I have just received from Stockholm, that many of the reputable dealers who have been handling American goods have been almost shut down from inability to receive material. However, in the face of this they have tried to keep loyal to their American connections by not entering into promiscuous dealing with inferior goods as a substitute. In adopting this policy the author of this letter, who is a personal friend of the writer, states that these dealers have allowed opportunities for making a lot of money to pass. They prefer, he says, to continue to wait until they are able to renew their relations with their American manufacturers of first-class articles, claiming that they built up sufficient reserves in the past through these connections to tide them over until the time when they can resume their work in the usual way.

This evidence of loyalty is worthy of our most profound respect and should give us the incentive to be absolutely fair, square and lenient with these connections when they are again established.

How Design Affects the Millwright

By Donald A. Baker

Some time ago an accident occurred at a plant which may be worth relating. A number of heavy-duty drilling machines had just been purchased. Four of them were erected and two of them were running for a short time on production, when one morning, on starting the third machine, there was a crash and the machine stopped. On investigation it was found that the main drive shaft, which ran from a bevel gear at the bottom of the machine to a spur gear at the top, was supported by a ball-thrust bearing. In assembling the machines this shaft was dropped down from the top, the lower end being splined to take the key in the bevel gear in which it was a sliding fit.

When the shaft was lowered into position it of course held the ball bearings in place and so the designer had not thought it necessary to provide a cage, or retainer, for the balls to hold them in place. All this would have been well enough but for the fact that the machines had to be shipped in a horizontal position with the result that the jarring incident to travel caused the vertical shaft to slide endwise, allowing the balls to roll out of the bearings. The effect was that when the machine was started one of the balls got into the gears. As $\frac{3}{8}$-in. balls of this kind are rather hard propositions the results can well be imagined. Suffice to say I immediately shut down the first two machines and on overhauling I found that in four out of the five the bearings were out of place. It was pure luck that the first two had not had the same trouble.

For the benefit of future purchasers of this particular line I may say that I have called the manufacturers' attention to this slight defect in design, but up to date they have not so much as said "Thank you."

III.—Manufacturing Parts

In the manufacture of a calculating machine some very interesting methods are employed; and in this article the special drilling, milling and grinding fixtures used in making baseplates, brackets, etc., are illustrated and described.

IN AN article appearing in the *American Machinist*, Vol. 47, page 995, illustrations were presented depicting some of the important methods used by the Marchant Calculating Machine Co. of Oakland Calif., in finishing carriages for their calculating machines.

The calculating-machine carriage, it will be recalled, slides longitudinally in a guide machined in the baseplate of the apparatus, and carries two sets of numbered dials, one at the right-hand side being the product, or dividend, dials and the other, or left-hand set, the quotient, or proof, dials. Back of the carriage, between

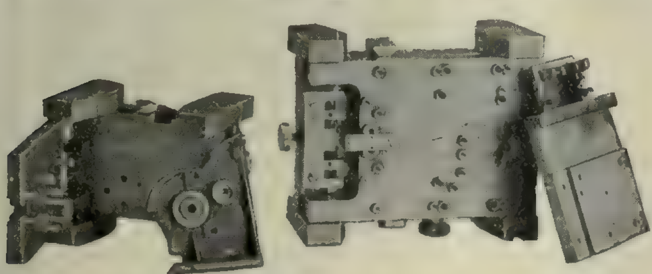


FIG. 25. JIGS FOR BASEPLATE AND SIDE BRACKETS FOR CALCULATING MACHINES

a pair of side brackets, is a third set of dials which with their spindle constitute a drum operated by a crank handle at the right side of the machine. The members of this set are known as the setting dials.

The illustrations in this article have been selected to show a few of the tools and methods employed in machining the baseplate and side brackets above referred to

The baseplate, Fig. 25, is shown resting against the corner of a drilling jig to the right, to which reference

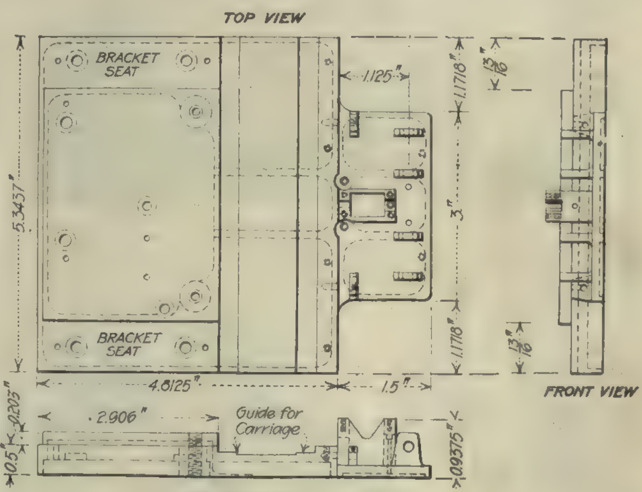


FIG. 27. DETAILS OF BASEPLATE

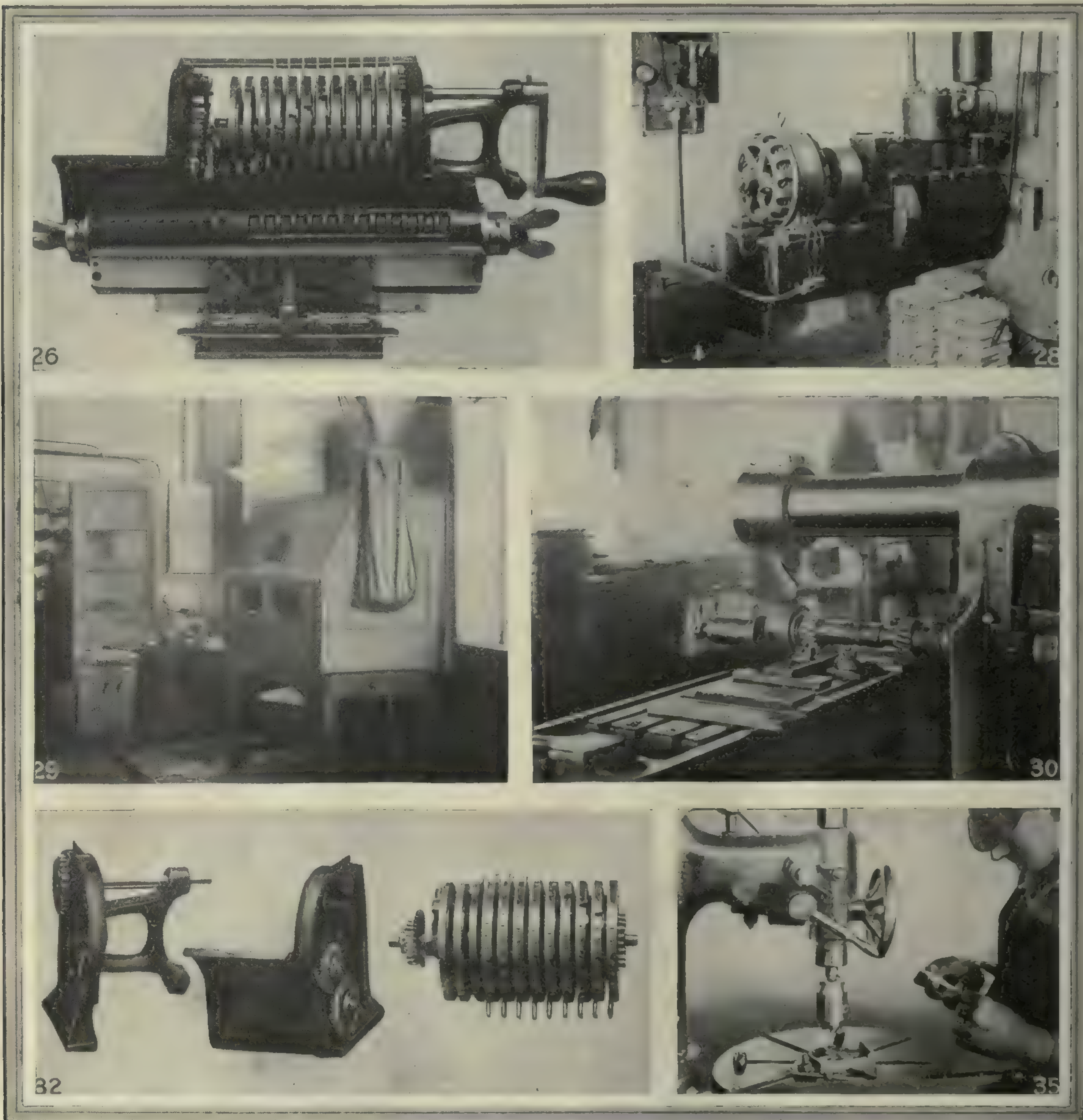
will be made later in this article. In Fig. 26 the baseplate is shown with the carriage in place and with the two side brackets attached to the rear of the base. In this view the cover plate of the machine has been removed so that the brackets and setting dials carried between them may be distinctly seen.

A detail drawing of the baseplate, Fig. 27, gives the dimensions for this part as used on the pony, or the smaller one of the two machines manufactured by the company. It will be noticed that the plate is $5\frac{11}{32}$ in. wide by $4\frac{13}{16}$ in. long over the main portion, with an extension at the front $1\frac{1}{2}$ in. long by 3 in. wide. This extension is adapted to carry the carriage-shifting

mechanism which is arranged as shown in Fig. 26 and which shows the position of the rocker shaft and arms through which motion is transmitted by the key levers to the small pinions engaging with the rack at the front of the carriage.

A stack of baseplate castings as they come into the shop from the foundry is shown in the foreground of Fig. 28. Much of the material is sandblasted in this plant and thus thoroughly cleaned of scale and irregularities to be ready for machining operations. Certain finished members, such as sheet-metal covers and case parts, are also put under the sandblast before enameling, the surface of the metal being thus cleaned and prepared to receive the enamel smoothly and hold it securely after baking.

The machine in the background of Fig. 28 is a motor-driven compressor for supplying air to different machines, among them the sandblast apparatus already mentioned and illustrated in Fig. 29. At the top of the box will be noticed the pressure gage for the air blast and the feed pipe for the sand. The air currents are so controlled that very little sand or dust escapes from the front of the box, and the admission and discharge of the sand are adjusted so that the work may be done under suitable conditions.



FIGS. 26, 28, 29, 30, 32 AND 35. MACHINES, TOOLS AND PROCESSES USED IN MANUFACTURING THE MACHINE
Fig. 26—Baseplate with carriage and side plates in place. Fig. 28—Baseplates ready for starting to the factory. Fig. 29—Sandblast used in the shop. Fig. 30—Milling baseplates. Fig. 32—The side brackets with setting dials. Fig. 35—Facing bracket boss to height

The baseplate casting is finished practically all over. After the bottom surface and the edges are machined, two important operations remain—the finishing of the carriage guide across the baseplate and of the two seats at the rear for the side brackets, the surfaces of both

being machined exactly at right angles to the carriage guideway.

For the operation of milling out the carriage guideway, the baseplate is mounted on the milling-machine table with fixtures that hold it squarely in position, and when the work is ready for the milling of the bracket seats it is located from the carriage guideway to insure the bracket seats being square with the latter. This operation is illustrated in Fig. 30, where a pair of straddle mills are shown passing over the casting.

Gages are used to determine the depth of the cuts, the width of the carriage guideway, and the distance between the bracket seats. The work is also tested for straightness and parallelism and the surface scraped to assure a correct fit at the important points.

upward nearly to the top of the jig cover, which is cut out to clear the lug and which is covered at this point by a tool-steel plate *F* $\frac{1}{4}$ in. thick, in which there are five holes to act as drill guides for putting in the holes in the top of the lug. This plate is hardened and lapped as an individual bushing would be. It is $1\frac{13}{16}$ in. long by $\frac{17}{32}$ in. wide, and at the rear end it has a projection $\frac{5}{32}$ in. wide reaching down $\frac{3}{16}$ in. into a slot in the top of the lug in order to guide the small drill down as near the work surface as possible. This slot, with other small cuts indicated on the detail drawing Fig. 27, is a machining operation which must be performed before the work is ready for drilling.

Another tool-steel block attached to the jig and acting as a drill guide without the use of bushings is shown

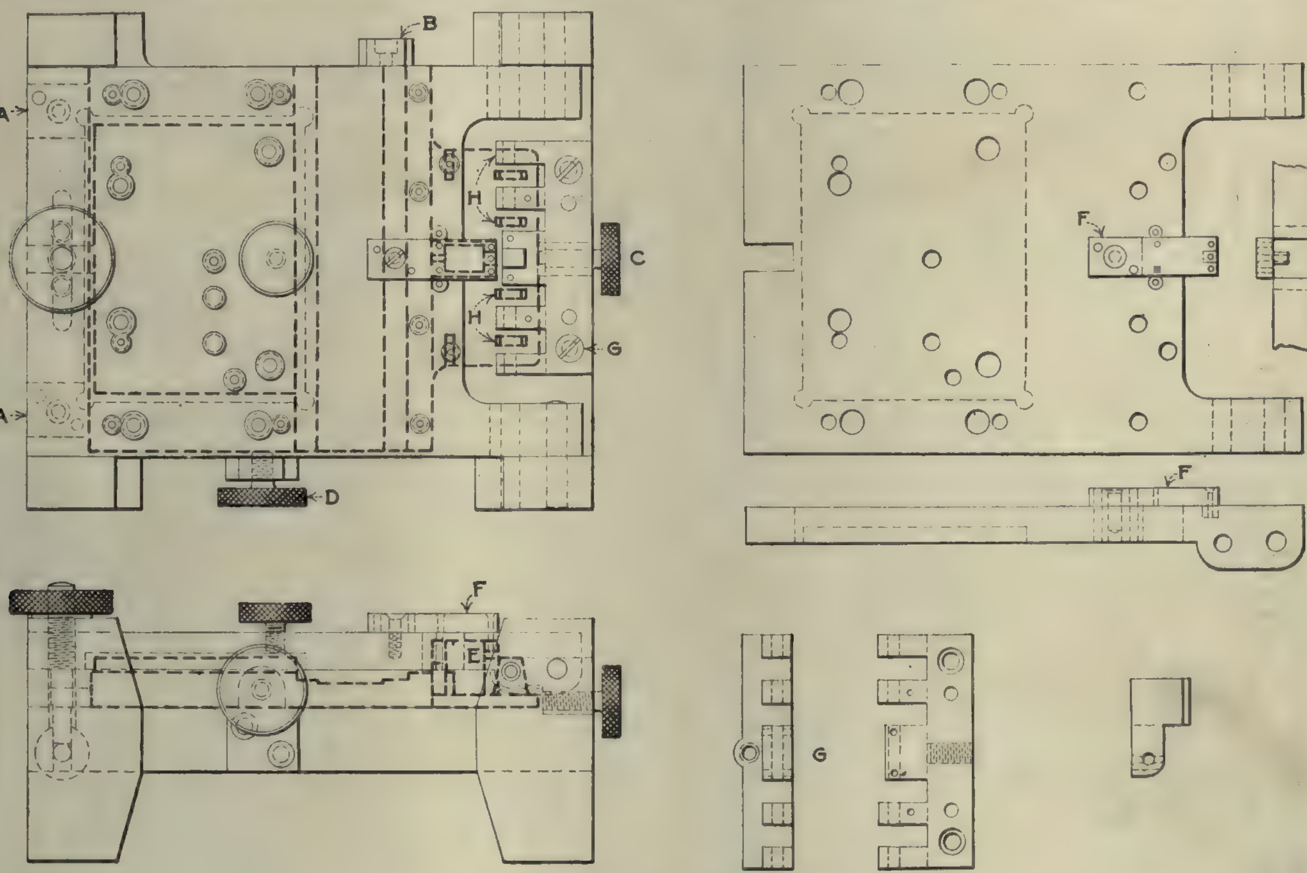


FIG. 31. DRILL JIG FOR BASEPLATE

The drilling of the various holes in the baseplate is accomplished in the jig shown to the right in Fig. 25. A detail drawing is shown in Fig. 31.

This jig is of the leaf, or hinged-cover, type and takes care of the drilling of 42 holes, most of them being small. The baseplate to be drilled is located in the jig with the end of the casting resting against two stops *A*, and the side against stop *B*, the two knurled head screws *C* and *D* being set up lightly to hold the work against the stops. The cover of the jig is secured, when closed, by a small knurled nut on a swinging bolt at the front end; a thumbscrew in the cover holds down the casting while being drilled.

Most of the drill guide bushings are carried in the jig cover. There are, however, near the end of the work a number of small holes which do not permit the use of the usual form of bushing. For example: on the front extension of the work there is a lug *E* projecting

at *G*, Fig. 31. It is secured to the wall of the jig body and is used when the jig is placed on edge for guiding the drill through the thin lugs *H*, of which there are four extending above the face of the baseplate. There are also four smaller holes drilled with the aid of this block when the jig is placed horizontally. This block, like the smaller piece *F*, is fixed in place by means of screws and dowels.

The Side Brackets

The two side brackets, which are secured to the baseplate for carrying the drum of setting dials, are 4 in. high and stand on a base 3 in. long by $\frac{3}{4}$ in. wide. Their general form is well brought out in Fig. 32, which shows an outboard support for the gearshaft attached to the right-hand bracket and a sheet-steel cover secured to the left-hand one. The shape and body proportions are also indicated on the drawing Fig. 33, which shows

the fixture used for grinding the right-side bracket across its face. A similar fixture is employed for the corresponding operation on the left-side bracket, with the stops and clamps in opposite position.

Although this surface-grinding fixture is of simple design, there are two or three points about its construction that are worthy of notice. The locating points of the bracket casting are the base and the back edge of the bracket, which present surfaces at right angles. The casting rests upon a hardened tool-steel block projecting from the face of the fixture as shown at *A*. This block is cut away so as to provide four narrow bearing points on which the work rests. The support *B* for the vertical edge is made in a similar way, but has only two bearing points. There are two pins *C* and *D* shouldered and fitted into the upright face of the fixture at the points represented in the front elevation to receive the thrust of the work during the operation. The lower edge of the piece cannot be moved inward because it bears its full length against the face of the fixture.

The two clamping devices at *E* and *F* serve to hold the work firmly against its seat on stops *A* and *B*. The clamps *E* and *F* are in the form of a rocker arm pivoted near the middle of their length in a fork formed at the top of a steel bracket *G*. Two of these brackets are secured to the inner face of the fixture by two fillister-head screws each. The clamps are of tool steel with hardened points for the gripping ends, the ends being finished to a sharp chisel shape and the end of the oblique clamp at *E* being curved to conform to the casting with which it comes in contact. The inner face of the gripping edge of the clamps is sloped to an angle of 45 deg.; the outer face is nearly vertical.

The edge of each clamp is about $\frac{1}{32}$ in. below the pivotal point, and when the rear end is elevated by tightening the clamping screw the working end swings slightly inward, following a circular path, and this combined with the inner slope on the gripping edge draws the work securely against the stops.

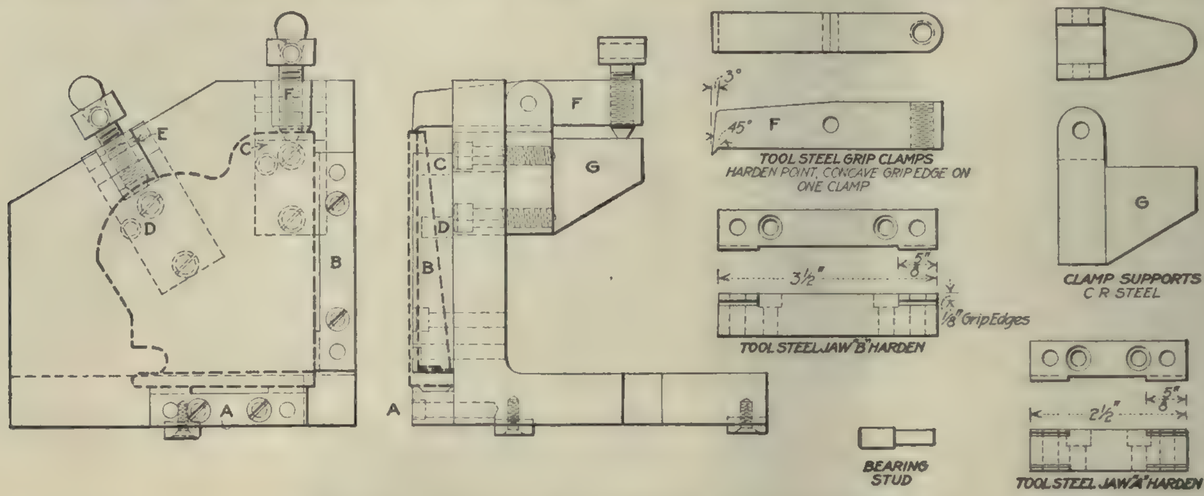


FIG. 33. GRINDING FIXTURE FOR SIDE BRACKETS

Both right and left side brackets are drilled in the one jig illustrated at the left in the Fig. 25 and shown in detail in the line drawing, Fig. 34. This jig has two covers, or bushing plates, one on each side of the central wall. The right and left hand castings, when placed for drilling, rest against this wall, which forms the body of the jig. The base of the casting rests upon the tool-steel angles, secured to the middle wall upon either side, while the vertical edge before mentioned rests against lugs which form the feet on which the jig stands while drilling, pressure being applied in both directions by the knurled-head screws. The thrust of the drill is borne by the middle wall of the jig, on which the flat surface of the bracelet casting rests. The positions of the holes in the side walls and the bottoms of the brackets are shown on the drawing, and it will be

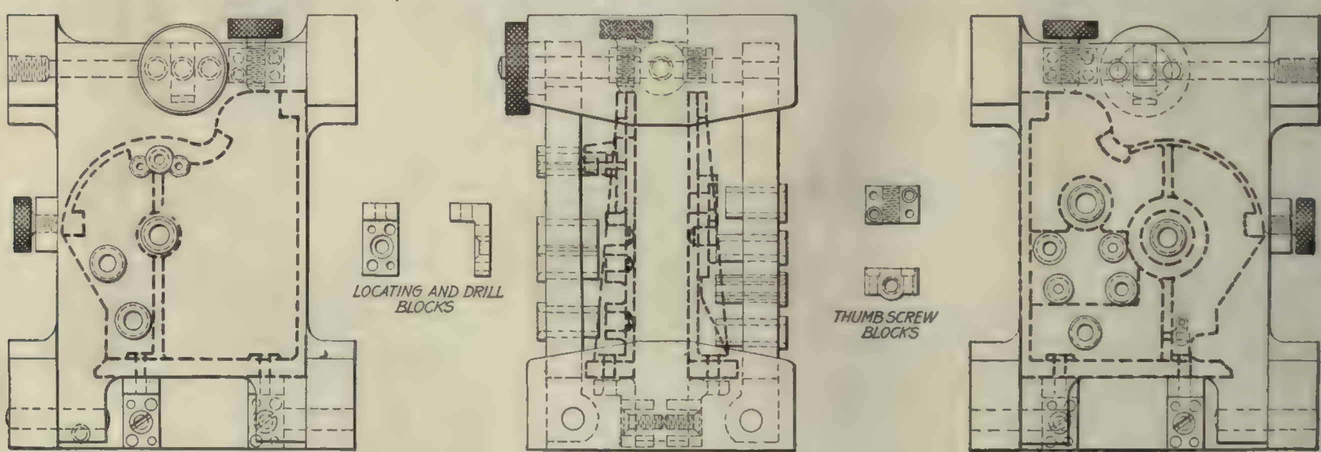


FIG. 34. DRILL JIG FOR SIDE BRACKETS

noticed that in most cases the holes are drilled into bosses which are cast on the side of the bracket to provide the necessary thickness of metal.

Certain of these bosses have to be machined accurately for height, measured from the ground face of the bracket, and in the process of facing off such bosses with counterbores care must be taken to preserve the required thickness. The facing operation is performed after the brackets are removed from the jig, the work being placed on the table of the drilling machine, as in Fig. 35. The stop on the quill of the drilling machine is set as accurately as possible, but further check is maintained on the work by calipering each casting with the micrometer until the exact dimension over the boss is obtained.

Counterbores with various sizes of pilots to fit the different reamed holes in the work are provided in the outfit of tools. The holes themselves, particularly the bearing holes for the shaft of the setting dial drum and for the operating gearshafts, are located and accurately finished in the jig, as are the holes in the bottoms of the brackets for the screws and dowels by which these brackets are positively located on the baseplate of the calculating machine, so that true alignment is maintained when the machine parts are assembled.

The Modern Foreman—What Is His Present Job?

By Entropy

Once a foreman was the whole thing. He hired his own men, paid them what he pleased, fired them at will. He practically bought the machinery and tools for his department, and whenever the notion seemed good he redesigned not only the jigs and fixtures but the very product he was making. He was practically general manager of his department and could thumb his nose at the proprietor because all knowledge of what had been turned out in his department was contained in a little notebook in his hip pocket. The only restraint put on him was the fear that if the owner of the plant discovered he was making too much money on his job that next year's price might be cut.

Things are a bit different today. This old stager overworked a good thing and made more money than the man who risked his capital. Now we have an efficiency department and a planning department, and an engineering department, and an employment department, all doing things which the old-timer half did and got away with. Now when a job comes to his department with it comes a blueprint from which he dares not deviate because his work is all inspected by people to whom he is no terror; with it a route sheet showing what machine, tools and methods to use for every step in the work and a schedule of rates for paying for the work. It seems sometimes as though every function had been diverted and that he was merely a clerk to transmit orders to the individual men who could not understand what came from the office.

However there are two very valuable functions still left. They are both most important, but not always realized. These are leadership and instruction. Discipline now is a dead letter in its old sense. Laying a man off to give him a chance to think over his sins no longer works, because it means either a much-wished-for vacation or else a change of job, of which he might not have thought had he not had an enforced opportunity to look it up.

The only hope which a foreman has today of making himself additionally valuable is through leading his men—not driving them. Any tendency to arbitrary driving shows immediately in the labor turnover. Formerly this was not followed up by the management, but now it is taken as just as important a part of the business barometer as the cost accounts. Keeping men means making the best possible use of the best that can be had and attracting better men by making it possible for them to run their production up to large figures.

Reducing the Breaking-in Period

One essential is that the breaking-in period be reduced as much as possible. This is just as desirable and profitable to the management as to the employees. The management pays for time wasted while the new man is learning the ways of the shops and his new duties, and the man loses especially in a shop where piecework prevails. We often hear a foreman lament that the kind of men whom he can get cannot be taught anything. Such a foreman, if he really believes his own statement, should give up being a foreman and get some other job, because teaching his men something and doing it quickly is the biggest part of his job.

No good comes from aping the ways of the college professor and the school-teacher. The first is teaching things which the pupil almost knows and the latter is teaching pupils who come by compulsion. Men in the shop must be approached on the ground that they can be offered help. The approach is almost always an appeal to the pocketbook. "Let me show you how you can set that job up in half the time." "If you will lift with your legs instead of your back you can get the thing up there easier and quicker." Such remarks open the way to more production and make the workman feel that the foreman is working for his interest. And really the man who has helped you get an increase in pay is the man that you stick to closest. Every foreman who reads this will immediately say that this hits someone else, but not him. That is where he is mistaken. It hits him and everyone that he knows. There are foremen who have exceptional ability to train men, but the number who go at it intelligently is almost at zero. It is not enough to tell a man what he ought to do. He must know why that is the best thing and he must have faith in the foreman, who really knows what is best. Telling a man what to do and having him understand it are two different things. The new man in the shop may be bright and quick and he may be dull and stupid, but we need both of them if we are going to get out production. The dull, stupid man is harder to show, but the most dependable after he once gets it through his head. It is cheaper to hire a dull man and put him on a dull man's job and have him stay than to hire a dozen bright men, break each one in quickly and have them chasing each other out of the shop.

Time, patience and perseverance, the old trio, go together just as surely as they ever did, and our modern foreman must have them all if he is going to hold his own, to say nothing of going ahead.

Training of War Welders

By M. J. CARNEY

President of the Oxweld Acetylene Co. and the Prest-O-Lite Co., Inc.

We are very glad to give our readers an authoritative article on the subject of increasing the number of welders. It is one that demands immediate attention. At our request Mr. Carney has herewith expressed his views as to how this matter should be handled.

THE past decade has shown a remarkable growth in the recognition of the importance and utility of oxyacetylene welding and cutting as a factor in developing the metal-working industry in America. Since the entrance of the United States into the world war the oxyacetylene process has received recognition as a leading essential in winning the war.

Prior to our entrance into the war the shortage of welders was keenly felt. This resulted in a great influx of partially trained welders, who, lacking the proper training and experience, reflected seriously on the worth of the process.

The demands on our peace industries prior to April, 1917, were severe, and increased production in practically every branch of metal working made this shortage of trained welders acutely felt. Subsequently the increased production due to manufacturing war necessities for our own use further seriously taxed the welding capacity of the country.

Welding and cutting processes have taken an important position in the building of ships, locomotives and rolling stock, the production of airplanes and automobiles, the manufacture of munitions and ordnance, the cutting of armor plate, and other requisites.

The Draft Took Many Welders

Most of the welders of the country are between the ages of 21 and 31, consequently when the first draft call was made the already inadequate supply of welders was further depleted. By the working of the draft these welders were lost to industry, and their industrial value to the military department was also lost.

With this condition facing the industry a call now comes from practically every section of the military department for experienced welders. They are required for the maintenance and repair of military equipment, such as locomotives, rolling stock, tracks, air motors, metal parts of airplanes, motor trucks, tanks, water and sanitary systems; for the construction and demolition of bridges and steel structures, the upkeep of base-repair-shop equipment, destroying guns about to fall into the hands of the enemy and emergency repairs to guns in the field.

It is estimated that about 5000 welders are needed at once to perform these important tasks, and while they cannot be spared from essential industries, they must be found. The question then is, from where, and how?

This brings us to the question of the source from which potential welders may be drawn.

In the ranks of the drafted army can undoubtedly be found men of sufficient mechanical ability who under proper instruction are capable of being developed into excellent welders.

Assuming that these men can be made available from the drafted ranks, we come to the question of their training. The superficially trained welder is a liability, not an asset. There is no trade in which the reliability of the work depends more on the personal factor than welding.

Of the war welder: Most of the work will be of an emergency nature on which large issues may depend; consequently great care must be taken that in his training he will obtain not only a knowledge of the theory of welding but also sufficient practical experience to enable him to apply it even under adverse conditions.

In developing trained welders for this emergency, time is a vital factor. It has been proved in the industries that a fairly proficient welder may be made in three to four months, but it usually requires about two years to train a man so that he can be classed as an expert. However, the military needs are so urgent that they cannot wait for experts; therefore under this pressure what is the shortest period of time in which welders with sufficient experience can be turned out?

It is evident that the training must be of a highly intensified nature. The student welder should be selected from among those who have some experience in the metal trades and must be given a sufficient amount of theory, be able to identify the metals and their peculiar properties, thoroughly understand the principles of welding by fusion, be familiar with the effects of the different phases of the oxyacetylene flame, thoroughly understand his apparatus, recognize the necessity of proper equipment and materials to work with, and be able to plan and lay out his work so that he can produce a satisfactory weld in the shortest time.

The Limitations of Welding

The welder must also consider the practicability of the work before him, be familiar with the properties of the weld and have some knowledge of the mechanical and physical requirements of the weld in service.

Combined with the foregoing and absorbing by far the major portion of his period of training should be thorough practice in the actual manipulation of the blowpipe and the performance of representative jobs. In order to adequately cover these points in the training of a welder a minimum period of eight weeks is required. During this time the student should be under the direction and observation of skilled instructors; he must devote at least five hours a day to the actual handling of the blowpipe; his interest must be sustained by lectures and demonstrations of the process, and his whole atmosphere must be that of intense and concentrated training.

Every welder so trained should be competent to immediately take hold of welding and cutting work and should not require further training and instruction such as would be required if a shorter course were adopted. Any attempt to turn out practical welders in less than eight weeks and under less stringent conditions than outlined would be unwise and even dangerous.

Sidelights

EDITED BY E. C. PORTER

Shell manufacturers in Canada now produce 800,000 complete shells every week, which is more than was produced before the war by any nation except Germany.

* * *

More than 70,000 acres of land in this country has been planted with castor-bean plants to produce sufficient oil for aircraft.

* * *

During twelve months the number of United States army hospitals increased from seven to 63 and from 5000 beds to 58,400. Thirty thousand more beds are being added.

* * *

Save a quarter a day and it amounts to nearly $100 a year. Put by as little as $50 a year (that means less than 14 cents day) and at the end of 20 years it will amount to $1,383.38 at 3 per cent., $1,463.42 at 3½ per cent., $1,548.46 at 4 per cent.

* * *

There are eleven shipbuilding plants on the Delaware River, which at the present have 53 shipways in use or ready for use. The expansions and improvements now going on will bring the total number of shipways to 113. These plants have orders for the building of 382 vessels valued at half a billion dollars, all of them under construction for the Emergency Fleet Corporation. The total deadweight tonnage involved is 3,200,000. Sixty thousand men are employed, or 33 per cent. more than the number in the whole shipbuilding industry of the United States before the war. These 60,000 men earn $2,000,000 a week.

* * *

It has been estimated by the Treasury Department of the United States that the total money cost of the present war to Aug. 1, 1918, will be as follows: United States $13,000,000,000, Great Britain $34,000,000,000, France $23,800,000,000, Russia $21,500,000,000, Italy $7,500,000,000, Belgium, Serbia, Portugal, Rumania $6,600,000,000, Germany $29,500,000,000, Austria-Hungary, Turkey, Bulgaria $19,700,000,000, a total for all of $155,600,000,000. These figures compare as follows with the approximate money cost of the world's most notable struggles: Napoleonic wars, 1793-1815, $6,250,000,000; Crimean war, 1853-1856, $1,000,000,000; American Civil War, 1861-1865, $8,000,000,000; Franco-Prussian war, 1870-1871, $3,500,000,000; South African war, 1900-1902, $1,250,000,000; Russo-Japanese war, 1904-1905, $2,500,000,000.

* * *

March imports and exports show a partial recovery from the decline in recent months, according to a statement issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce. Exports for March amounted to $531,000,000, an increase of $119,000,000 over February. For the nine months ended with March exports were valued at $4,394,000,000, a decrease from the $4,637,000,000 recorded for the nine-month period a year ago. Imports were valued at $242,000,000, a gain of $34,000,000 over February. During the nine months ended with March imports amounted to $2,084,000,000 against $1,818,000,000 a year ago. Imports of gold during March amounted to less than $2,000,000 and during the nine months ended with March to $83,000,000 against $801,000,000 for the nine months in 1917. Exports of gold were valued at less than $3,000,000 in March, and for the nine months ended with March amounted to $181,000,000 against $150,000,000 in 1917. Imports as well as exports of silver are somewhat larger this year than in 1917, the imports amounting to $7,000,000 in March and to $53,000,000 in the nine-months period against $26,000,000 for the corresponding period in 1917. Exports of silver amounted to $13,000,000 in March, and to $72,000,000 for the nine-month period against $59,000,000 in 1917.

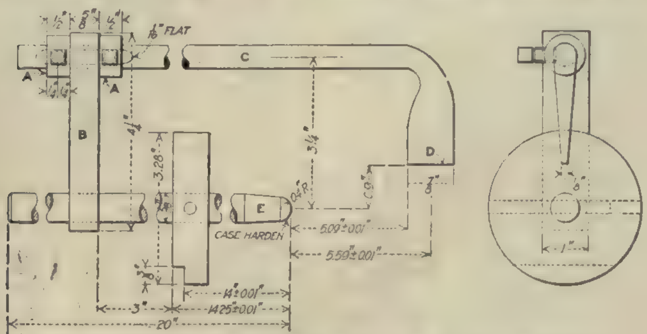
* * *

Italy's leading airplane factory, the S. I. A. (Societa Italiana Aviazione) now finds employment for 2850 people, of whom 1050 are women. The S. I. A. is an offshoot of the Fiat Motor Car Co. created since the war for the production of airplanes only apart from engines. Although S. I. A. airplanes have been supplied to all the allies they have only become known to the general public by such sensational exploits as the nonstop flight from Turin to London and the still longer nonstop flight from Turin to Naples and return, both performed by Captain Laureati. The main S. I. A. factory is at Turin, near the Fiat factory, but is independent of the latter for all its supplies except some small bronze parts. The main buildings cover an area of more than 36,000 sq.yd., while the propeller and woodworking departments, which are separate, occupy 44,000 sq.yd. With the various outside services the total covered area is nearly 90,000 sq.yd. In addition to the factory the company has its own sheds and flying ground. Within a very short time these sheds will occupy an area of 15,000 sq.yd., while the flying ground now covers an area of 40,000 sq.yd. As an indication of the varied amount of work in the building of an airplane it may be mentioned that the S. I. A. factory has 19 distinct departments, this, of course, being exclusive of the engine works. The various power-driven machines total nearly 300, all of these being run day and night in two shifts of 11 hours each. The average working day is 10 to 11 hours, with an average of 60 to 72 a week, for under war conditions there is no half-day holiday. It is not considered advisable to state the number of finished airplanes shipped every day from the S. I. A. factory after having been flown and accepted by the authorities, but this number is higher than the number of motar cars produced daily by some important European factories before the war. Three types of airplanes are built, all of them fitted with Fiat engines.

Nose-Thickness Gage for 5-in. Shells

By R. S. Myers

The illustration shows a gage for checking the thickness of a 5-in. navy-shell nose on the cutting-off operation. The part *C* is machine steel, casehardened



NOSE-THICKNESS GAGE FOR 5-IN. NAVY SHELLS

at point *D*, and can be adjusted by collars *A* to accommodate any thickness of nose desired.

To use, insert point *E* into the cavity of the shell, then rotate *C* until point *D* is over the end of the shell, *C* having a free radial movement in the hole of part *B*.

Molding a Propeller Hub

By Charles A. Otto

In our ship-repairing centers it is very necessary to make use of the quickest methods in repairing or replacing any portion of a ship that it may be ready to go to sea with the least possible delay. This requirement is fully recognized in more peaceful times, but in these strenuous times of national emergency it becomes doubly essential that our docks and basins shall not become congested or that ships shall not lie up preparatory to repairs being executed. It is of primary importance that as large a proportion as possible of our vessels in war service should be maintained in a seaworthy condition. This involves increased efficiency and the initiation of new methods. The labor expense of making repairs is only incidental to the cost of lost time.

A short time ago a propeller hub for a ship was urgently required. The ship was in dock for repairs of less importance and the firm making repairs had been requested to have the ship ready at a specified time. To meet the case it was necessary to secure the casting for the propeller hub without delay. The method usually adopted in preparing a mold for such a casting is by means of a wood pattern and core box, which involves a considerable amount of work in the pattern shop. To overcome the need for so much time on pattern work, it was decided to prepare a loam pattern by means of a sweeping board revolved about a vertical spindle.

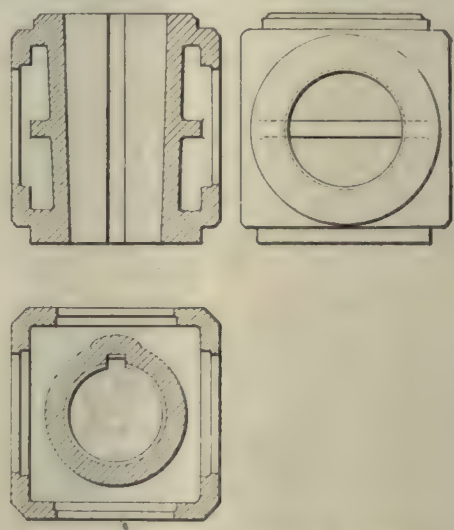


FIG. 1. THE PROPELLER HUB

The sketches shown in Fig. 1 are three views representing the propeller hub required, the top and bottom of which were intended to have steel rings shrunk on.

Working in conjunction with the foundry, the pattern shop supplied a cup-board and a hub-board, sim-

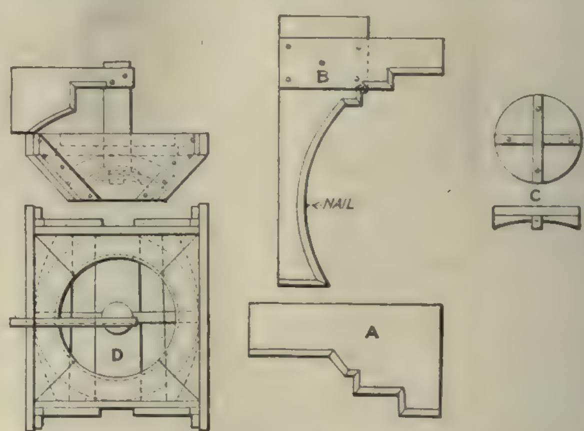


FIG.3 FIG. 2

FIGS. 2 AND 3. THE CUP-BOARD AND CORE BOX

ilar to those which are used in sweeping up the hub for a solid propeller. The cup-board shown at *A*, Fig. 2, was used to sweep out a bearing or cup to support the sweeping up of the complete pattern. After this had

been swept up in the loam and allowed to stiffen a little, the inside was dusted with parting sand and a bedding of loam made to receive a plate suitable for lifting the loam pattern when completed. This plate was of clay, washed and bedded in the loam in the cup. The sweeping board *B*, shown in Fig. 2, was attached to the spindle, and the spherical hub was swept up, brick and loam being used in the process. When this was satisfactory it was placed in the oven to be dried.

Fig. 3 illustrates the core box which was supplied, four cores being required from it; one as shown, and three without the piece marked *D*. It will be noted that the flats on the propeller hub were obtained by sweeping a spherical portion on the cores to fill in the mold, and also a print to set it in the mold correctly.

The grids for these cores were made in two pieces and bolted or wedged together when making the cores. Arrangements were made for lifting these cores in a vertical position for placing in the mold and for securing each core to the side of the box when set in its correct place. In each case a staple cast into the grid was sufficient.

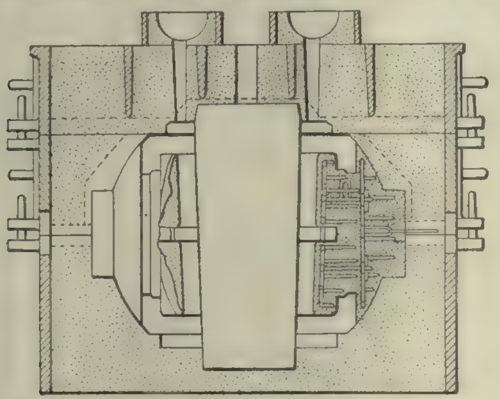


FIG. 4. THE JOB READY FOR CASTING

When the loam pattern was dry and withdrawn from the stove, the four centers were marked and the four prints *C*, Fig. 2, were attached. A nail fixed in the center of the main sweeping board made it a comparatively easy matter to fix the prints in their correct relative positions, as the mark formed thereby was divided off easily. The cup-board was used in preparing a bed for the loam pattern; the ramming of the sand comprising the bottom of the mold was more easily accomplished in this way. The pattern was lowered into the portion of the mold thus formed, and the bottom box was set so that the top of it was approximately in a line with the centers of the four prints. It was then rammed up with sand to form a joint. This method was followed with a middle box, making another joint near to the top of the job as shown in Fig. 4, and rammed up to make a covering box part. A good strip was obtained and the loam pattern lifted out whole. After a little cleaning up the mold was dried, then blackened and dried again preparatory to setting the cores. The center core being of a simple character was made on a spindle revolved horizontally on racks.

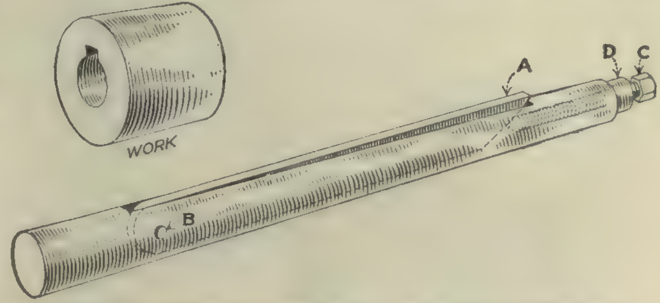
Fig. 4 shows the job with cores set and ready for clamping down preparatory to casting. The time occupied in producing a successful casting was considerably less than would have been required had the complete pattern been made in the pattern shop.

Tool for Cutting Keyways in Small Bushings

BY S. H. DRAKE

It being necessary to cut keyways in a number of bushings of $\frac{3}{16}$-in. bore, and no means of broaching them being at hand, the tool here illustrated was devised. While this is not advocated as an efficient method of manufacturing, as a makeshift it removed a difficulty very satisfactorily.

A piece of drill rod to fit the bore of the bushing was slotted through the center and the blade *A* set in and



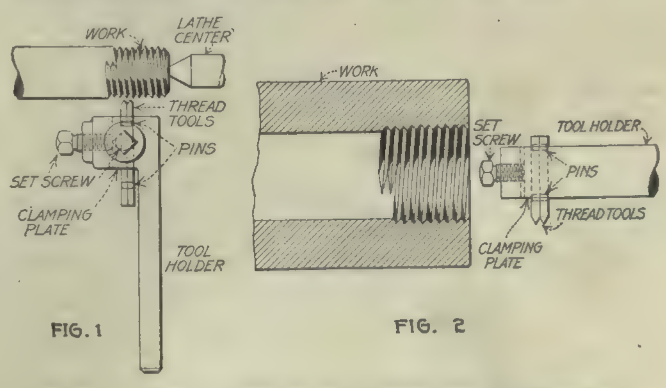
TOOL FOR CUTTING KEYWAY IN SMALL BUSHING

pivoted at *B*. Care was taken to have the end of the blade bear against the metal of the bar at the end of the slot so as to relieve the pin *B* of the thrust. The cutter is fed to the cut by the pointed screw *C* bearing on the beveled end of the cutter, the screw being turned in a little after each pass of the cutter until the stop collar *D* comes in contact with the end of the bar; the position of the collar determines the depth of cut. The bar was held in the chuck of the sensitive drilling machine, the movement being obtained by means of the hand lever.

Cutting Double Threads in One Operation

BY CHARLES EISLER

The accompanying illustration shows tools that have been in use by the writer for some time for cutting double threads; and they have saved considerable time



FIGS. 1 AND 2. TOOLS FOR OUTSIDE AND INSIDE THREADS

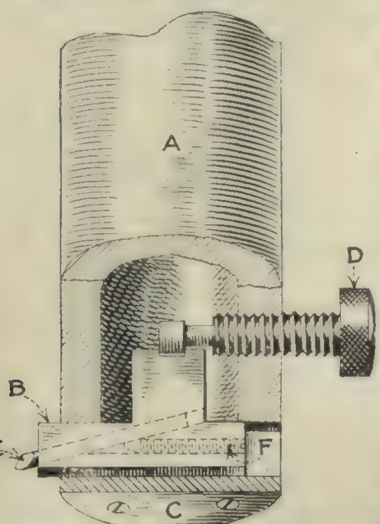
and avoided the necessity for changing gears for the second cut. The tool bits are ground all over upon the surface-grinding machine and are accurately fitted to the correct center distance. When once properly set,

the operation is no different from cutting a single thread. Fig. 1 shows the tool set for the male thread and Fig. 2 shows the method of applying it to chasing or cutting of inside threads.

Undercutting Tool for Tap Holes

By H. D. Chapman

The illustration shows a tool which the writer employed to undercut a number of holes that were to be tapped to the bottom. The body of the tool *A* was turned to a loose fit in the hole to be tapped and the shank fitted to the spindle of a drilling machine. In the illustration the lower part of the tool is shown in section in order to make clear the method of construction.



THE TOOL FOR UNDERCUTTING

The tool is chambered and a slot cut across its diameter to fit the cross-slide *B* which is held in place by the round cap *C*. A projection upon the cross-slide extends into the chamber and is slotted to receive the enlarged end of the feed screw *D*. The cutting tool *E* is fitted to the cross-slide and is bound by the screw *F*. The tool, with the cutter drawn back into the bar, is run down to the bottom of the hole, the machine is started and the tool fed out by means of the feed screw until the required depth of undercut is reached, when the machine is stopped, the cutter run back and the tool transferred to the next hole.

Manufacturing a Steel Chair

By S. A. McDonald

An article on page 92 of *American Machinist* by G. F. Wetzel describes in a very clear and instructive manner a method of manufacturing steel chairs.

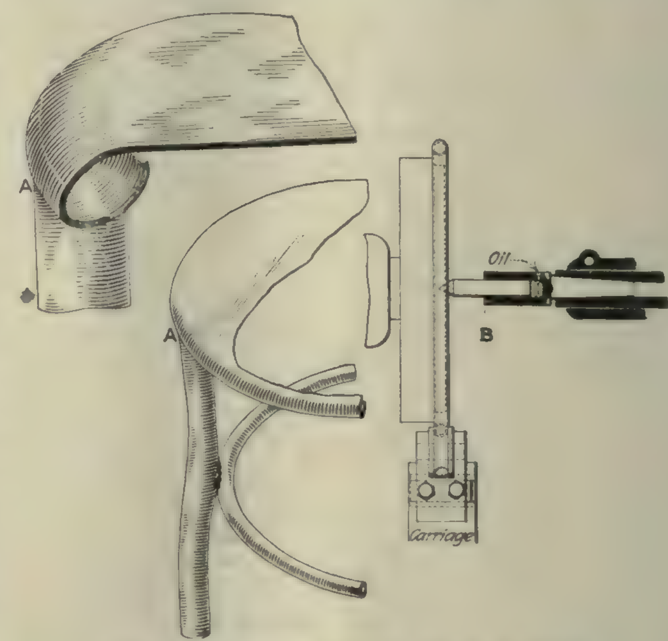
My experience in sheet-metal work and acetylene welding leads me to suggest that in making the seat the blank be made larger and the edge spun over as shown at *A* in the accompanying illustration. This would eliminate the spot welding of the seat and also the necessity for filing and grinding the edges, which operation must consume considerable time.

Another advantage of this method is derived from the fact that the spinning operation removes all scale from the bead, leaving the metal clean and smooth and in excellent condition for welding.

The spinning operation can be performed in the lathe, the method and the tools required being shown at *B* in the illustration. The blank could be located on the faceplate by the perforations if this perforating was done before spinning, in which case the holding plate need be brought up only with sufficient pressure to prevent the beading roll from bending the blank away from the faceplate. The tail center is designed to revolve, and the thrust is taken by two hardened steel buttons, provision being made to keep this bearing well supplied with oil.

The bracket carrying the beading roll is firmly fastened to the lathe carriage in any convenient manner. The roll, the shape of which is clearly shown in the sketch, may be made of machine steel and casehardened, but if many pieces are to be beaded, I would advise making it of tool steel properly hardened, as the work is apt to cause the surface of the roll to roughen.

As stated by Mr. Wetzel, forming dies of cast iron stand up very well; but sometimes, when quick delivery is required and there is not time to wait for patterns



METAL CHAIR SEAT WITH BEADED EDGE

and castings, it is advisable to consider the possibilities of machine steel for this purpose. I have used machine-steel bars formed into rings which have acetylene-welded joints—the rings being finished in the lathe—and I find that they stand up better than cast iron, especially if they are casehardened.

Thread Limit Gages and Master Gage

By Joseph K. Long

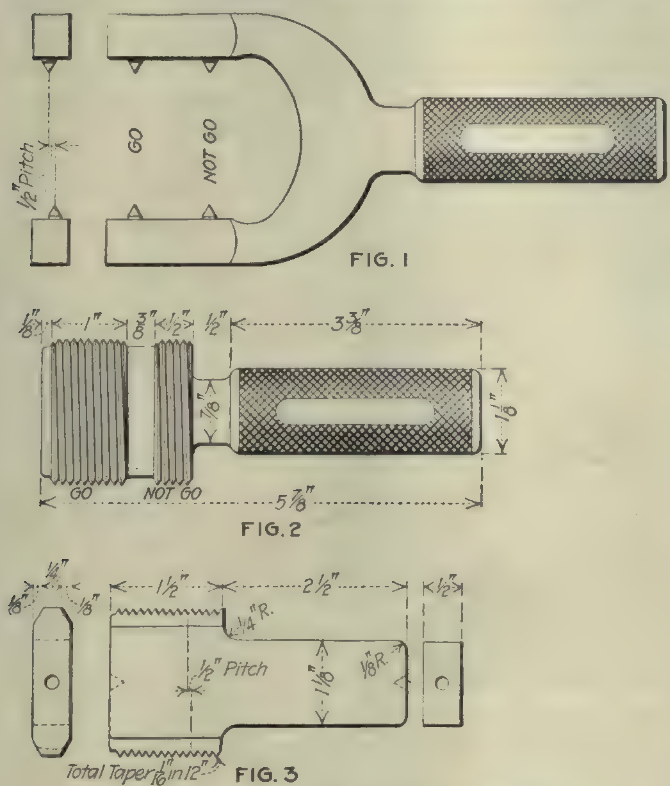
The illustrations show limit gages for the threads of 2,- 2½- and 3½-in. crosshead pins and nuts as used in locomotive construction, all being 10 pitch.

Fig. 1 shows the working or shop gage for outside threads. The pins or measuring points are ground to the correct thread angle, and each pair are set one-half of the pitch apart measured from a vertical center line, as shown in the end view. The first pair of pins, or go gage, are set to pass over pitch diameters of 1.935, 2.435 and 3.435 for the two 2½- and 3½-in. threads respectively, while the no-go gages are 1.932, 2.432 and 3.431 for the same sizes.

Fig. 2 is a plug gage for the nuts, and the same tolerances are allowed; that is, the go gage is of the same diameter as the relative part of the outside gage, and the no-go gage is 0.003 larger in each of the

respective sizes. The handles of these plugs are knurled and a flat spot is milled on them to provide a place for stamping sizes, pitch, identification number or other information.

The master gage, Fig. 3, is flat, $\frac{1}{2}$ in. thick, and on its threaded portion is slightly tapered, the taper being about $\frac{1}{16}$ in. a foot. At a point one-third of the way from the end the diameters of the gages are 1.932, 2.432 and 3.431 in. respectively, while two-thirds of the way from the end they are 1.935, 2.435 and 3.435 in. for the corresponding sizes. The master gage is used for testing and correcting the outside working gages, while the latter serves the same purpose for the plug gages.



FIGS. 1 TO 3. THE THREE GAGES

A Form for Pattern Orders

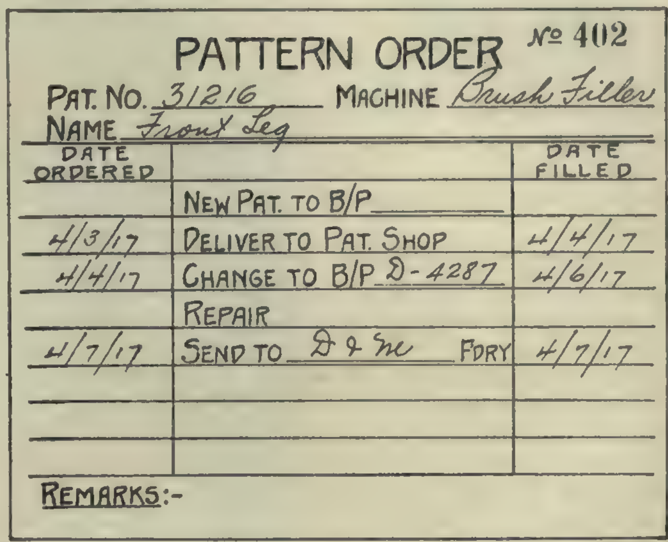
By T. A. Bryson

In a small shop where castings are made at various outside foundries and there is considerable movement of patterns from place to place, there are many chances for delays unless some follow-up system is used. The illustration shows a form designed to cover all orders concerning patterns, and through considerable use it has been found very satisfactory to all.

Its use may be explained as follows: A pattern stored at the D. & M. foundry requires alteration. An order is made out in duplicate by the engineering department, and on the line marked "Deliver to Pattern Shop" the date is entered in the "Date Ordered" column. The duplicate is filed in this department.

The original is sent to the pattern clerk, who fills in the "Date Filled" column when the pattern is delivered, and returns the order to the engineering department. The "Date Ordered" is then entered on the "Change to B. P." line, and the duplicate is brought up to date by copying from the original all notes that have been added. The original now goes to the pattern shop together with a blueprint showing the work to be done.

This procedure is continued until the pattern finds its way to the foundry again, the order returning to the engineering department for every addition in the "Date Ordered" column. A space for remarks is provided for special instructions, sketches, etc. The form



PATTERN ORDER № 402

PAT. NO. 31216 MACHINE Brush Filler
NAME Front Leg

DATE ORDERED		DATE FILLED
	NEW PAT. TO B/P	
4/3/17	DELIVER TO PAT. SHOP	4/4/17
4/4/17	CHANGE TO B/P D-4287	4/6/17
	REPAIR	
4/7/17	SEND TO D & M FDRY	4/7/17

REMARKS:-

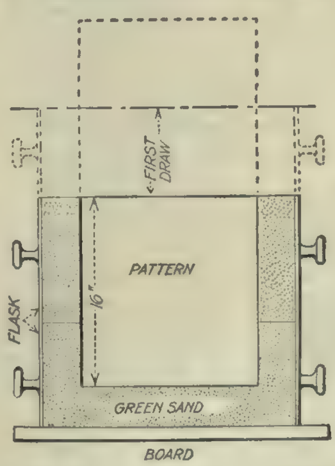
A FORM FOR PATTERN ORDER

avoids misunderstanding of verbal instructions, serves the purpose of several individual orders, fixes responsibility for delays, etc., and the duplicate file in the engineering department shows the status of every pattern in process.

Molding Cylindrical Patterns on the Installment Plan

By M. E. Duggan

Two round castings were required of the same diameter but of different lengths. They were to be 12 in. in diameter and 16 and 38 in. long respectively. The patternmaker made two patterns, the longer one split lengthwise for molding on the side. The molder, however, did not use the longer pattern at all, but for this casting set the shorter pattern on end, ramming it up in the usual way. Then drawing the pattern partly out of the mold he added another flask and rammed up this section, repeating the process until the mold was of the required length or depth. Patterns for use in this manner should be without draft and the pressure of the sand against the sides will support it in the successive positions. The illustration shows plainly the manner of procedure.



MAKING A CASTING LONGER THAN THE PATTERN

Editorials

The Needs of the Aircraft Board

THE recent changes in the personnel of the Aircraft Board is sufficient evidence that the results previously obtained were not satisfactory. The introduction of a well-known business man, John F. Ryan, who is to be given full charge of production is a recognition of the fact that the production of munitions and implements of war is a manufacturing and not a military problem.

From the best evidence that can be gathered the main trouble with the old management was that it depended too much upon theorists and too little upon the practical men of the industry. For, although the airplane industry was small in this country, it contained builders who had actually built hundreds of more or less successful planes for various purposes, and whose opinions were scarcely invited in this all-important problem. Engineers of long experience in motor design were turned over to committees of college professors and students who had almost no practical experience in this work. Airplane compasses were condemned for small air bubbles which always appear when a liquid compass is shipped, and which can be remedied in five minutes by any practical man.

Young graduates of military schools were sent as inspectors and as engineers to plants which had built planes while they were in short pants, and experienced engineers were obliged to change designs at their orders. Inspectors with no practical knowledge were allowed to hold up what little production was attempted by making demands which were impossible of fulfillment. Specifications were written which could not be complied with and which would be excruciatingly funny if it were not for the seriousness of the situation.

These instances are cited not in the spirit of fault-finding but to point out some of the pitfalls to be avoided if the new management is to be successful, as we believe it will be. It boils itself down to the common-sense plan, which any good business man will follow, of securing the most practical engineers possible, of consulting the best manufacturers and of preventing mere theorists from interfering with production.

With such a corps of engineering advisers, coupled with the practical business sense which sees clearly the necessity of securing as many good airplanes as possible in a given time, we need have no fear as to the results. Such a combination of intelligence will decide upon the best type of machine available and build a large number of them as rapidly as possible. They will realize that they will not be perfect machines and that it will be criticised. But they will also realize that no machine will ever be perfect; that it is far better to have a thousand or ten thousand machines which will give a good account of themselves than to wait for better machines next year; that it is far better to be criticised for something done than for letting the precious days go by with nothing to show for it.

Men like John F. Ryan have succeeded because they have had the courage to decide on what seemed to be the best method and to get something done rather than to attempt to play safe and to attempt perfection. They have made mistakes, but they have been right in the majority of cases, and they have accomplished the desired results. They have preferred action with the possibility of error to inaction with its waste of time and of lives in such a case as this.

The people of this country can forgive honest mistakes even if these mistakes involve a waste of money. They will not forgive inaction when thousands of our boys are in danger on the other side; they will not forgive graft nor favoritism.

We have a plane-building capacity of from 50 to 100 planes a day if it is utilized to its best advantage, and this can be increased if necessary. We have mechanical brains and skill at least as great as can be found elsewhere. We have a far greater manufacturing capacity which is anxious to be utilized. And it is manufacturing capacity which is going to count in this war. The present task is to utilize the capacity we have rather than to establish new factories. And this only means that we shall decide upon what to build, and then to build it with all our might.

We believe that the new personnel will utilize these possibilities.

Coal for Next Winter

ACCORDING to those who are close to the coal situation we are likely to have trouble next winter unless every precaution is taken and unless there is great coöperation between the industries and domestic users. The demands on transportation were materially increased by the German drive so that it became necessary to utilize coal cars for other purposes than the carrying of coal. As a result many of the mines are not receiving cars enough to keep in operation, and this means that miners are idle, that coal is not being mined as we had hoped and that many of the miners may be forced into other occupations.

This situation is being relieved to some extent, and the general plan is to get all the coal possible mined during the summer. The report comes from some quarters, however, that orders are not being placed and that dealers do not know how much to order. This is mostly for industrial uses and is attributed to a holding back in the hope that prices may be lowered.

The men who know the situation and all its possibilities are urging all to place their orders now so that there may be no delays on account of dealers not ordering from the mines. By placing orders as soon as possible, arranging for storing as much as can be stored, and doing all we can to get much coal into the different industrial districts before next winter, we can probably avoid many of the hardships of the past winter.

ORDNANCE DEPARTMENT

GEN. C.C. WILLIAMS

The New Chief of Ordnance

GEN. CHARLES B. WHEELER, who since the retirement of General Crozier has been Acting Chief of Ordnance, has gone to France to study ordnance conditions at first hand.

The new chief is Gen. C. C. Williams, whose experience makes an excellent groundwork for his new duties. General Williams (then Major Williams) was in direct charge of the shops at the Watertown arsenal, General Wheeler (then Colonel) being the commandant. His success in the handling of men and his knowledge of shop work and methods cannot fail to be of great value in his new work.

It was General Williams who went to England and learned the Hadfield process of making projectiles in order to install the system at Watertown on his return. From here he went to the proving grounds at Sandy Hook, then to the border during the Mexican eruption, and to France with General Pershing last June. All this experience, backed by an actual knowledge of conditions and the needs of the army in France, makes General Williams admirably fitted for the strenuous work which lies before him.

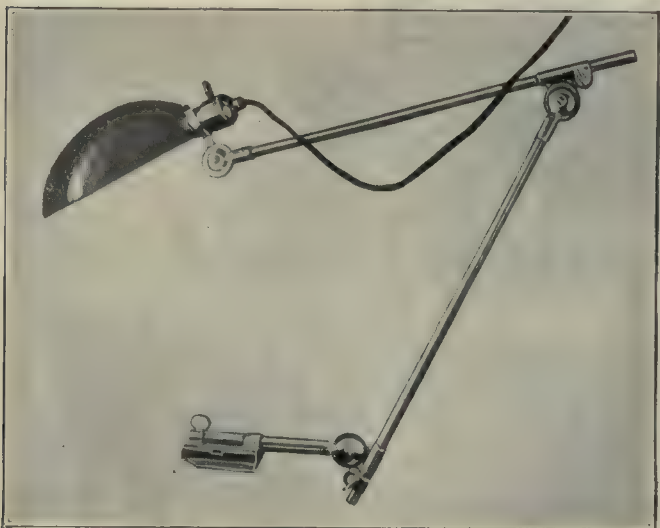
Those who are privileged to know General Williams personally and to know of his practical grasp of the many problems which confront him have no doubts as to his ability to fill his new position as successfully as he has those which have preceded it.

The "American Machinist" and the whole machine industry stand ready to co-operate with him and to render any possible service.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

"New York Universal" Light Holder

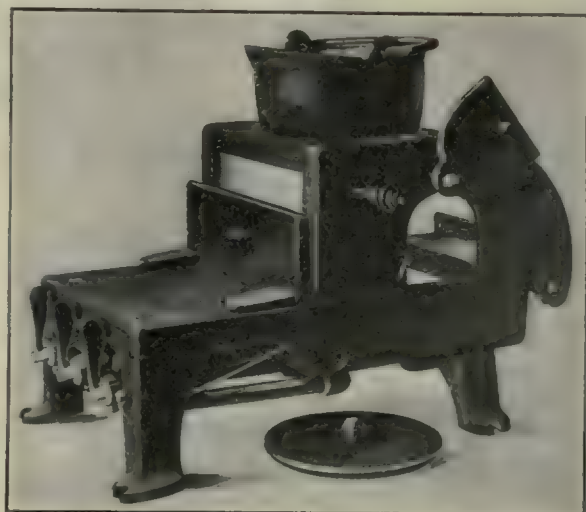
The Light Holder Manufacturing Co. of 79 East 130th St., New York City, is bringing out under the name of the "New York Universal" a device for holding electric lights in suitable position to enable a workman at the bench, the lathe or other machine to see his work to best advantage. This holder is made in several styles designed to be supported from the floor, the bench, the overhead works of a lathe or from any convenient part of a machine. The several parts are arranged to telescope, thus providing adjustment for length, and the swivel joints allow for movement in any direction. The ordinary form of lamp socket snaps into the spring yoke and requires no screws or other means of holding. The action of picking up a light or replacing it in the holder is almost as simple as picking it up from or laying it down upon a bench or table. All joints and movements are held by friction under tension of adjustable springs, so that to move a light from one position to another requires scarcely more than a movement of one hand, as the fixture moves easily and the light stays in whatever position it is placed, so that the adjustment may be made without the necessity for laying down tools or whatever may be held in the hand when the adjustment is required. The bases are interchangeable, so that with one base for each tool or bench any one of the several styles of holder may be used, the latter being as easy to pick up from or return to any base as a similar movement of a wrench from its place on a wrench board. The style of holder illustrated is designed for draftsmen and architects, the base being fastened by means of four wood screws to the underside near the back edge of the drawing board.



"NEW YORK UNIVERSAL" LIGHT HOLDER

Johnson No. 118 Bench Furnace

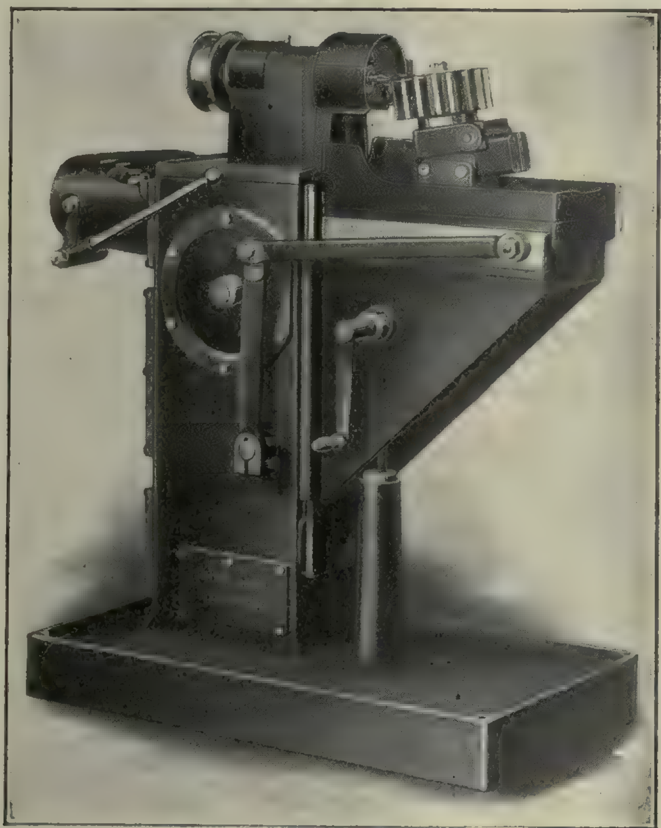
The Johnson Gas Appliance Co., Cedar Rapids, Iowa, has recently added another type of furnace to its line. This is known as the No. 118 bench furnace, and is suitable for machine-shop and toolroom work. The fuel used is gas, and it is claimed that a temperature of from 1400 to 1800 degrees F. is obtainable without the use of a forced-air blast. The plate in the front of the furnace is removable, which is also true of the melting pot placed in the top. The cover beneath the furnace is inserted in the top when the pot is not in use. The side door can be dropped so that all of the heat can be concentrated in the chamber, and the heating of long rods is permitted by opening the side doors on the hood and passing the work directly through. The furnace will heat 20 lb. soft metal at a time, or soldering irons up to 14 lb. to the pair. The fire is controlled by means of the three operating valves which may be seen at the front of the furnace.



JOHNSON NO. 118 BENCH FURNACE

Walker Automatic Gear-Tooth Rounding Machine

The illustration shows an improved model of the gear-tooth rounding machine that was described on page 439, Vol. 46. The machine is the product of the Charles H. Walker Machinery Co., 42-44 East Larned St., Detroit, Mich. A double eccentric spindle bearing is now used, which gives any degree of offset necessary for work on any pitch from 20 to 2½. The spindle is mounted in ball bearings; the drive is through a Carlyle-Johnson friction clutch and the main driving

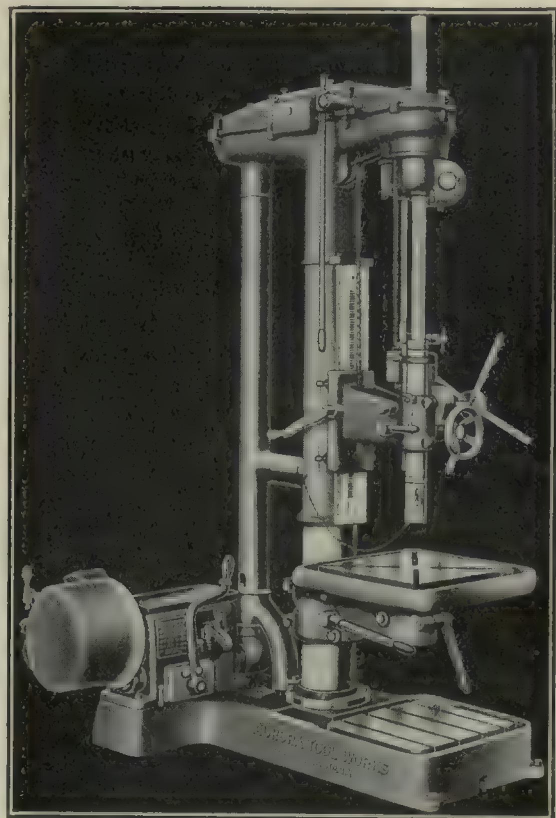


WALKER GEAR-TOOTH ROUNDING MACHINE

pulleys are inclosed. The work-holding spindle is mounted in a tilting base which allows it to be tilted forward up to 15 deg., permitting the ends of the teeth to be rounded at various angles. The base is inclosed and serves as a reservoir for the cutting lubricant, a circulating system and splash guards being provided. The pump is inclosed in the column, but is easily reached if necessary. Oiling is by the splash system and the table is also automatically oiled. A three-step cone is used for the drive and the spindle is driven by an independent belt at a speed of 960 r.p.m. The capacity claimed for the machine is 26 teeth per minute up to 6 pitch, 16 teeth per minute from 4 to 6 pitch, 8 teeth per minute 3 pitch and 4 teeth per minute 2½ pitch. The indexing mechanism consists of a rack with master teeth of the same pitch as the gear being operated upon. As the table moves out, the rack swings forward the correct distance so that when the table moves in again the next tooth to be rounded is brought into mesh with the indexing rack and carried in and automatically centered with the cutter. The indexing rack is adjustable through a stop screw which gives it the proper amount of outward swing. The operation is entirely automatic, the only thing necessary being to put the work in place and remove it when finished.

Aurora Drilling Machine

The 28-in. ball-bearing drilling machine illustrated is one of the late products of the Aurora Tool Works, Aurora, Ind. The machine is of the friction, back-gear type with speed-box drive. One of the features is that every moving part with the exception of the spindle and the feed rod is inclosed. This not only renders the machine safe and does away with gear covers, but prevents dirt from entering the working parts of the machine. Another feature of the machine is that all bearings and gears run submerged in oil, gage glasses being provided to indicate the oil level. All movements, including the clamping of the table and table arm, may be performed by the operator from the front of the machine. All speeds and feeds are plainly marked. Nickel-



AURORA BACK-GEARED DRILLING MACHINE

alloy steel, heat treated, is used for all spur gears, which are of the spiral stub-tooth form with a 20-deg. pressure angle. All bevel gears are also of the spiral form. The loose pulley is equipped with an oilless bearing and is smaller than the tight pulley in order to slacken the belt when the machine is idle. The speed box and back gears give 16 speeds. The spindle is machined from a high-carbon-steel forging, is double splined and is equipped with ball-thrust bearings. A reservoir for compound is cast integral with the base, which is provided with an oil groove extending completely around the base. This feature also allows bolts to be entered into the T-slots from either end. The machine can be equipped with a friction-tapping attachment.

"Bull Dog" Toolholder

The Green Bay Drive Calk Co., Green Bay, Wis., is now marketing a line of toolholders like that shown in the illustration. These are made in five different sizes and either straight or with right-hand or left-hand offset. The feature of this toolholder is the center piece, which is pivoted and has on one end a sharp point or tongue and on the other end a setscrew. When the piece of tool steel is long it is held by a double grip—the sharp end of the pivoted section and the setscrew. When the piece of tool steel is short it is held by the sharp end of the pivoted section only. The holder itself is provided with a projecting tongue which supports the cutting end of the tool bit. The holders vary in size from $\frac{1}{2}$ x $1\frac{1}{8}$ x 6 in. accommodating a $\frac{5}{16}$-in. square cutter, up to 1 x 2 x 11 in. accommodating a $\frac{5}{8}$-in. square cutter.

"BULL DOG" TOOLHOLDER

Americanizing the Alien

By A. Ellsworth

Referring to your editorial on page 637 of the *American Machinist* there is more to the problem of assimilating the alien than merely to provide for him some useful occupation, though this is of course an essential, and perhaps the first step. He must from the first be imbued with the idea that by his own act in coming to this country he has signified his dissatisfaction with the order of things from which he has sought escape and has expressed a desire to identify himself with the principles and customs of the country of his adoption. He should be taken in charge, or at least put under the supervision of a department of the Government, which should not lose sight of him until his Americanization is far enough along to insure that it will reach completion.

There is no good reason why he should have newspapers printed in his home language or form societies in which only his mother tongue is spoken; there is even no paramount reason why there should be churches in which the service is conducted in the language with which he is familiar. While these things may tend in some degree to mitigate the pangs of separation from the life he has left behind, they tend in infinitely greater degree to prolong the period of assimilation, if not to entirely prevent its consummation, and thus the least harmful thing that can result is that the new citizen ultimately suffers a greater amount of inconvenience and homesickness than if the transition were abrupt. The process is analogous to having the dentist extract a tooth gradually by means of some screw or wedge device or mechanism so as not to hurt the patient too much all at once.

The more serious aspect of what might be termed the "letting down easy" process is that it not infrequently fails completely, with the result that we have among us large bodies of people whose ideas and ideals, whether or not they may be good in themselves, are inimical to our form of government, yet who have the same voice and influence in conducting it, the same voting power, as those whose ideas are wholly American. It becomes therefore not only our duty to the immigrant from the moment he reaches our shores to put forth every effort to render it easier for him to become an American than to remain a foreigner, but in infinitely greater degree is it our duty to ourselves, our wives and our children to make this latter condition practically impossible.

America has with considerable appropriateness been called the "melting pot;" but what would we think of the metallurgist who not only did not stir his melt but rather exercised a sort of benevolent supervision over the tendency of his ingredients to segregate?

One of the most important lessons that we should learn from the present world cataclysm is that we must allow no condition to exist in our land which conduces to the formation or dissemination of a spirit antagonistic to our institutions or that may, however remotely, threaten our political liberty.

In these perilous times every American of whatever nativity should protest by every means in his power against any influence that may tend to foster in the slightest degree a feeling of hostility or aloofness, or in any way retard the complete Americanization of those whose previous life training has been such that their only conception of government is that of a brutal and malignant force, tolerant to its subjects only when they assume an attitude of abject submission to its will, and teaching the absolute subjugation of individual honor and ambition to the desire or whim of its ruling class.

Let us not only teach the newcomer the principles of democracy from the moment he reaches our shores, but let us see that no malevolent influence reaches him through the anesthetizing atmosphere of home with which he now surrounds himself to sow the seeds of distrust, discontent and suspicion which may later reach fruition in treachery or open sedition.

It may savor of extreme radicalism to say suppress the foreign-language newspapers, abolish foreign-language societies and to demand that only the English tongue be used in church service; but the situation demands extremity.

If adequate measures concerning these matters had been taken twenty years ago, the appalling condition of internal dissension with which we are now confronted would not be existing and a united America would now be exerting her resistless power in the direction of peace, if indeed the possibilities of that power had not deterred the madman of Europe from provoking it. If we of America hesitate to adopt radical and even extreme measures to proclaim and uphold the principles of our democracy, who in heaven's name can we expect will?

Let us unhesitatingly and emphatically say to the world, and let us instill into the souls of those who seek the protection of our laws the desire to say with equal emphasis and fervor from the moment of their landing, "This Is Our Country."

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., May 4, 1918—If anything were needed to emphasize the fact that a continuous stream of war materials is needed the present struggle in Picardy and Flanders should furnish the evidence. And, as we all know, the only way to get continuous production is by continuous operation of the shops and factories. The whole question of labor and production is involved, and we should try and not be too hasty in our judgments of either side. But both sides should be made to understand in no uncertain tones that nothing whatever must interfere with production.

Experience has shown Great Britain that long hours do not pay. But it has also shown her that the man who does not work regularly is a menace to the whole program and that one single man may upset the production by holding up some vital part of the work. And so they have, we understand, established a court for delinquents, in which a man must explain his absence from the shop without an excuse, which is very evidently as valid as it should be.

The cases are decided by a magistrate, a representative of the employer and a representative of labor. And it is reported that there is seldom any dissension over the man's innocence or guilt, which is as it should be.

Question of Enthusiasm

But is such a court necessary? Is it not possible to so fill our workers (and this means the boss as well as the man at the lathe or bench) with a zeal and an enthusiasm, with a desire to do his full duty that nothing even approaching compulsion is necessary? Can we not make it so evident to the men in the shop that the least we stay-at-homes can do is to keep everlastingly on the job regardless of the wages we are earning and the desire we have to go to the ball game or stay away for any other reason? And this applies just as much to the boss who stays weeks at Palm Beach as to the man who goes to see the Giants beat the Cubs when he ought to be on the job.

The first days of spring always bring uneasiness and the desire for change and adventure. And this accounts for many of the strikes which always occur at this season of the year. But even this can be curtailed if we can but make our men as well as ourselves see that this is a time to sacrifice personal desires to make up in some small measure for the suffering and the hardships, not to mention the supreme sacrifice of life itself, that our boys over there are making that we may not know the horrors of war in this country.

Statistics show that from 10 to 30 per cent. of the employees of munition and other allied industries are absent from day to day. This, to some extent at least, reflects the hard winter through which we have just passed. But if every shop and every man in the shop can be enlisted in the great army of steady workers we shall see great improvements in output. If every man in the shop would feel that he owed it to his sons and his friends' sons on the other side to work his full 48, or 52 or 55 hours a week we should see a great improvement. Can we not instill this feeling into the shops by a proper spirit of coöperation? Is there not something lacking in us if we cannot make the men not only see but *feel* that the least they can do is to stick to their job through thick and thin—that they are soldiers of the shop just as truly as their brothers are soldiers in the great war for democracy?

The Need of Big Men on the Labor Program

One of the biggest and most significant movements which have been attempted is that of the new labor program. It has great possibilities, and can if wisely carried out be of inestimable value not only at present but after the war is over. But according to those who are studying the question closely the personnel of the new organization is not in keeping with the magnitude of the task.

Secretary Wilson is without doubt an estimable man and one sincerely devoted to the best interests of the country as he sees them. He is, however, far from being in good health, and this is a task that will try any man of excellent health even without the other duties which fall to his lot. The whole personnel needs to be most carefuly selected, which unfortunately has not been done in all cases. Men of broad vision and undoubted capacity have been passed by for those with far less capabilities in this line, and some of the district offices are not up to standard in many ways. Of course the work is new, but there is no reason why we should not profit by the experience already secured by such efficient employment offices as can be found in several cities of the state of New York.

Petty jealousies and personal preferment or partisanship of any kind have no place in such an important movement, especially at a time like this. The carrying out of the legitimate work of such a department in the best manner is a task worthy of the best brains which can be secured from any source. On the proper distribution, the intelligent selection and on the training of the employees of our factories depends much of our future as well as of our present success.

Personals

V. Baudin, engineer, formerly located at 44 Whitehall St., has moved his office to 21 East 40th St., New York.

W. B. Greenleaf, formerly of Plymouth, Mich., is now superintendent of the Kohler Die and Specialty Co., DeKalb, Ill.

C. L. Campbell, formerly with the C. A. Strelinger Co., has become connected with the Cadillac Tool Co., Detroit, Mich., in its machinery sales department.

C. B. Leeds, formerly with the National Automatic Tool Co., Richmond, Ind., is now in the machinery sales department of the Cadillac Tool Co., Detroit, Mich.

J. M. Taylor, for 25 years with the Carnegie Steel Co. of Pittsburgh, Penn., has resigned and was succeeded by **C. A. Miller,** assistant purchasing agent.

Carl M. Nelson, formerly with the E. L. Essley Machinery Co., Chicago, has become associated with the Dale-Brewster Machinery Co. at Chicago in the sales department.

C. B. Pritchard, formerly machine-shop foreman of the Scottdale Machine Manufacturing Co., has been appointed superintendent of the Marion Machine Foundry and Supply Co., Scottdale, Penn.

Lieut. Victor Garmen, lately of the machine-gun battalion of the Rainbow Division in France, has accepted a position as safety engineer at the Lebanon, Penn., plants of the Bethlehem Steel Co.

John G. Zummach, formerly chief of the tool-designing department of the Mitchell Motors Co., Racine, Wis., has accepted a position as chief engineer and assistant factory manager with the Perfex Radiator Co., Racine, Wis.

Herbert Longstaff is now manager of the St. Louis office of the Asbestos Protected Metals Co., Pittsburgh, Penn. The St. Louis office is located in the Boatman's Bank Building. A previous notice on page 686 about Mr. Longstaff was incorrect.

E. C. Peck, superintendent of the Cleveland Twist Drill Co., Cleveland, Ohio, has been appointed lieutenant-colonel in the Engineering Bureau of the Ordnance Department. He will have charge of the gages used in the production of munitions and kindred materials.

Frederick Field, engineer and superintendent of the city filtration plant of Montreal, Canada, has asked for an indefinite leave of absence to go to Washington to fill a position with the chief engineer of the housing department of the United States Shipping Board.

J. F. Davidson, formerly assistant purchasing agent for the Jeffrey Manufacturing Co. of Columbus, Ohio, has been appointed purchasing agent, succeeding **Norman O. Aeby,** who recently resigned to accept a position with the Liberty Steel Products Co. of New York City.

Fred D. Williams, formerly at the head of the power specialties department of the H. W. Johns-Manville Co., has severed his connection with that company and is now assistant general manager of the combined properties of the H. L. Gilmer Co., with headquarters at Tacony, Philadelphia, Penn.

L. M. Hartzell, for some years manager of the bessemer steel department at the Homestead Steel Works of the Carnegie Steel Co. and later in the sales department in the general offices at Pittsburgh, has been appointed assistant manager of sales in the Cincinnati office under **J. G. Caruthers,** who is manager of sales at that office.

George W. Thexton, Milwaukee, Wis., has resigned the position of assistant to the general manager of the Cudahy works of the Worthington Pump and Machinery Corporation to become works manager of the Bucyrus Co., South Milwaukee, Wis. He is succeeded by **Thomas O'Neil,** formerly of the Hercules Gas Engine Co. of Evansville, Ind.

Charles M. Schwab, chairman of the board of directors of the Bethlehem Steel Corporation and president of the Bethlehem Shipbuilding Corporation, has been made director general of the Emergency Fleet Corporation. He will devote all of his time to speeding up shipbuilding, and has arranged to have the offices of the Fleet Corporation removed to Philadelphia, which is the center of shipbuilding in the East. He will have no connection with the letting of contracts.

Obituary

Phil Pidgeon, president of the Thomas Pidgeon Iron Co., Memphis, Tenn., died Monday morning, Apr. 29, 1918.

Business Items

The Jas. Clark, Jr., Electric Co., 31 North Jefferson St., Chicago, has moved its office to 23-27 South Jefferson Street.

The Sprague Electric Works of the General Electric Co., has moved its Boston office from 201 Devonshire St. to 84 State St., Room 906, Boston, Mass.

The Lapointe Machine Tool Co. of Hudson, Mass., is putting up a large additional building, three stories, 60 x 180 ft., to take care of the rapid growth of its business.

The Link Tool and Machine Corporation of New York has been incorporated with a capital of $25,000. The incorporators are A. S. Aleinikoff, G. Shiloff and H. J. Buierman.

The Al-Ko Co., New Haven, Conn., has incorporated with authorized capital stock of $25,000 to manufacture machinery. The incorporators are Arthur B. Bulling, Frederick H. Wiggins and I. Dwight Dana.

Sidney Diamant, formerly an owner of the De Mant Tool and Machine Co., of New York City, is continuing his tool and manufacturing business and operating as the Diamant Tool and Manufacturing Co. at 164 Emmet St., Newark, N. J.

The Federal Machinery Sales Co. of 12 North Jefferson St., Chicago, Ill., has opened a branch office at room 1320, Majestic Building, Milwaukee, Wis., under the supervision of H. L. Cole. Mr. Cole was for several years the Milwaukee manager for Manning, Maxwell & Moore.

The Dale-Brewster Machinery Co. of Chicago has moved its New York quarters to 54-60 Lafayette St., where they will have 16,000 sq. ft. of floor space to care for the needs of their machine-tool and supply business. William Brewster has disposed of his holdings in the company to James J. Dale, president.

The J. R. Stone Tool and Supply Co., dealer in machinery, tools and machinery-tool accessories, recently located in the Goebel Building, Detroit, Mich., has moved to its new quarters at 997 Woodward Ave., where it will carry a stock of new and second-hand machinery and tools of all descriptions to meet the needs of the metal-working industries.

Sir Isaac Pitman & Sons, Ltd. (the English publishing house), recently purchased all the existing copyrights of the numerous scientific and technical books previously issued by Messrs. Whittaker & Co. of London, and in future the American agency for these works will be controlled by Isaac Pitman & Sons, 2 West 45th St., New York. This series include many important works relating to airplanes, submarines, wireless telegraphy, etc.

The Buckeye Twist Drill Co's new officers are O. F. Transue, president; W. H. Purcell, vice president; F. E. Dussel, secretary and treasurer; and A. A. Mulac, general manager, together with the following board of directors: O. F. Transue, C. S. Hoover, E. D. Rogers, F. E. Dussel, W. H. Purcell, A. A. Mulac and J. O. Whitaker. E. D. Rogers, the former president and majority stockholder, has sold all but a small portion of his holdings to the remaining stockholders.

The Ohio Electric and Controller Co., 5900 Maurice Ave., Cleveland, has been incorporated with a capital stock of $200,000 for the purpose of manufacturing lifting magnets and electrical controlling devices. Lifting magnets will be built at once and controlling devices later. The officers of the new company include F. W. Jessop, president; W. B. Greene, vice president, and A. D. Walter, secretary and treasurer. Mr. Jessop was formerly works manager of the Electric Controller and Manufacturing Co., Cleveland. He has had an extensive experience in the manufacture of lifting magnets and electrical apparatus for the control of motors.

The Independent Pneumatic Tool Co., and the **Aurora Automatic Machinery Co.** have effected a reorganization for convenience in handling business. Under this plan the company is known as the Independent Pneumatic Tool Co. Ten directors will serve on the board as follows: John P. Hopkins, former Mayor of Chicago, chairman; John D. Hurley, James J. McCarthy, William A. Libkeman, Leonard S. Florsheim, Edward G. Gustafson, Robert T. Scott, Ralph S. Cooper, August Gatzert and Fletcher W. Buchanan. The officers are John D. Hurley, president; Ralph S. Cooper, vice president; Fletcher W. Buchanan, secretary, and Edward G. Gustafson, treasurer. The general offices of the company are in the Thor Building, 1307 South Michigan Blvd., Chicago, Ill. Branches are maintained in New York, Pittsburgh, Detroit, Birmingham, San Francisco, Toronto and Montreal.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City. The May meeting, at which the subject of labor turnover will be discussed, will be held on Tuesday, May 21. G. R. Woods of the Allied Machinery Co. of America will be chairman of the meeting.

American Society of Mechanical Engineers. Spring meeting at Worcester, Mass., June 4, 5, 6 and 7, with headquarters at the Hotel Bancroft.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The next convention and exhibit of the Georgia Retail Hardware Association will be held at Savannah, Ga., June 4, 5 and 6, 1918, with the Savannah Hotel as headquarters. Exhibits and convention sessions will be held in the new municipal auditorium on Barnard St. Walter Harlan, 44 Boulevard Circle, Atlanta, Ga., is secretary of the association.

The National Gas Engine Association will hold its eleventh annual meeting at the Hotel Sherman, Chicago, Ill., June 3 and 4. The headquarters of the association are at Lakemont, N. Y.

The spring convention of the National Machine Tool Builders' Association for 1918 will be held Thursday and Friday, May 16 and 17, at the Marlborough-Blenheim Hotel, Atlantic City, N. J. Charles L. Taylor of Hartford, Conn., is secretary.

A joint convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held at Cleveland, Ohio, May 15-17. Among the important subjects to come up for action will be Government control of fuel, transportation and shipping of materials and price fixing. The coöperation of labor in war activities will also be discussed at length.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Condensed Clipping-Index of Equipment

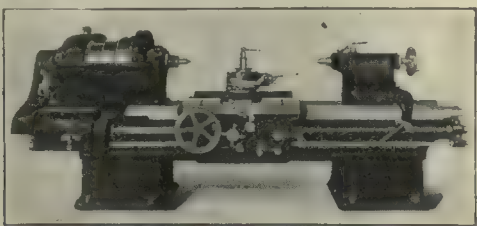
Clip, paste on 3 x 5-in. cards and file as desired

Lathe, Gun-Boring
Springfield Machine Tool Co., Springfield, Ohio

"American Machinist," Apr. 25, 1918

Length of machine, 28 ft.; hole through spindle, 15 in.; capacity, holes up to 7 in. in diameter and 21 ft. long; horsepower of variable-speed motor, 35; mechanical speed changes, four, which together with the variable-speed motor gives spindle speeds of from 20 to 200 r.p.m.; diameter of balls in thrust bearing, 1 in.; drilling feeds, ten, 0.0015 to 0.016 in. per spindle revolution; weight without electric equipment, 28,000 lb., with electric equipment, 31,000 lb.; capacity of compound pump, 26 gal. per minute at a pressure of 100 lb. per square inch.

Lathe, Heavy-Duty 25-In.
Sidney Tool Co., Sidney, Ohio

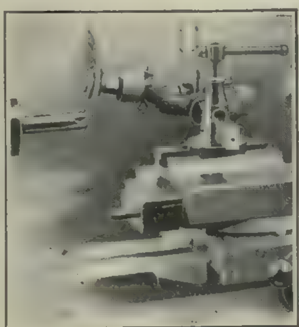


"American Machinist," Apr. 25, 1918

Swing over shears, 27½ in.; swing over carriage, 19 in.; distance between centers with 10-ft.; bed 4 ft. 6 in. front spindle bearing, 4¾ x 6¾ in.; rear-spindle bearing, 3¼ x 4⅝ in.; size of hole in spindle, $2\frac{3}{16}$ in.; back gear ratios, 4¼ and 11½ to 1; travel of tailstock spindle 10⅜ in.; travel of compound rest, 5 in.; capacity of steadyrest, 8 in.; threads cut, 1 to 46; gearbox feeds, 0.005 to 6.220 in. per spindle revolution; weight with 10-ft. bed, 7000 lb.; additional weight for 2 ft. of bed, 300 lb.

Toolpost Grinding Attachment
Gale-Sawyer Co., 33-37 Wormwood St., Boston, Mass.
"American Machinist," Apr. 25, 1918

A toolpost grinding attachment that has a swiveling device. This is graduated and, it is claimed, permits adjustment for a range of work impossible with other toolpost attachments. This is said to be especially valuable in sharpening cutters with end teeth and doing other similar operations. The spindle is designed to operate at speeds from 8000 to 12,000 r.p.m. The illustration shows the device equipped with a 3-in. saucer wheel



Castellating Machine
Matthews Engineering Co., Sandusky, Ohio, Manufacturers
J. R. Stone Co., Detroit, Mich., Selling Agents.
"American Machinist," Apr. 25, 1918

This machine is for automatically castellating nuts or other small parts suitable for chucking. The pieces to be castellated are placed in a hopper and are fed down a chute to the chucks, after which they automatically pass under six jaws, each of which makes a separate cut in the work. Sizes of nuts handled, ¼ to ½ in. hexagon, S. A. E standard; output, 600 to 1400 per hour, according to size; size of cutters, 2½ in. diameter; speed of cutters, 160 ft. per min.; size of drive pulleys, 16 in. diameter by 3½ in. face; height of machine, 4 f t. 8 in.; floor space, 3½ x 3¾ ft.; weight, about 1500 lb.

Chuck
Simplex Tool Co., Woonsocket, R. I.
"American Machinist," Apr. 25, 1918

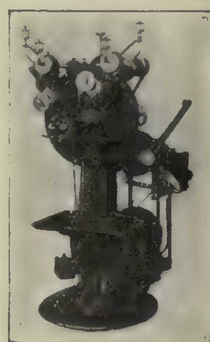
An improved form of a chuck previously described on page 830, Vol. 46. It is claimed that this chuck is so made that it is impossible to strain the jaws so that they only grip at the back. Each jaw has a through bolt to hold it tightly to the face of the chuck, these bolts being adjusted by means of countersunk nuts at the front of each jaw. The back of the chuck is so made that a back plate can be attached to secure it to the lathe spindle.

Rack for Blueprints, Drawings, etc.
National Company, 273-279 Congress St., Boston, Mass.
"American Machinist," Apr. 25, 1918

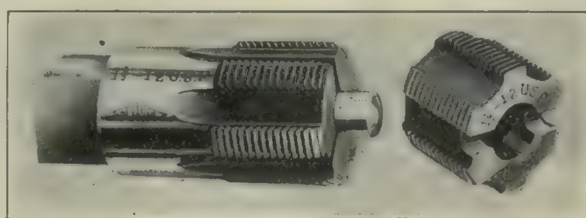
A wall with rack for use with the Presto blueprint holder described on page 1059, Vol. 47. Is provided with hooks for suspending from ordinary picture molding or can be bolted or nailed directly to the wall. Is made of varnished oak and all metal parts are nickel. The dimensions of the rack ready for use are 24 in. wide, 20 in. deep and 30 in. high, while the dimensions folded are 24 in. wide, 4 in. deep and 30 in. high.

Drilling Machine for Ignition Tubes, Multiple-Spindle
Langelier Manufacturing Co., Arlington, Cranston, R. I.
"American Machinist," Apr. 25, 1918

This machine is for drilling at one operation twenty-four 0.031-in. holes in the walls of primer ignition tubes. Two six-spindle drilling heads located 90 deg. apart are located on the upper half of the vertical faceplate and drill diametrically through both walls of the tube. The spindles are ball bearing and are belt driven from a motor at the base of the machine. The spindle speed is 4800 r.p.m. and cutting fluid is supplied by a rotary pump. The motor used is of 3 hp. and the floor space is 32 x 62 in.



Taps
Wetmore Mechanical Laboratory Co., Milwaukee, Wis.



"American Machinist," May 2, 1918

These two taps are of a line that has been developed by this company specially for munitions work. The particular ones shown are for cutting threads in the fuse holes of shells.

Patent Applied For

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$37.00
No. 2X, New York	34.25	.....	42.50
No. 2 Southern Foundry, Chicago	33.00	37.00	.....
*Bessemer, Pittsburgh	36.15	37.25	43.95
*Basic, Pittsburgh	42.00	33.95	40.00
No. 2X, Philadelphia	34.25	33.75	42.50
*No. 2, Valley	33.00	33.95	42.00
No. 2 Southern Cincinnati	35.90	35.90	39.90
Basic, Eastern Pennsylvania	32.75	33.75	38.00

*Delivered Pittsburgh: f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4.195	$4.195	$5.00	$4.20	$4.50	$4.20	$4.50
Soft steel bars	4.095	4.095	4.75	4.20	4.75	4.10	5.00
Soft steel bar shapes	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Plates, ¼ to 1 in. thick	4.445	4.445	7.00	4.20	6.50	4.45	6.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Apr. 25, 1918	One Year Ago
Pittsburgh, mill	$3.50	$3.60
Warehouse, New York	4.70	4.25
Warehouse, Cleveland	4.10	4.00
Warehouse, Chicago	4.10	3.90

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	5.00	6.445	6.445	8.00	6.385	7.75	6.45	7.25
*No. 26 black	4.90	6.345	6.345	7.90	6.285	7.65	6.35	7.15
*Nos. 22 and 24 black	4.85	6.295	6.295	7.85	6.235	7.60	6.30	7.10
Nos. 18 and 20 black	4.80	6.245	6.245	7.80	6.185	7.55	6.25	7.05
No. 16 blue annealed	4.45	5.645	5.645	7.20	5.585	7.20	5.65	6.70
No. 14 blue annealed	4.35	5.545	5.545	7.20	5.485	7.10	5.55	6.60
No. 10 blue annealed	4.25	5.445	5.445	7.50	5.385	7.00	5.45	6.50
*No. 28 galvanized	6.25	7.695	7.695	9.75	7.635	9.00	7.70	9.00
*No. 26 galvanized	5.95	7.395	7.395	9.45	7.335	8.20	7.40	8.70
No. 24 galvanized	5.80	7.245	7.245	9.30	7.185	8.55	7.40	8.55

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 10%	List plus 25%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Current	One Year Ago
New York	$15.00	$13.00
Chicago	15.00	12.00
Cleveland	18.50	8.75

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel	7.50	8.00	7.50
Spring steel (crucible analysis	11.00	11.25	11.00
Coppered bessemer rods	7.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel	9.00	8.25	8.50
Floor plates	6.19½	6.00	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	41.9%	26.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	37.9%	23.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	32.00
Tin, in 5-ton lots	95.00	85.00	38.50
Lead	7.00	7.25	10.50
Spelter	7.00	7.50	9.75

*Government price.

ST. LOUIS

	Current	One Month Ago	One Year Ago
Lead	6.80	7.10	10.25
Spelter	6.75	7.25	9.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	31.50-33.00	32.00	44.00	35.00	42.00	31.50	43.00
Copper wire (carload lots)	32.00	32.00	39.50	34.00	41.00	31.00	40.00
Brass sheets	30.75	30.75	45.50	30.00	43.00	30.00	43.50
Brass pipe base	36.50	36.50	47.50	41.00	50.00	40.00	47.50
Solder ½ and ½ (case lots)	62.00	62.00	36.00	51.25	36.50	55.00	36.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under: over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	28.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:
Carload lots f.o.b. mill 19.00

	In Casks Current	In Casks One Year Ago	Broken Lots Current	Broken Lots One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	20.00	23.00	20.50	23.25
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	13.50	36.00
Chicago	14.00	37.00
Cleveland	15.25	35.00

TRAINING INSTRUCTORS ACCORDING TO THE GISHOLT IDEA

BY FRED H. COLVIN

Part II. The art of teaching requires more than a mere knowledge of the things to be taught. It requires a knowledge of human nature, of how to arouse interest and enthusiasm, and to make the student see the possibilities of future development. The way in which this is handled in the Gisholt plan shows a vision of the requirements for such work as well as the gift of so appealing to the man from the shop as to make it attractive and to arouse his ambition.

INTEREST of the student in the Gisholt method of teaching instructors begins when the man reaches Madison and ends only when he leaves. The first thing is to secure for him a comfortable boarding place, this being done by one of the students who is about to leave, and who knows the town. Incidentally, it gives the newcomer a chance to get acquainted with a man who has gone through the course and to absorb some of his enthusiasm, and also to get the newness worn off so that he does not feel strange when he joins the class. Before going into the class the new student is guided through the plant by one of the graduating students and imbibes a general knowledge of the way the Gisholt machines are built, as well as something of the atmosphere of the shop, which in itself is an important factor in the course. Fig. 1 shows a new student being shown through the plant by one about to graduate.

The Gisholt Service Course consists of the following divisions, 25 in number, although the course is being slightly modified to reduce its length to six or even four weeks.

1. Dismantling a Gisholt tool-grinding machine to learn its construction.
2. Assembling, adjusting and oiling the grinding machine.
3. Grinding a set of standard tools on the grinding machine to learn clearances and rake.
4. Brushing and cleaning the grinding machine to teach care and neatness.
5. Dismantling an H-21-in. standard belt-driven Gisholt turret lathe.
6. Scraping bearings, Vs, etc., for use in overhauling machinery.
7. Assembling, adjusting and oiling the lathe to learn construction and care.
8. Operating the lathe to be familiar with all of its movements.
9. Heavy cuts on J-28-in. standard belt-driven Gisholt lathe to see execution.
10. Placing tools on lathe as per layout sheet for machining countershaft pulley.
11. Operating 28-in. lathe on countershaft pulleys as per time study.
12. Dismantling tool set-up to teach proper disposition of tools.
13. Cleaning lathe and tools to teach care and neatness.
14. Boring jaws on an H-21-in. standard motor-driven Gisholt turret lathe for practice.
15. Cutting threads on lathe to learn method and practice.
16. Turning tapers on the lathe to learn method and practice.

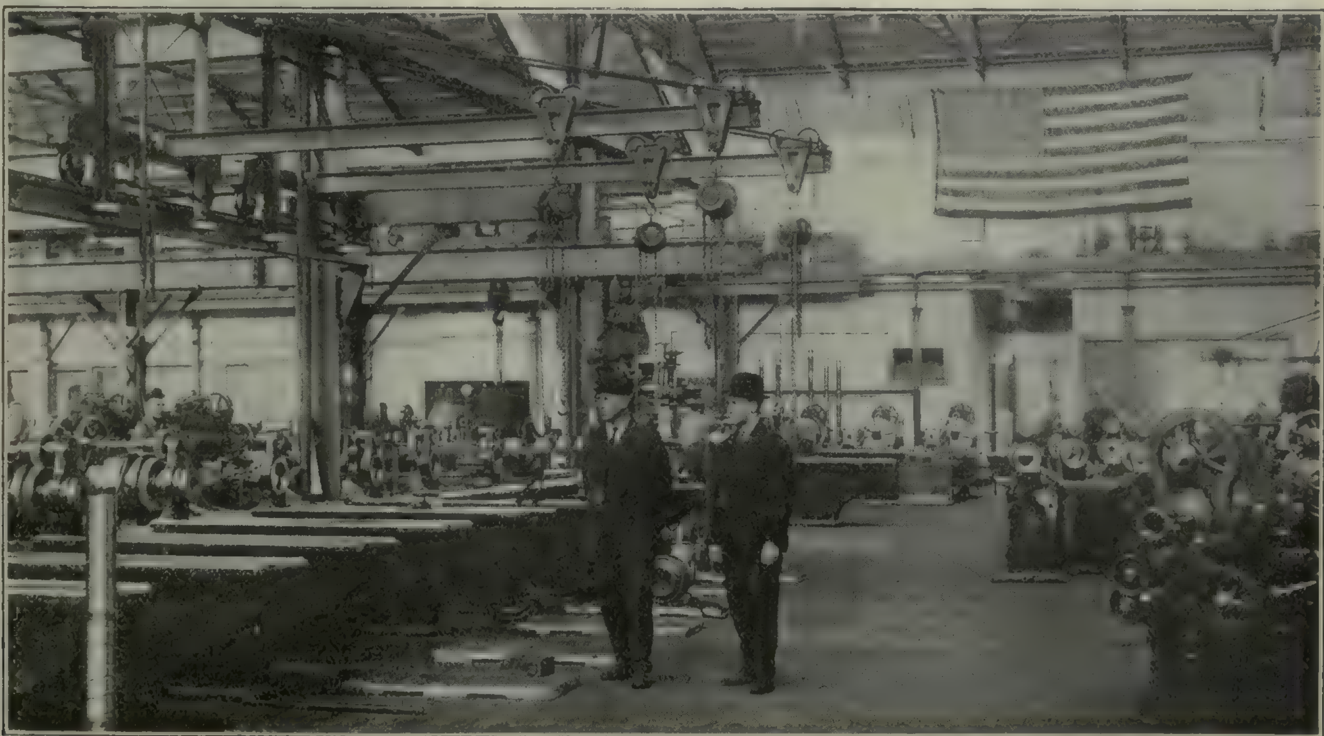


FIG. 1. SEEING THE SHOP

17. Placing tools on the lathe as per layout for drilling, boring, reaming, and turning a steel piece.
18. Operating the machine on a steel piece for experience on steel work.
19. Dismantling set-up and cleaning tools to teach care and neatness.
20. Placing tools on the machine as per layout sheet for making crosshead pins from bar stock.
21. Operating machine on crosshead pins for experience with bar stock tools.
22. Dismantling and cleaning up tools to teach care and neatness.
23. Cleaning up machine to teach care and neatness.
24. Estimating the basis for planning method and tooling of work.
25. Taking a new man for a trip through all departments of the factory.

Before proceeding to the first division of dismantling a Gisholt tool-grinding machine the student becomes familiar with the use of the Periodograph, shown in Fig. 2, by which his time is recorded, so that he knows exactly what progress he is making, how much time he is spending in the different divisions, as well as giving him a knowledge of modern timekeeping methods. He is then shown the tools which he is furnished for his work, this equipment being shown in Fig. 3.

The actual work begins with the dismantling of the Gisholt tool-grinding machine in order to learn its construction. This also gives a man who has not had the opportunity of taking machines apart a good idea of the construction of simple machines of various kinds,

FIG. 2. USING THE PERIODOGRAPH

and increases his confidence in his ability to handle different work. This operation, Fig. 4, illustrating the grinding machine completely apart, shows the instructor pointing out some of the features of the main spindle. It also shows how complete the dismantling is done, and instructors will appreciate the beneficial results obtained from work of this kind.

The next step is the complete assembling, adjusting and oiling of the grinding machine, which is done by the student himself before he is taught how to use the machine in grinding standard-shaped tools for Gisholt or other machines. Next comes the grinding of a set of standard tools, 27 in number, so as to learn the clearances and rakes, followed by brushing and cleaning the grinding machine in order to instill the need of proper care and neatness in handling machines (Fig. 5).

After the student's first day in the school he receives a copy of Lesson No. 1, a manila folder containing 14 mimeographed letter-sized pages and two blueprints. This is the first of 15 lessons, all prepared in the same way, and all devoted to definite parts of the course. To quote from the introduction: "Increased production or

FIG. 3. THE TOOLS USED

improved conditions usually entail changes in tools. Though they may be very slight changes, instructions of some kind must go to the toolmaker or blacksmith, or whoever is to make these new tools.

"At this time the Service Course man will feel the need of, or appreciate having, at least an elementary knowledge of free-hand drawing, as this is a very quick and effective method of showing, or giving to another, an idea of a proposed change in tools.

"We know that very few men operating or in charge of turret lathes have access to a drawing table or possess a full line of drawing instruments with which to make a complete detailed mechanical drawing even if they knew how.

"A draftsman working day after day at his usual work must be expected to make a better drawing, and faster, than the operator or foreman who is at his own work regularly.

"Summing up all these points and reaching a conclusion formed to a great extent by a wide range of personal experience, we think the best drawing instruction for the service-course man is that of free-hand drawing as taken up by the 15 lessons presented herewith."

Then follows a page of pithy paragraphs on the advantages of application and the necessity of earnest at-

tention to both the work and the instruction. These quotations are carefully selected from various sources, and while they are not given in the form of lessons and no questions are asked in regard to them there is every evidence that they make a deep impression in almost every case. Here are a few of the sayings:

"To become more successful, become more efficient."

"Do the little things better."

"The world is hungry for quality service. It wants to pay for it. It is paying for all it can get. The market is not crowded. There is a chance for you right now. There is a chance for you right where you are. The time to start is now. Your reward will take care of itself."

FIG. 4. DISMANTLING A TOOL-GRINDING MACHINE

The sketching lessons are very clearly and plainly given, beginning with the simple parts of a machine, such as a plain bushing, and continuing to bolts and nuts, showing conventional methods of drawing threads, giving different ways of dimensioning drawings where limits are used, and showing the arrangement of the three used when they are necessary to show a piece. All the illustrations are from sketches, duplicated by mimeograph, and embrace different parts of the machine, some of them more or less complicated. The directions are given in very simple, concise language, and both plain mechanical drawings and also free-hand perspectives are shown in many instances.

At the end of each lesson is a blueprint of a piece of work suitable for the Gisholt lathe and a layout sheet showing how it is held, and a blank or skeleton sketch on which the tool layout can be made. These are used in teaching the best way of laying out the tool equipment, which is, of course, an important part of the course.

As before stated, there are 15 lessons, each containing suitable selections and suggestions. These include pointed paragraphs on Application; The Secret of Success; Optimism Versus Failure; Single Purpose and Concentration; Perseverance; If; The It Habit; The Man Who Stands Alone; It Couldn't Be Done—But It Was; Take Aim Before You Shoot Your Mouth; Envy; Pathfinders; Originality; Hate; Why Worry; When Seeking a Job.

Beginning with the seventh lesson the tool layout, Fig. 6, is followed by a time study of each operation, one of these being shown in Fig. 7. These show first the blueprint of the piece to be made, which is a stub-tooth gear; next the layout sheet for both the first and second operations, followed by the time study for both tool setups.

In the meantime the student's shop work consists in dismantling an H-21 standard belt-driven Gisholt turret lathe, Fig. 8. This is done in an orderly and systematic manner, suitable boxes being provided for the various units assembled, some of these boxes being shown in front of the lathe, which has been completely taken down. The student is then shown how to scrape bearings and the V of the lathe, this instruction applying not only to this lathe, but to almost any machine.

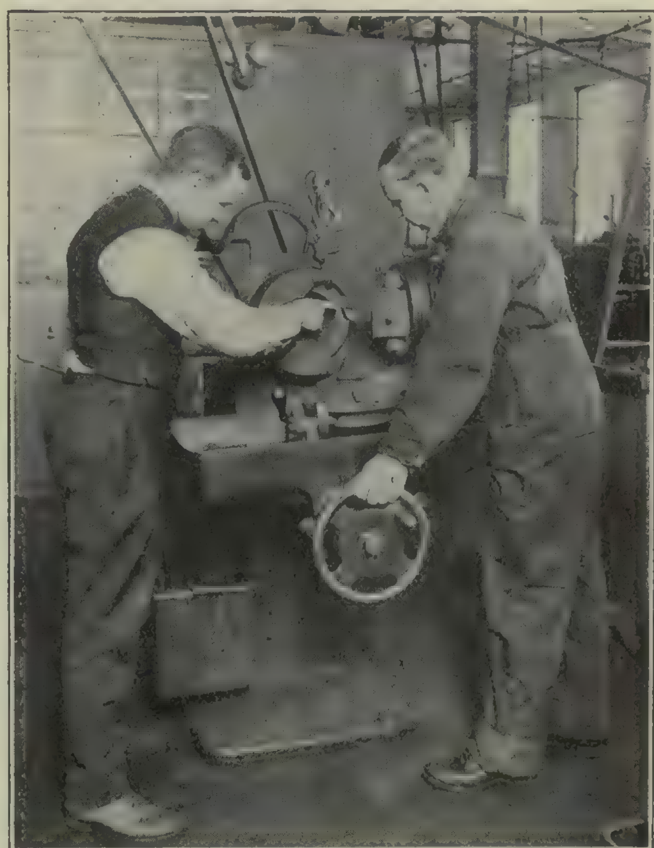


FIG. 5. GRINDING STANDARD TOOLS

The whole machine is now reassembled, adjusted in every detail, and oiled ready to begin operation. No man with any sort of good mechanical training as a foundation can fail to gain valuable knowledge and experience in this way, and this experience not only helps him in handling Gisholt machines, but other kinds of machinery. For after all there is far greater similarity between machines of different kinds than many seem to realize.

It will also be noticed in Fig. 8 that the student scraping the bearing has an open book in front of him. This is a copy of the Gisholt Service Book, and on page 98 is a very concise but complete outline of the way in which this work should be done. Page 99 shows devices for lining up the ways of the machine. The book covers every detail of the machines which require attention, and numerous instances can be cited to prove where these directions have enabled men of comparatively little experience to make satisfactory repairs.

Further attention is also given to scraping, the end of a test piece being used for this purpose, as shown in Fig. 9. This is the same test piece used for demonstrating the ability of the lathe to take heavy cut, as will be seen later. The end of this piece is faced square in the lathe and then the student scrapes it to a surface plate in the usual manner.

The student is made familiar with the lathe by being taught to put it through all its paces, so as to be sure that he understands exactly what is accomplished by every movement and how the different speeds and feeds are secured.

A demonstration of the taking of heavy cuts is shown in Fig. 10, this being done from a specially cast piece, which it will be observed has openings that provide all the shocks to both the tool and the lathe of intermittent cutting. This is for the purpose of demonstrating conclusively to the student that these lathes will take extremely heavy cuts where necessity demands, these ranging from $\frac{3}{4}$ in. deep with $\frac{1}{16}$-in. feed to $\frac{1}{2}$ in. deep to $\frac{1}{4}$-in. feed on the U-28 machine. He also learns how to hold a piece firmly with very little gripping surface by having it of the proper shape.

Then comes the tooling up of a lathe in accordance with a layout sheet which is provided for the purpose, this being for machining a countershaft pulley. After tooling up the machine the student spends sufficient time in actually operating it to assure himself that he can handle the work in the time allotted by the time study. Fig. 11 shows the countershaft pulley which is used for

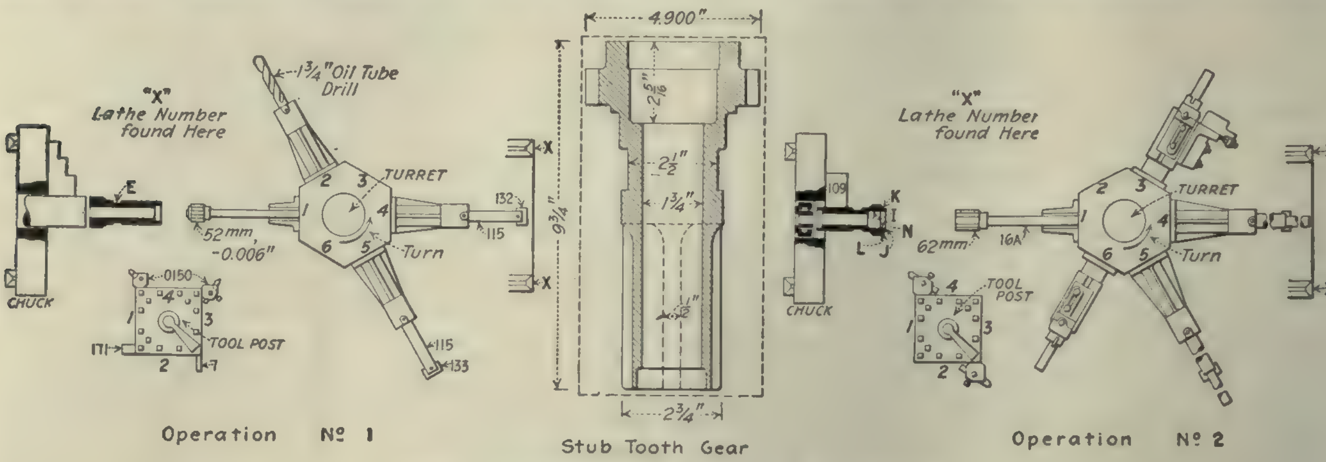


FIG. 6. WORK TO BE DONE AND TOOL LAYOUT

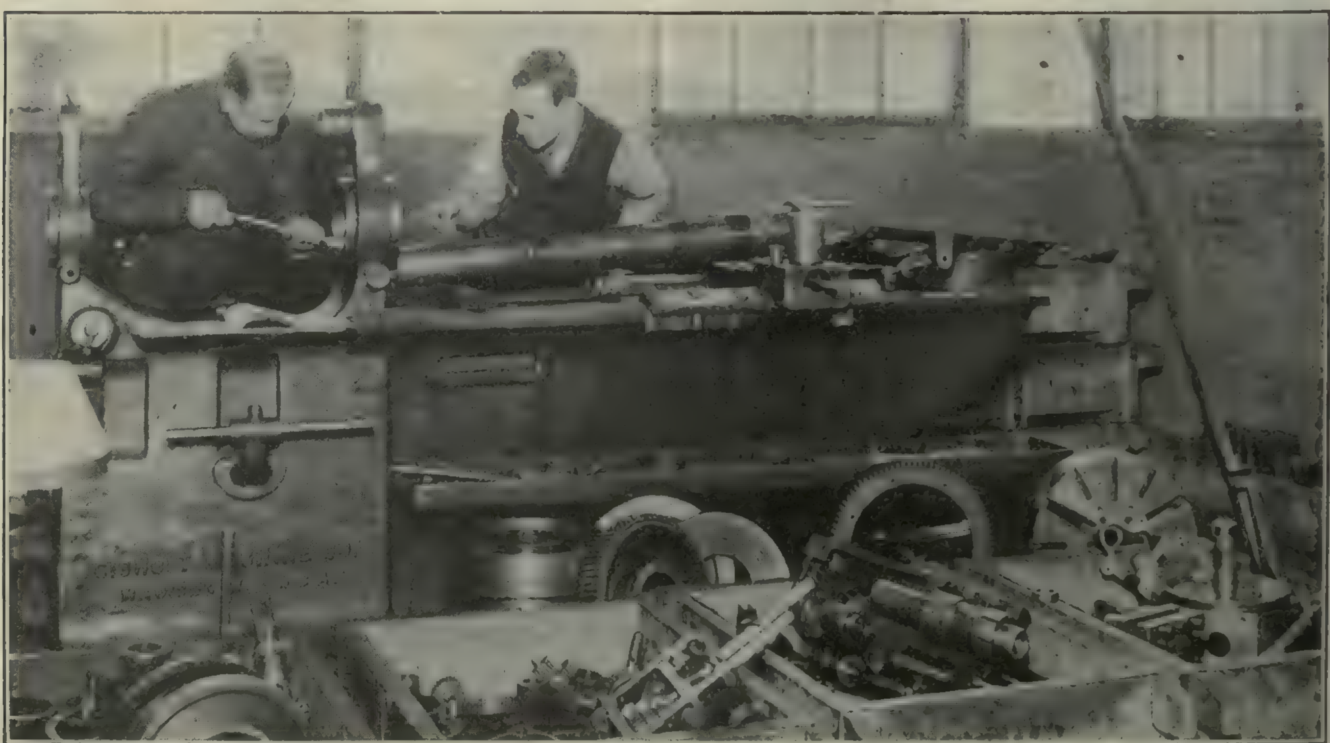
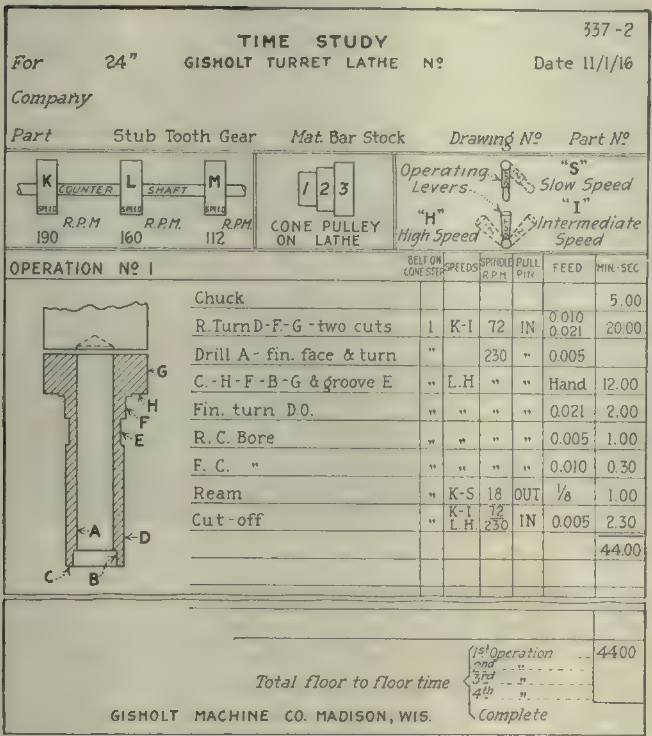


FIG. 8. TAKING DOWN A TURRET LATHE

this work, and after the learner has acquired the desired speed on the machine he then dismantles the turret in order to learn the proper way of taking down and caring for the tools. After this the lathe and tools are thoroughly cleaned to teach care and neatness.

As will be seen from the work divisions already published, the student learns to bore the chuck jaws for special work, to cut threads, to turn tapers, and all of the other operations which are necessary in order to become a good Gisholt man. And it must be remembered that while these instructions are primarily for the training of Gisholt instructors and operators it cannot fail to be beneficial in the handling of any kind of machine, of any type of machine tool, even if not very closely related to the turret lathe. These instructions impart a knowledge of the fundamentals of machine tools and machine tool work which unfortunately are not as thoroughly understood and appreciated as they should be.


TIME STUDY 337-2

For 24" GISHOLT TURRET LATHE Nº Date 11/1/16

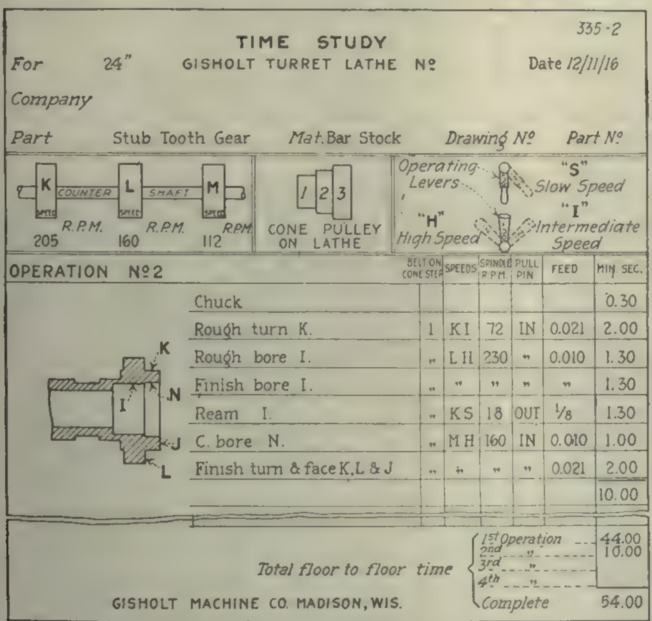
Company

Part Stub Tooth Gear Mat. Bar Stock Drawing Nº Part Nº

OPERATION Nº 1	BELT ON CONE STEP	SPEEDS	SPINDLE R.P.M.	PULL PIN	FEED	MIN. SEC.
Chuck						5.00
R. Turn D-F-G-two cuts	1	K-I	72	IN	0.010 0.021	20.00
Drill A- fin. face & turn	"		230	"	0.005	
C.-H-F-B-G & groove E	"	L.H	"	"	Hand	12.00
Fin. turn D.O.	"	"	"	"	0.021	2.00
R. C. Bore	"	"	"	"	0.005	1.00
F. C. "	"	"	"	"	0.010	0.30
Ream	"	K-S	18	OUT	⅛	1.00
Cut-off	"	K-I L.H.	72 230	IN	0.005	2.30
						44.00

Total floor to floor time: 1st Operation 44.00; 2nd "; 3rd "; 4th "; Complete

GISHOLT MACHINE CO. MADISON, WIS.


TIME STUDY 335-2

For 24" GISHOLT TURRET LATHE Nº Date 12/11/16

Company

Part Stub Tooth Gear Mat. Bar Stock Drawing Nº Part Nº

OPERATION Nº 2	BELT ON CONE STEP	SPEEDS	SPINDLE R.P.M.	PULL PIN	FEED	MIN. SEC.
Chuck						0.30
Rough turn K.	1	K I	72	IN	0.021	2.00
Rough bore I.	"	L H	230	"	0.010	1.30
Finish bore I.	"	"	"	"	"	1.30
Ream I.	"	K S	18	OUT	⅛	1.30
C. bore N.	"	M H	160	IN	0.010	1.00
Finish turn & face K, L & J	"	"	"	"	0.021	2.00
						10.00

Total floor to floor time: 1st Operation 44.00; 2nd " 10.00; 3rd "; 4th "; Complete 54.00

GISHOLT MACHINE CO. MADISON, WIS.

FIG. 7. TIME STUDY OF WORK

Considerable time is spent in teaching the student to estimate carefully and accurately the time required for work. And even with the shortened course it is astonishing to find what can be accomplished in a very short time. There are numerous instances where the time studies of the students are almost identical with those of the most experienced estimators, which is the greatest possible praise of both the methods and the thoroughness of the intensive instruction.

The last exercise of the student is to take a new man for a trip through all the departments of the factory. This refreshes his memory, and as he now has an excellent idea of the construction of the machine it leaves a deep impression as to the way in which the machine is built and gives him a lasting remembrance of the whole shop.

Lest there be doubt as to this plan being entirely practical let it be remembered that it has been in operation for about six years, and while a large number of students have not been turned out in that time, the scheme has been remarkably successful in various parts of the country. As the proof of the pudding is in the eating I am quoting from a specific case in connection with the Navy Department, and incidentally it shows a liberal and broadminded policy on the part of the Assistant Secretary of the Navy as well as the officers of the Boston navy yard.

FIG. 9. LEARNING TO SCRAPE

Charles Lawson, who was working at the Boston navy yard, was instructed to proceed to the Gisholt School on Sept. 12 of last year, to take an eight-weeks' course at the request of Commander F. Lyon, Engineer Officer, U. S. N., of the Boston navy yard. Mr. Lawson

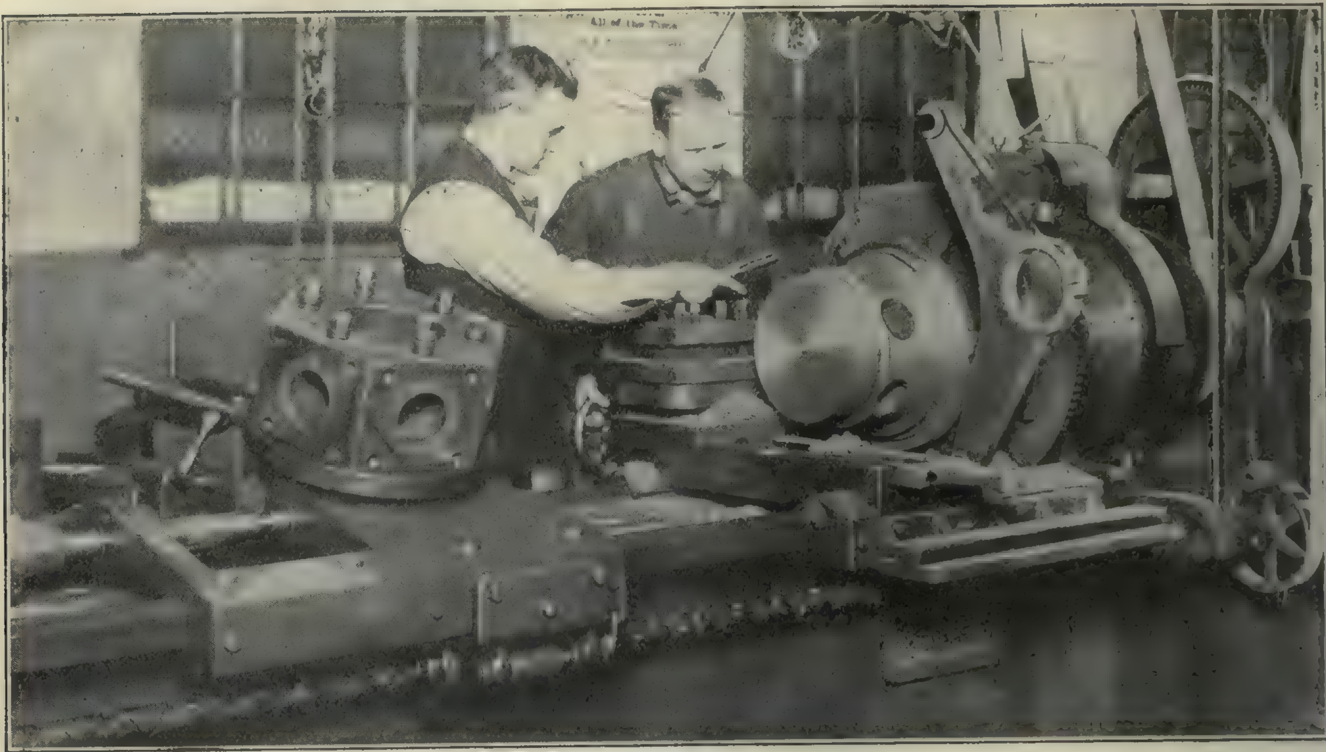


FIG. 10. TAKING HEAVY CUTS

was 26 years old, a native of Cardiff, Wales, and had been at work ten years. He took the course in eight weeks, as was specified at that time, and at the end of that time returned to the Charlestown yards. As a result of this course Mr. Lawson soon after his return was put in charge of the Gisholt lathes, his first job being to repair an old I-24 lathe.

His instruction at the Gisholt plant had taught him not only how to do this work himself, but how to instruct others to do it, and although this lathe was in a very bad condition and required considerable repairing, including the replacement of several parts, Mr. Lawson was able to handle the whole job to the entire satisfaction of his superior officers. And in the face of several difficulties he carried out the repairs in a thoroughly practical manner based upon what he had learned by personally handling the machine and also what he had learned of its construction from his familiarity with the Gisholt shop.

He followed the Gisholt service book, made the necessary sketches for the various repair parts to be made, and had no trouble whatever in completing the work

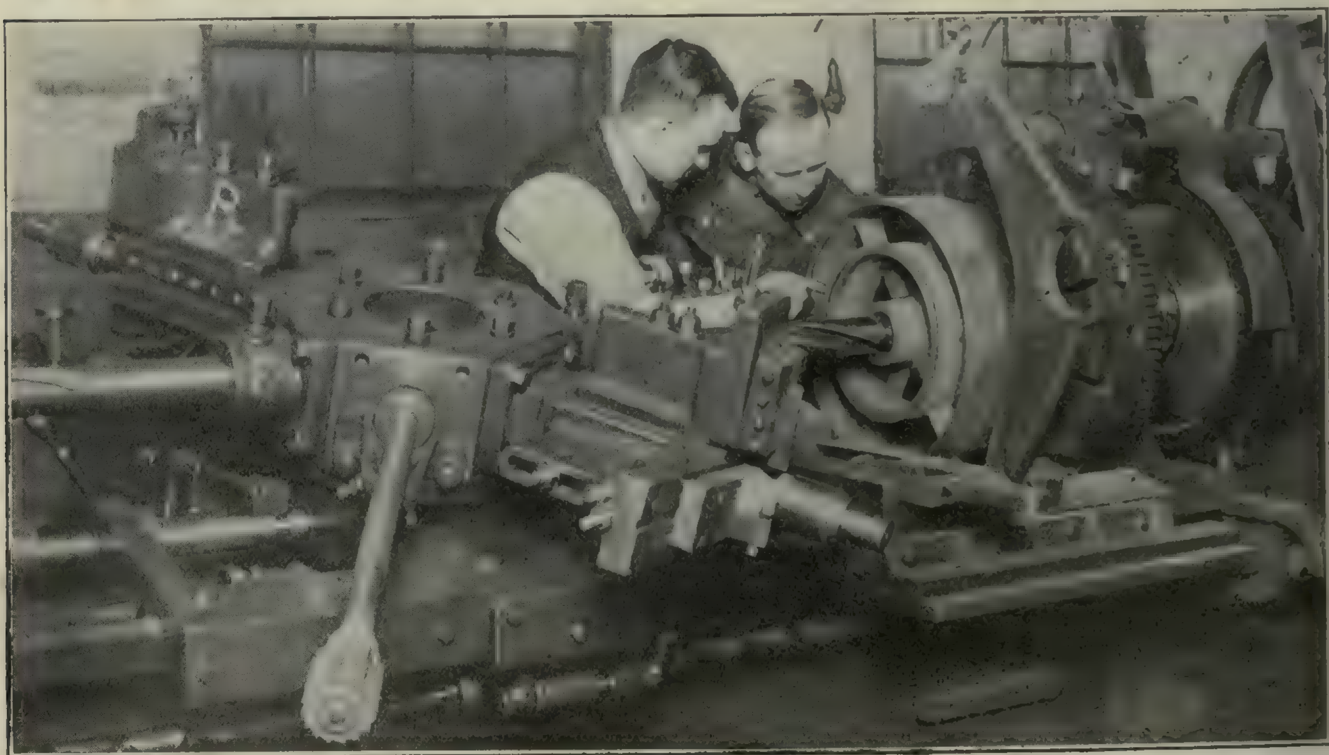


FIG. 11. MACHINING FRICTION PULLEYS

to the entire satisfaction of all. It is interesting to note that his sketches were particularly good, especially when it is considered that he had never before had any work of this kind.

This experience can be duplicated in many ways, and is one of the best proofs possible that such an intensive method of training is thoroughly practicable in every way.

On completing the course the student receives in addition to the 15 lessons which he has already acquired one of the service books, a guide to the Gisholt lathe, blanks for making time studies and tool layouts, and is made to understand that the experience of the Gisholt company is always at his disposal whenever he needs advice of any kind. There are numerous instances where uneducated men have taken this course, and where it has proved the beginning of their voluntary study along this and other lines.

The whole spirit of coöperation, which is plainly shown by all who come under its influence, together with the actual information absorbed and the incentive which is planted to acquire more knowledge, seems to have the possibilities of transforming some characters to an astonishing degree. With the modifications of this course, which have now been worked out, it is believed that it will be feasible to give a thoroughly satisfactory course in four weeks instead of eight, and there can be no doubt as to the value to the country at this time of having similar schools established in the various machinery centers. And the spirit prevailing in the Gisholt plant and which has prompted the Gisholt Machine Co. to make public all its methods at this time is to be highly commended.

Drill Jig for Bars and Similar Long Pieces

By Christian F. Meyer

Fig. 1 shows a number of cross-sections and a plan of bars used in a machine in the textile industry. These bars, which are about 4 ft. long, are provided with holes over their entire lengths as shown by top view of upper bar in Fig. 1. The holes are of various diameters; some are tapped or reamed, others are simply drilled. They are not located in a straight line or lines, but at different points on the surface of the bars, according to the requirements of the machine.

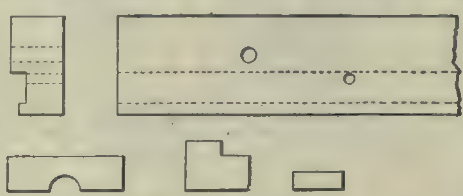
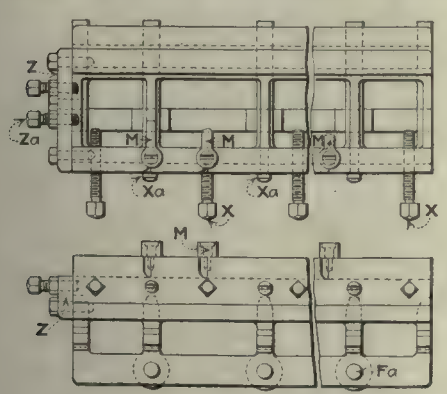
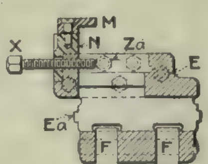


FIG. 1





SLIDE E HOLDING WORK
FIG. 4

FIGS. 1 AND 4. THE BAR AND THE WORK-HOLDING SLIDE

Fig. 1—Cross sections and plan of textile machine bars. Fig. 4—Work-holding slide

It was, therefore, a slow, unreliable and costly job to lay out these holes preparatory to the drilling operation. Not only did mistakes frequently occur in the layout, but the man at the drilling machine was forced to refer constantly to the blueprint, in order to ascertain size and other details of each hole. It was also necessary to employ a skilled drilling machine hand with the ability to read blueprints. All these precautions failed to produce duplicate bars and, as they wore rapidly, the labor caused by fitting proved expensive.

The jig described in this article was designed to overcome all these difficulties. Since in use all shapes and kinds of bars are drilled positively alike and interchangeable, without any previous layout or reference to a blueprint. The danger of a mistake is slight and the work is completed in a fraction of the former time. Like reference letters are used in all the cuts.

The jig consists of a cast-iron base *B*, Fig. 2. Two ribs *C* and *C* are cast integral with this base and provided with square, finished slots *Ea* which extend over the full length of ribs *C*. Side ribs *C* are connected with each other by a number of cross ribs (see section of Fig. 3). The spaces between these cross ribs are open to reduce the weights of the casting. Two other ribs *D* also run along the entire length of *B*. The upper surfaces of these ribs are finished, and serve as rails for steel rollers *F* which revolve about axles *Fa*. These axles are held in a cast-iron slide *E*, Fig. 4, at regular intervals. The slide is composed of several long ribs connected by cross ribs, as shown by the sketch. Each one of these cross ribs has a square, finished extension on either side which fits into the grooves provided in *C*, Fig. 2. These square extensions hold and guide slide *E* while it rolls along on base *B*. A steel bar *N*, Fig. 4, is fastened to one side of *E* by means of screws *Xa*. Small steel levers *M* of different lengths are loosely attached to top of bar *N*. Coinciding with the center lines of these screws holding these levers and directly below them, are sawtooth-shaped notches cut into the sides of *N*. The end of slide *E* is closed by a steel bracket *Z*, which holds two setscrews *Za* extending into *E*. A number of setscrews are also provided in slide *E*, which pass loosely through *N*, as shown. The top surfaces of the crossribs in *E* as well as the surface running opposite and parallel to *N*, are finished. A bracket *O* is fastened to the side of *C*, Fig. 2. This bracket is provided with a hardened plunger *Q*, the extending end of which fits into the sawtooth-shaped notches of slide *N*. *Q* is constantly pressed toward these notches by a suitable spring which is held in its place by a steel cover *Y*. Plunger *Q* can be drawn back by means of a knurled knob.

Another supporting bracket *G* is bolted to a side extension of base *B*. A cast-iron guide plate *H* is attached to this bracket. A slide *I* is operated in this plate and held to it by the adjustable steel plate *Ha* in the manner shown in Fig. 5.

Slide *I*, Fig. 2, is operated by a spindle which is held by a cast-iron bracket *K* and a steel cover *U*. Handle *S* revolves the spindle.

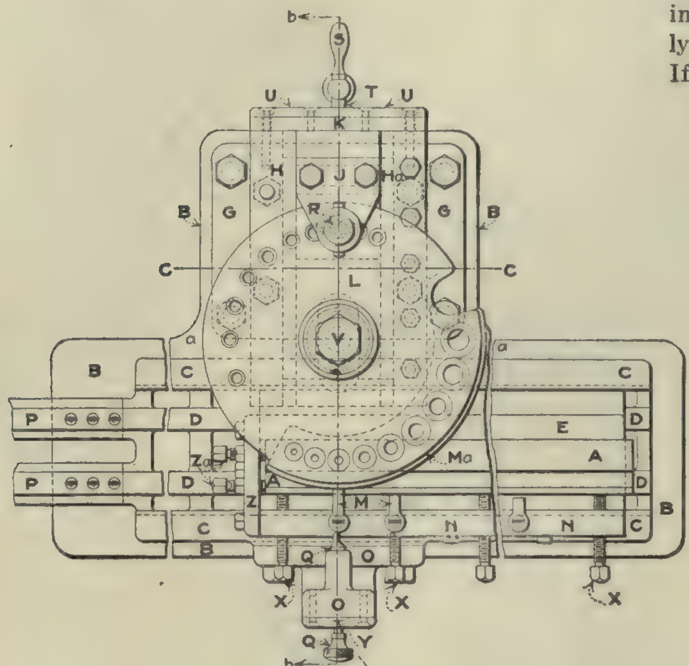
Another cast-iron bracket *J* is secured to *I* and provided with a steel plunger *R*. The tapered end of this

plunger fits into a number of corresponding holes located in a steel disk *L*. Plunger *R* is pressed into these holes by a spring and can be withdrawn by means of a knurled knob, as shown. Disk *L* is mounted on slide *I* and revolves easily about a pivot on the slide. It can, however, be held in any desired position by a bolt *V* and a nut *W*. The latter is prevented from turning by flats fitting into a slot. This slot is long enough to allow the nut to slide with *I* as the latter moves. Disk *L* has a number of hardened bushings which are arranged in such a manner that the center of each bushing is always on centerline when plunger *R* slips into the corresponding hole on the opposite side of disk *L*, Fig. 6.

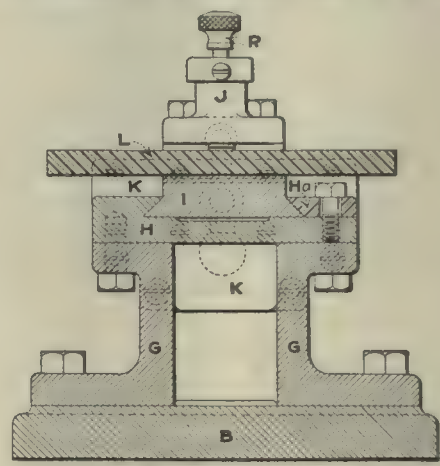
The hole in each of these bushings is of a different size and the size of each hole is stamped on the surface of disk *L*, Fig. 2, at the side of the respective bushing. That part of the circumference of *L* where these steel bushings are located is also provided with a finished edge *Ma* which is extended from disk *L* at the same height as the ends of levers *M* on slide *N*.

The jig is operated in the following manner: The bar *A* to be drilled is laid upon the finished surfaces of the cross ribs of slide *E* with one end against the two setscrews *Za* which are fixed by check nuts. Setscrews *X*, Fig. 6, press the bar against the finished side of *E* and hold it securely. Guide-bar *N* is fastened to *E* by screws *Xa*, and slide *E*, with the work, rolled forward until the first notch *N* is engaged by plunger *Q*, thus holding slide *E* in a positive position. The lever *M* above this same notch is then swung out, and slide *I*, Fig. 2, is moved forward or backward, as the case may be, until the swinging lever just touches the extending edge *Ma* of disk *L*. On the top surface of each lever *M* is stamped the specifications of the hole which is to be drilled. Disk *L* is now revolved until the bushing indicated by the markings on the respective lever *M* is opposite this lever. Plunger *R* is then allowed to slip into the opposite hole in *L* thus locating the disk exactly. *L* is secured by bolt *V* and the proper hole is drilled. If the markings on *M* indicate that it is to be tapped or reamed, disk *L* is revolved after the hole is drilled until the large cutout provided in *L* for that purpose is above the hole, thus giving any tap or reamer ample room to perform its work. Plunger *Q* is withdrawn and slide *E* moved forward again until the next notch in *N* is engaged, thus indicating the position of another hole. Lever *M* for this notch is swung out and the entire operation, as described, is repeated.

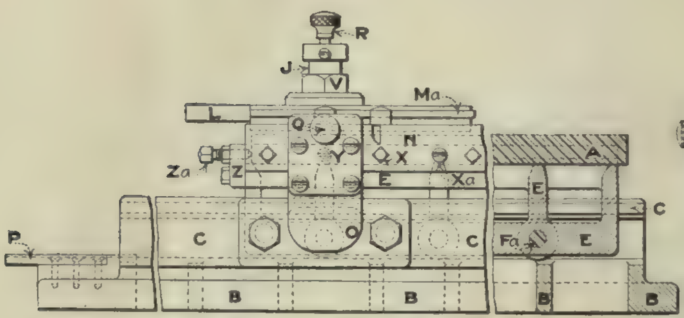
The jig will give satisfactory work for any kind or shape of bar within its capacity. The only thing necessary is a guide bar *N* for each kind of new work. If the work in hand is long, the bars may be extended at one end by steel rails *P*, Fig. 6, as shown. This eliminates excessive weight.



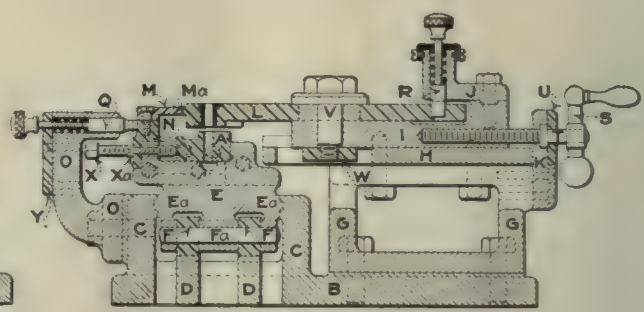
TOP VIEW
FIG. 6



SECTION ALONG LINE C-C
FIG. 5



FRONT VIEW WITH PARTIAL SECTION
FIG. 3



SECTION ALONG LINE B-B OF FIG. 3
FIG. 2

FIGS. 2, 3, 5 AND 6. VARIOUS VIEWS OF THE BAR-DRILLING JIG
Fig. 2—End view of jig. Fig. 3—Front view of jig. Fig. 5—Cross section of slide plate and guide. Fig. 6—Top view of jig.

The Problem of Labor Turnover*

By M. C. HOBART

Labor turnover is a problem that is always a puzzle, and anything that tends to its solution along sane lines is of interest. This article presents conditions in a very practical way.

RECENTLY manufacturers have been directing their attention to the money loss caused by the large number of employees who leave their employment. We believe that the first step toward eliminating this loss is to obtain the coöperation of foremen, and to this end the subject of labor turnover and its cost was presented at a recent executives' meeting of our company by the employment manager as follows:

"You foremen are continually hearing from the production department and from the shop superintendent about getting work out on time, and from these same people and from the inspection department about cutting down spoiled work. Now you can't do these things by yourselves; you have to accomplish them through the men who are working under you. Maybe you say to yourselves that it is all very well to be calling for more production and less spoiled work, but look at the incompetent help that the employment department is getting for us. But why is it necessary to hire so much new help? The reason that last new man was hired for you is because someone had quit. And he not only quit working for the company but he quit working for you. And if he had not quit your department he would still be working for us and it would not have been necessary to hire a new man who probably was not nearly so good a workman.

Men Not Discharged

"Most of the men who leave our employ are not discharged; they go of their own account. Two years ago 40 per cent. of the men employed were hired to replace men who were discharged, while last year only 20 per cent. of the new men were necessitated because of discharging old employees. In many cases discharge was due to the incompetence of the new men who had to be engaged because of the scarcity of competent workmen.

"Last year we employed 1130 men to maintain an average working force of 373 men. Of these 1130 men 170 never reported for work. There were 1045 men who were removed from our payroll last year, which is nearly three times the number of men we had working here on the average throughout the year. To be exact it is 280 per cent. of the average working force, and this is what we mean by a labor turnover of 280 per cent. It is the ratio of the number of removals from to the average number on the payroll for a given period.

"There is not one of you who at the end of the week would tear up his salary check and throw it away. Not even after thinking about it a good many times would you do so. Yet every time a man walks out of the factory, either by quitting or being discharged, it means a loss of at least $40 to the company. Probably it is not quite that much in the case of a boy or of an unskilled laborer, but it is much more in the case of a skilled workman. Forty dollars is the average figure for the men on our payroll. That meant a loss of $40,000 to us last year on account of quitting and discharges. When you begin to realize that you foremen are the ones who are in direct contact all the time with the men and who are responsible for giving them the right start when they enter our employ, and seeing that all get a square deal, that they understand the company's attitude toward them; when you begin to realize that you are the ones who must interpret to them this attitude and that their staying with us depends in a large measure upon your success in accomplishing this, the question will look considerably more important to you, especially when its value can be reduced to a dollars-and-cents basis.

"But perhaps you do not agree with me that it means a loss of from thirty to fifty dollars every time we lose a man. Let us spend a few moments looking at the figures in the case.

The New-Man Expense

"Our help-wanted advertisements last year cost us 50c. for each new man. The time of the employment department and the payroll clerk in hiring the man and entering his name on our records amounted to 75c. for each man. The foreman's time spent with the new man in getting him properly started on his work and familiar with our methods takes, or should take if it is properly done, at the very least 10 minutes a day for a month, which means $4.50, plus the time of some older workman who should be set to keep an eye on the new man and help him along, which means an additional dollar.

"Next is the wear and tear on the machinery—an important item. As is shown by our machinery and tool repair account each month, a man does not have to smash many gears in the change gear box of a lathe, or break many sixty-dollar hobs or thirty-dollar cutters or do any of the other thousand-and-one things that a green man does to make the cost of this wear and tear on machinery amount to an average of $12 for each new man.

"Then we have the loss of production owing to the new man not reaching the normal production rate in from three to six weeks. Deficiency reports show that this loss is a large one. For the first two or three days a new man is not likely to do more than half the usual amount of work; from this on he improves until at the end of a month he should reach the standard. If he loses many hours during the first few days he does not have to lose many such in the following weeks to have lost 30 hours' time in production while he has been breaking in. And 30 hours means, with his wages and overhead, $25.50.

"But we are not through yet. The cost of work spoiled in the shop during the month of December was

*Read at a recent meeting of the executives of the Albaugh-Dover Co., Chicago.

over $600 and the cost of correcting mistakes was $1300, making a total of $1900 for the month.

"Forty men were taken off the payroll and replaced by others during that month, and about the same number for November. This $1900 means $48 apiece for each new man hired during December, and I think you will admit that much of the spoilage and mistakes are due to new men, although not entirely so. Suppose then that we divide this given figure by four and call it $12.

"Now we come to the accidents and injuries, which are greater in number with new men than with older employees and for which $3 is a conservative figure.

Poor Equipment

"Somewhat related to the item of decreased production is the loss caused by maintaining more equipment than would be necessary were it not for this loss. On a basis of 10 per cent. loss in production on each new man for the first month of his work, and an average of 80 new men a month for last year, this means that 22 per cent. of our equipment is working only 90 per cent. efficient, so far as time consumed on the work done by new men is concerned. The interest on this equipment at 10 per cent. a year amounts to 50c. for each new man hired. Let us now see what we have:

For advertising	$0.50
For hiring and clerical work	.75
For instruction	5.50
For wear and tear on machinery and tools	12.00
For loss of production	25.50
For spoiled work and mistakes	12.00
For accidents	3.00
For interest on extra equipment	.50

making a total of $59.75 as the cost to place a new man at work, and this is a very conservative estimate in the light of studies that have been made in industrial plants throughout the country. Therefore I say we have a real problem to face when desirable men leave our employ.

"What are some of the reasons for a man quitting his position and what goes on in his mind at the time of making the change?

Dissatisfaction With Wages Not Always the Cause

"In the first place the man may be dissatisfied with his wages. But dissatisfaction with wages will not alone induce a man to give up his job. A man has to feel that he is going to be benefited all around before he will change, and some of the things that contribute to his decision to leave are unsatisfactory surroundings, long hours, lack of a consistent policy of advancement, lack of instruction and faulty machinery or tools.

"Now there are several characteristics of workmen which may lead to giving one or more of the above conditions undue prominence in his mind and cause him to leave.

"First is his lack of specialized training. Most of our men cannot even do one thing and do it better than anyone else, so that he has no reason for remaining in one particular trade or place.

"Then there is so much seasonal employment, so much careless hiring and discharging of men, and it is so easy to move from one flat to another or from one town to another that the man does not throw himself fully into his work and identify himself with the company.

"In addition to the foregoing, there comes a time when things begin to go wrong either at home or in the shop; the man becomes discouraged or nervous or even physically ill, and almost any other job looks better to him than the one he has.

"You may be interested in knowing that there is a definite physiological and psychological basis for such a mental condition as this, and it is one of the duties of the employment department to avoid hiring men in whom such characteristics are developed to any great extent. Dr. Herman M. Adler, formerly of the Harvard Medical School and the Boston Psychopathic Hospital and now of Chicago, made a study of the cases of a number of unemployed men and their personality as related to their unemployment. And in just a short part of his report I want you to see how well he describes some of the men who have worked or are now working under you.

"Their reaction to the world is entirely egocentric. No matter what they experience, what they desire, their own ego is the center of the plot and dominates everything. They are always ready to undertake new schemes; they are usually working for the betterment of the rest of the world and claim all sorts of altruistic motives, and even may be altruistic to some extent, seeking merely the satisfaction of being in the limelight. Or the emotion may be a depressed one and the individuals are contentious, surly, suspicious, claim abuse, recognize no kindness that is done them, appreciate no favors, etc.

"This is by far the largest group in our table, comprising 43 cases out of 100, or almost half.

The Lack of Ability

"Emotional instability was the cause of the failure of the remaining twenty-two individuals. (One-third failed through lack of actual ability.)" Under this heading Dr. Adler included all the cases that showed "sufficient mental ability and judgment to satisfy the ordinary demands of life, and who showed no marked tendency to the egocentric attitude or to enlarge on their own significance, accomplishments or jealousies of others. These include the individuals who show excessive emotional reactions, who are at times buoyant beyond all reason, . . . Their minds are very active, they have many new ideas, they have a marvelous imagination, they undertake a dozen different obligations, none of which they can carry out. They tire of one thing before it is half begun and go rapidly to another. In another mood they may show an interference with thought, a lack of initiative, a tendency to be unhappy, a brooding disposition. They are extremely irascible, usually on account of some external provocation. The latter may be very slight. Impulsiveness amounting often to an obsession is frequently found.

"Here is an astonishing and highly suggestive finding. Among a hundred persons for whom unemployment was a serious problem, two failed for temperamental faults for one who was found inadequate to his work."

"Knowing these things, what can we do to improve conditions? Our executive meetings are by no means devoted only to the subject of employment, but we can well devote some of our time to a further consideration of that subject. We can well broaden our present methods as to promotion and transfer, providing rest periods during the day and giving our new men the proper start and instruction in their work. And betterment in this direction is impossible without the earnest coöperation of all our foremen."

Practical Cam Design

By L. G. Johns

It is not the purpose of this article to give the reader the detailed methods of laying out cams, for these have been made clear on many previous occasions both in the columns of this paper and in the various works on the subject. The idea is to make certain recommendations as to the best form of cam surfaces and the best operating angles for those surfaces.

The choice between the uniform motion, the harmonic or crank motion and the uniformly accelerated or gravity motion cam or any combination of these motions must be made by the designer, according to the purpose to which the cam is to be adapted. In some instances it is necessary that the cam follower pass through equal distances in equal intervals of time. In other cases the machine may be of a such a low-speed type that it permits of this condition, though this is not necessary. The uniform-motion curve cam is used in such machinery, as it may be cut on the standard milling machine without difficulty, and is therefore of cheap construction.

For machinery of moderately high speeds, and not requiring too high a refinement of the motions, the harmonic-motion curve cam is very satisfactory, giving the follower an acceleration from rest to maximum velocity, then retarding it to a state of rest, as in the motion of a plain crank through its cycle.

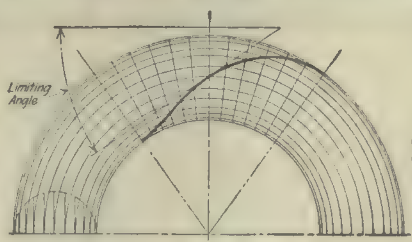
When, however, the highest refinement of motion is required with high speed, and the absence of shock is a point to be considered, the gravity curve is the proper one to use. This curve is based upon the parabola, and gives the same uniform acceleration as that in a falling body, the retardation being the reverse.

A Demonstration

As a practical demonstration of the widely different action of poorly designed cams and those of the gravity-curve type the writer had occasion to use a standard four-slide wire-forming machine for making a simple wire article, using about 3 in. of wire of 0.075 in. in diameter. The cams were of a mongrel design based upon no particular curve, though arriving and departing at their proper respective times. At 100 r.p.m. this machine could be heard all over the plant, and the vibration was so pronounced that nothing could be kept tight. We decided without delay to redesign the cams and used the gravity curve. The last I saw of the machine it was turning out the articles at 325 per min., and running as smoothly as a sewing machine. There seemed to be no particular reason why 500 per min. could not be attained without serious danger to the parts.

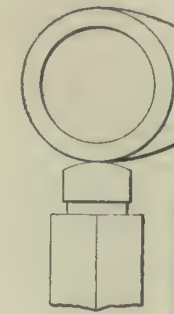
The limiting angle, formed by a tangent to the center line of the follower roll path, as shown in Fig. 1, is the governing feature in laying out a cam once the proper curve is decided upon and the stroke and degrees of rotation are known. In a recent investigation I have gone through the cam drawings of 18 machines of my own design, including sewing machines, hook-and-eye machines, eyelet machines, special wire-forming machines handling wire from a few thousandths of an inch in diameter to a $\frac{5}{8}$-in. half-round for cotter pins, and other special machinery. The records therefore include machinery from the lightest kind with speeds up to 3000 r.p.m. to very heavy machines running at 50 to 75 r.p.m. The investigation shows that the limiting angles of the cam-follower paths varied from 21 to 40 deg., only a very few lightly loaded cams being over 35 deg., and the great majority of all kinds at or below 30 deg. As these machines have all been successfully operated it would seem that they give a fair idea of what is desirable.

It is not always possible to hold the angle to or below 30 deg. and keep within reasonable limits of design for the other parts of the mechanism. Much can be accomplished, however, by keeping a sharp eye on the preliminary layout of the machine. When a great number of cams are arranged along one shaft it is desirable that their outside diameters be made equal. This adds to the appearance of the machine and the convenience of construction, and enables the assembler to lay a straightedge along the entire set and mark a zero line on the rims.

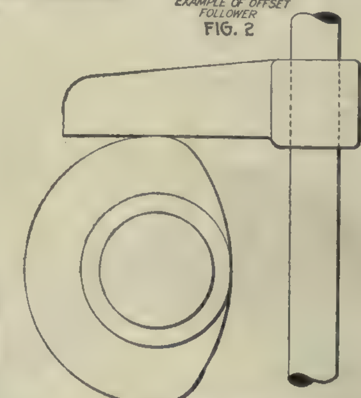


ILLUSTRATING THE LIMITING ANGLE OF A CAM
FIG. 1


EXAMPLE OF OFFSET FOLLOWER
FIG. 2


CAM AND PLUNGER FOR EYELET MACHINE
FIG. 3


METHOD OF BEVELING ROLL BUSHING
FIG. 5


CAM AND FLAT LIFT SHOE
FIG. 4

FIGS. 1 TO 5. CAM DIAGRAMS AND DATA

Fig. 1—Illustrating the limiting angle of a cam. Fig. 2—Example of offset follower. Fig. 3—Cam and plunger for eyelet machine. Fig. 4—Cam and flat lift-shoe. Fig. 5—Method of beveling roll bushing.

In order to carry out this plan the designer should hunt out the cam having the greatest stroke in proportion to degrees of rotation and make the diameter of the cam sufficient to keep the limiting angle reasonably near 30 deg. (the larger the cam for a given relation of degrees and stroke the easier the curve). He can then make all the other cams of the same outer diameter and be assured of an easy road to travel. If this plan is not feasible, owing to the excessive size of the worst cam, it may be possible to offset the follower and place the

roll off the center line of the cam, as shown in Fig. 2. Much can be gained in this way, but care must be taken not to overdo the offsetting, which should obviously be done in the direction opposite that of the rotation of the cam, as shown in the sketch, and not so great as to throw too heavy a side load on the follower.

Naturally the greater number of the cams investigated operated roll followers, and the rolls varied from $\frac{3}{8}$ in. to $3\frac{1}{2}$ in. in diameter. The majority of these ran about $1\frac{1}{4}$ to $1\frac{5}{8}$ in. The eyelet-machine cams operated on plungers with curved ends on the down stroke, Fig. 3, and on flat lift shoes on the up stroke, Fig. 4. The limiting angle of both of these styles of cams was about 27 degrees.

All cams for machinery doing any but the lightest duty should be both keyed and setscrewed to the shaft. The key insures against slippage around the shaft, and the setscrews serve the double purpose of preventing slippage along the shaft and holding the cams for preliminary setting before the keyways are cut.

For general work it would seem that it is cheaper and better to bush all cam-follower rolls with bronze. This saves internal grinding after hardening and permits of renewal of the bushings when worn. It is well to bevel the ends of the bushings, as shown in Fig. 5, to prevent crowding endwise outside the roll surface under the constant hammering of the roll while running.

As this article covers data taken from nearly 200 cams, and these cams have been working very smoothly and successfully for a number of years—some of them more than 15 years—it is safe to bank upon the results of the investigation. Cast-iron, machine-steel and hardened tool steel were used as the conditions seemed to require.

Qualifications of an Inspector

By W. R. Fradell

Your Washington correspondent in his letter of Apr. 18, page 684 of the *American Machinist*, brings up a question that may prove to be of vital importance to the Government before the war is over—that is, the matter of securing as inspectors men who have had the advantage of a mechanical training. No man should be considered for a chief or assistant chief inspectorship unless he has had at least three years' practical shop experience and a further training of not less than six months on accurate gaging work.

Men have been accepted who do not meet this requirement, and in some cases schools have been established from which in a few weeks' time persons who were without previous experience in the line they were expected to cover were graduated as full-fledged inspectors.

No manufacturer would consider such a course; rather would it be his policy to select for such positions men of wide experience and good judgment, for the successful manufacturer does not want to trust the reputation of his product to anyone until he knows that that person is fully qualified to maintain it.

On one occasion there was sent to a certain plant as chief inspector a man who not only was not a mechanic but who had no knowledge whatever of the line of work upon which he was to pass. If that firm had cared to turn out inferior work there would have been practically no restrictions upon it; but fortunately for the Government this firm was not only strictly honorable in its intentions but it possessed a thorough inspection system of its own.

Both England and Russia made the mistake of appointing in some cases men to their inspection staff who were without experience or knowledge of the product, and the United States should profit by their mistake and avoid trouble. In view of the unprecedented demand for workers of all kinds it is of course impossible to get a sufficient number of men qualified to fill all positions, and it is necessary to use whoever may be available—women as well as men. Though the latter are often more capable than men it is hardly to be expected that they will have the desired mechanical training and experience. It should, however, be possible to have duly qualified men at the head of departments in every plant.

Good judgment is an essential factor in the inspection department. Much time has been lost because inspectors insist upon conforming to measurement of the drawing in nonessential points. If the variation from established measurement does not affect the functioning of the part under inspection it should be passed. It may be said that this practice will tend to make contractors careless. In the writer's opinion this is not so, as in most cases not only the manufacturers but the operators desire to turn out the best work consistent with efficiency.

Mistakes will occur in the best-regulated shops, and it is up to the judgment of the inspector to prevent those that are detrimental to the product and to overlook those in which the defect is only technical. It is here that diplomacy is required, for when any quantity of parts is rejected it means a loss to the manufacturer and to the operator which unless the reason for the rejection is obvious is likely to leave a feeling of resentment toward the inspector. Some workmen feel that an inspector's sole province is to criticise their work, but no inspector has a true conception of his duty or measures up to standard until he is able to show both manufacturer and operator that he is their friend and helper.

Another point to be considered is the compensation. To secure capable men for positions of responsibility who possess the necessary qualifications (and none other should be appointed) will it not be necessary to increase their rate to at least correspond with that of a first-class toolmaker who is today receiving from \$2300 to \$2500 a year, while a Government inspector receives between \$1500 and \$2400?

For Exporters and Importers of Machinery

It has come to the attention of the War Trade Board that various individuals, firms and corporations have been advertising their services to be rendered in the matter of securing export and import licenses.

The War Trade Board suggests that it is not necessary for exporters or importers to consult such agencies. The various bureaus of the War Trade Board will supply all the information desired on receipt of requests.

The board desires to place as little inconvenience and expense upon importers and exporters as possible, and therefore this suggestion is made in order that they may not be put to the expense of employing such agencies to obtain licenses unless they so desire.

VII. The Receiver—VI

This closing article on the receiver will be confined principally to certain important operations that take place as the work approaches completion. The illustrations show the milling of the barrel thread in the front end of the receiver, the qualifying of the front end after threading, the grinding of the magazine hub to gage, and the grinding of the lock-up shoulder in the bore, which is the last machine operation performed on the receiver, the piece being ready then for assembling.

THE thread-milling operation in the front end of the receiver is accomplished with an attachment in the engine lathe, which is illustrated in Fig. 63, where the work will be seen held in a special fixture which is mounted upon the nose of the lathe spindle and supported at its outer end in a steadyrest, the jaws of which are adjusted to a cylindrical surface finished at the outer end of the fixture body.

The receiver in this operation is carried at its inner end upon a split plug or short mandrel fitted in the back of the lathe fixture, and adjusted to fit tight in the receiver bore by means of a tapered plug drawn back into the carrying mandrel by a closing rod and handwheel operated at the rear end of the spindle. The outer end of the receiver in which the thread is to be cut is securely clamped in the front end of the fixture and is then tested in the mouth of the hole for running true by means of the dial indicator shown mounted upon the upright on the baseplate to the left of the carriage. This indicator is constructed with a floating contact arm, the rear end of which operates under the spindle of the dial gage, so that any oscillatory movement of the front end of the arm is transmitted to the gage pointer where the fluctuations may be read on the dial. By application of the indicator to the end of the receiver counterbore the work is assured of running true before threading operations are started.

The milling-cutter spindle is mounted in an adjustable head on an upright fitted at the bottom for lateral adjustment on the cross-slide guide on the carriage.

The lathe-spindle drive is modified to give the necessary slow rate of rotation to the receiver during the thread-milling process. It will be understood that the milling apparatus is adjusted at the outset so that the cutting teeth will start the thread at the exact predetermined point in the rotation of the receiver. With similar procedure in milling the thread on the barrel, the qualifying operations for assuring correct results in assembling these parts will be greatly facilitated.

This naturally necessitates the application of some device for locating all receivers in the rotating fixture in precisely the same angular position about the axis of the holding plug or mandrel at the rear end. The means of establishing this relationship between the work and the rotary-fixture barrel is found in the hardened plug inserted in the plate which is definitely located across the front end of fixture and work, this plug entering the small hole or piston bore in the receiver.

In Fig. 63 a threaded receiver is shown on the lathe-carriage wings with half the rear end cut away to show the character of the threaded and counterbored portions that form the chamber for the reception of the barrel. The gages for testing the threads are seen on the bench immediately in front of the work.

Of the three gages shown in the group the one to the left is for testing the thread alone as to accuracy.

The gage at the right is a qualifying tool and is applied to the work to determine if the thread is located correctly in respect to the end of the receiver, so that when the gun is later assembled the barrel will screw up snugly to the abutting shoulders, with its locating lug in correct position; that is, on the top and central with the center line of the receiver.

The application of a qualifying gage in the bench operation is shown by Fig. 64. Each receiver is here touched with scraper and file, removing the least possible amount of metal until the edge of the gage comes almost into coincidence with the receiver edge. It requires very little touching of the work at this point to bring the gage up to the desired position, and it is of interest to note here that the final qualifying operation is not performed until after the receiver has been passed through the browning process, as the very thin coating formed or deposited upon the work has to be dealt with in the final test with the qualifying gage. The browning and finish qualifying, therefore, come almost at the end of the series of operations on the receiver, the only ones that follow after (aside, of course, from inspecting) being the grinding of the internal lock-up shoulder and the assembling in the gun.

FIG. 64. USING THE GAGE FOR QUALIFYING

It has been pointed out that as the receiver approaches completion there are various bench operations in the line of shaving and filing of certain surfaces, all worked to gages and taking care of various points where machine finishing to gage would not be feasible. These hand processes all told are, however, few in number—remarkably so, in fact, considering the total number of operations on the complete schedule. These qualifying operations just referred to are possibly the most important and most interesting of the series.

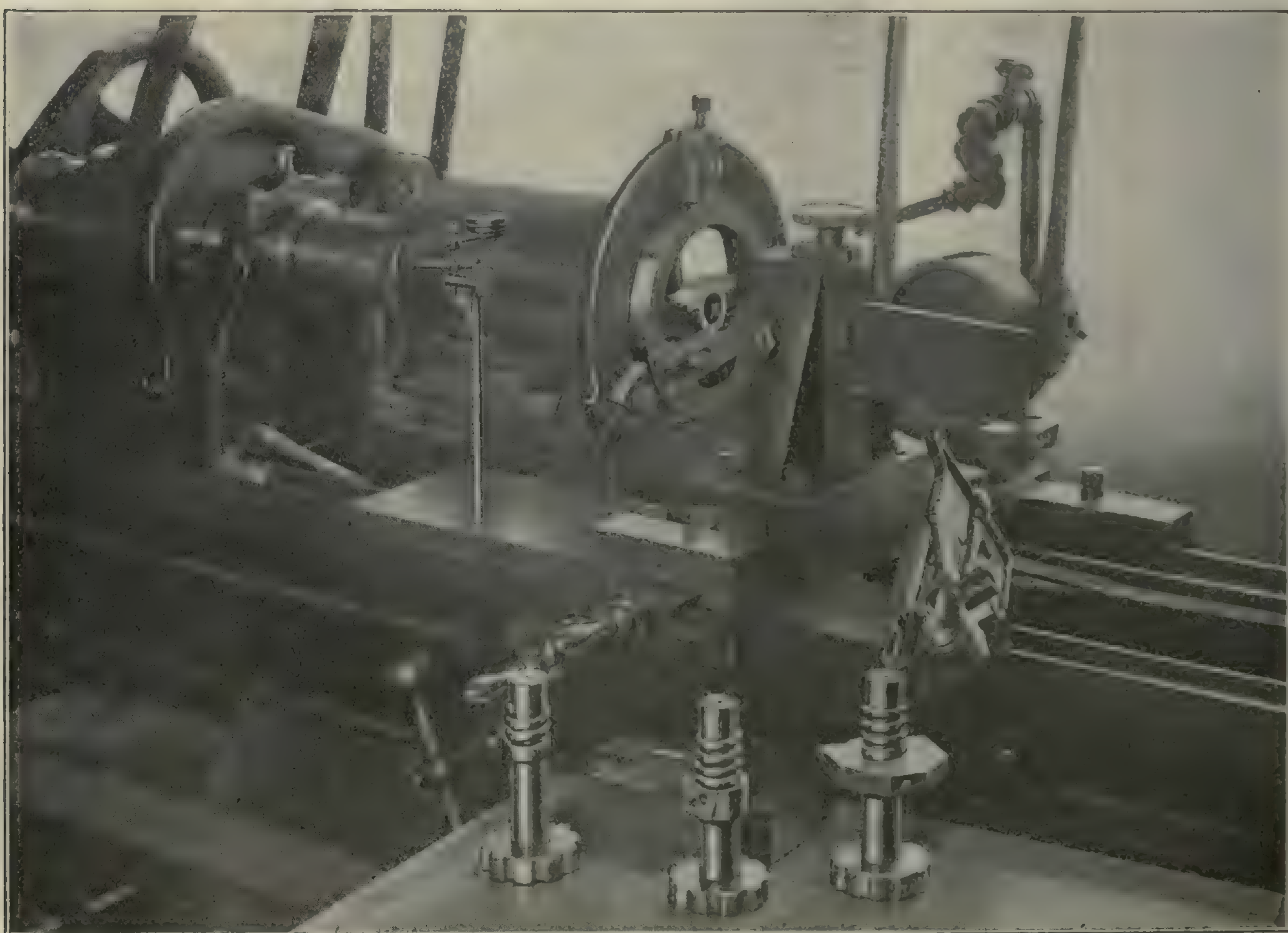


FIG. 63. MILLING THE THREAD FOR THE BARREL

There are two more machining illustrations which it is desirable to present in this article, both having to do with grinding. Fig. 65 illustrates the method of finishing the magazine hub or boss at the end of the receiver with the aid of a grinding attachment. The machine employed is a flat turret lathe with a big open faceplate for mounting the work-holding fixture and a pair of slides for carrying the grinding attachment on the turret.

The character of the work fixture on the faceplate is plainly illustrated, and the method of operating the grinding wheel over the magazine boss will be apparent to the observer. The fixture for gaging the boss after the receiver has been removed from the with the wheel in the bore of the receiver and against the lock-up shoulder. The receiver is mounted upon an expanding mandrel carried in the lathe spindle and adjusted to grip the work by the bore by means of a draw-in plug operated by a rod and a handwheel at the rear end of the spindle.

This gage consists of two separate members which are combined in use to test the position of the shoulder. The gage head to the left is made up of a threaded sleeve which is adapted to screw into the thread milled in the receiver end, and in this sleeve is fitted a micrometer screw with large graduated head. The other member of the gage is a shouldered rod which is slipped into the rear end of the receiver to be ground

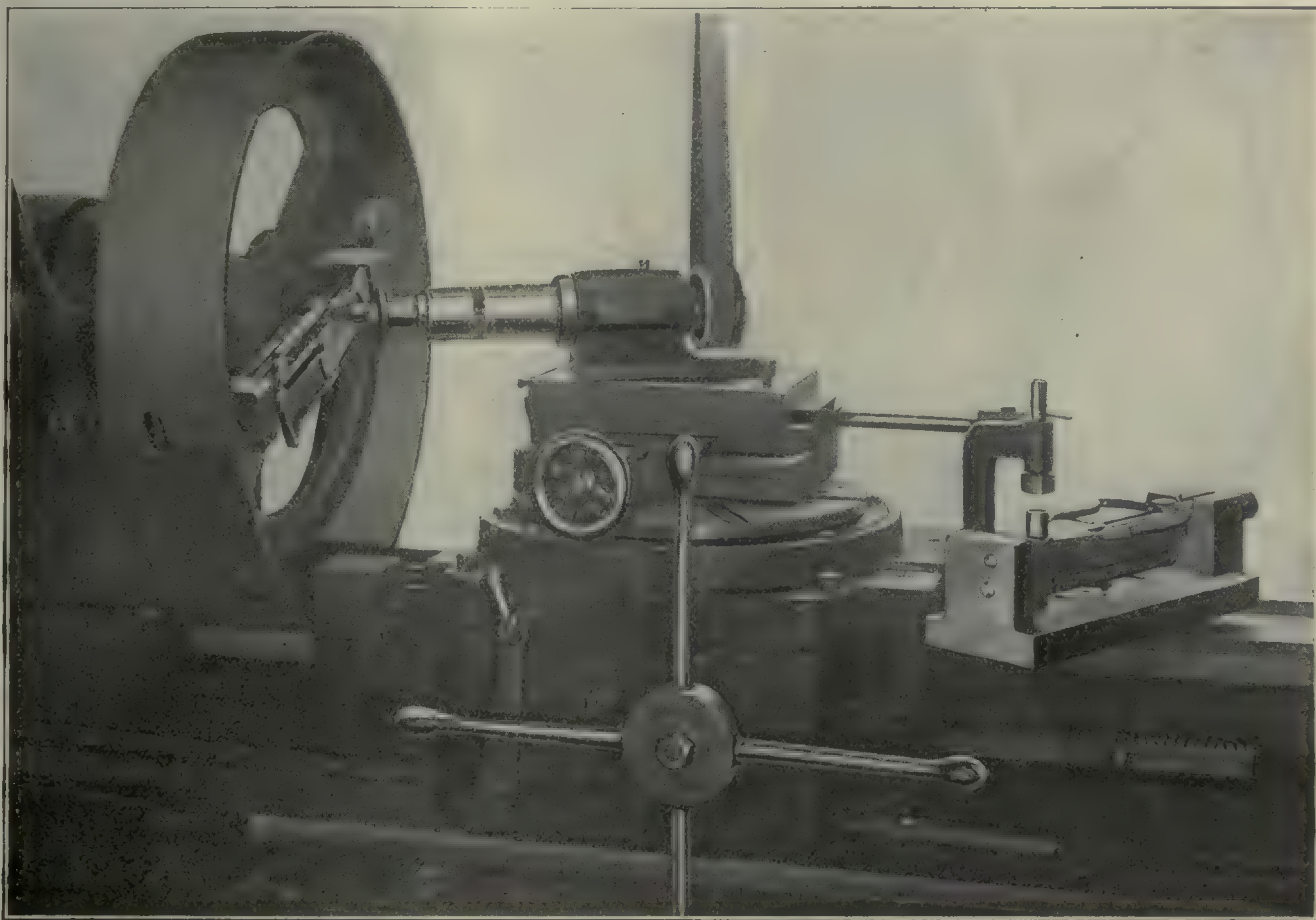


FIG. 65. GRINDING THE MAGAZINE HUB ON THE RECEIVER

machine is seen to the right of the turret. Ring gages are, of course, used for testing the boss before the receiver is taken out of its grinding fixture. The gaging device in this view goes further and not only gages the boss again for size, but also tests it for accuracy of location as finished on the receiver. The gage spindle carries a hollow cup or ring at its lower end, which must pass over the boss while the receiver is fixed on its central plugs underneath.

What is probably a novel practice to many readers is adopted in the hardening of various points on the receiver. This is the spot-hardening with the oxy-acetylene torch for heating at the precise point where a hardened surface is necessary, the surrounding metal not being affected and the receiver being thus kept free from distortion.

Fig. 66 illustrates the internal-grinding operation and its shoulder or collar brought into contact with the lock-up shoulders which are to be finished with the wheel. The micrometer spindle may then be operated to bring it against the collar on the gage rod, and a reading taken on the dial to determine how many thousandths must be removed by the grinding wheel to bring the lock-up shoulders exactly the right distance from the receiver face.

As explained in earlier installments of this article, the lock-up shoulders for the bolt are produced originally by a screw-machine operation, in which recessing tools are applied for forming an internal annular channel the rear face of which becomes the lock-up shoulders.

After the gage in this view has been applied to a receiver, as explained, and the amount to be ground off thus found by inspection of the micrometer dial, the work is placed upon the holding mandrel in the lathe

spindle and the internal-grinding wheel run into the bore until the starting of sparking shows that the wheel on its slender spindle is just in contact with the lock-up shoulders to be finished. A micrometer stop at the front of the carriage is then adjusted in accordance with the reading on the micrometer gage in making the preliminary measurement for position of the shoulder before the receiver is placed on its grinding arbor; and this carriage stop then allows the grinding wheel to be advanced the exact distance in thousandths required for finishing the shoulders to correct dimension from the face of the work.

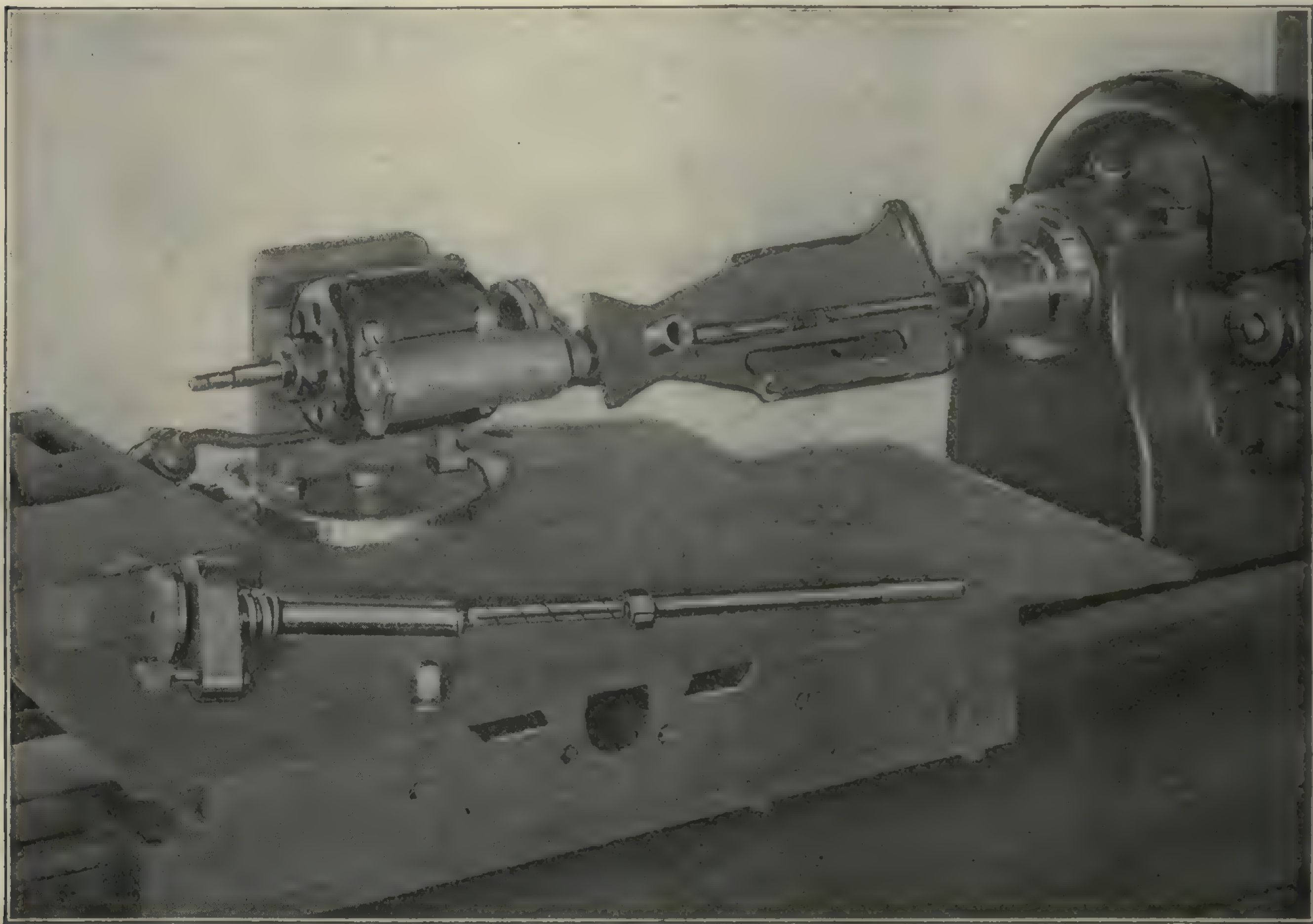


FIG. 66. INTERNAL GRINDING IN FINISHING THE LOCKING SHOULDERS FOR THE BOLT

Cost-Plus Basis for War Supplies

By C. J. Morrison

On page 937, Vol. 46, of the *American Machinist*, there appeared an article by the present writer under the above title. All of the difficulties and dangers that were then pointed out in connection with the cost-plus method of payment have been encountered.

The costs of all such work have been extremely high. There have been and still are numberless questions as to what constitutes cost, and in some cases the plan has even defeated its own ends by slowing up the work, owing to the excess of labor, which excess was sometimes so great that men could not work efficiently because of congested conditions and interference. This excess of labor was, of course, added to increase profits.

Probably the greatest difficulty has resulted from the unsettled condition of the labor market by reason of the exorbitant rates of pay that have been offered by contractors who were working on the cost-plus basis.

Rates were raised continuously, regardless of the fact that in many cases the work upon which the men were previously employed was quite as necessary to the conduct of the war as that for which the excess rate was offered.

Instances have been cited where contractors had actually been to other shops and endeavored to take men from their jobs by offering higher pay. Naturally these contractors were willing to pay the advanced rate, as the more money they paid out for this purpose the greater would be their profits.

A recent proposal is to let contracts on a cost-plus-fixed-profit basis, which is a step in the right direction and will go a long way toward stabilizing conditions; but it would be better still to take one further step and allow the contractor to make a profit in excess of the fixed profit on condition of their reducing their costs below some predetermined standard.

The great flurry and general disturbance occasioned by the entry of this country into the war has now passed, and it should be possible to predetermine standard costs for all jobs and thus establish a basis for original profit as well as the chance for an additional profit.

If the contractor can materially increase his profits by decreasing his costs he will endeavor to get his work done for the lowest possible figure, and thus the confusion prevailing in the labor market will gradually be reduced.

Heat Treatment of Gear Blanks

By C. R. Poole
Frost Gear & Forge Co., Jackson, Mich.

This article is based on a paper read before the American Gear Manufacturers' Association at White Sulphur Springs, W. Va., Apr. 18, 1918, and outlines the advantages of thoroughly annealed blanks to the subsequent machining and hardening operations, as well as an exposition of the structural changes undergone by a piece of steel in the heat-treating process.

In the past few years great advancement has been made in the heat treating and hardening of gears. In this advancement the chemical and metallurgical laboratory have played no small part. During this time, however, the condition of the blanks given the machine shop to be machined has not received its share of attention in the heat-treating department of many forge shops, and in many cases has been neglected or not considered by the machine shops themselves. This is especially true of shops using only the lower carbon steels.

There are two distinct types of gears, both types having their champions, namely, carbonized and heat treated. The difference between the two in the matter of steel composition is entirely in the carbon content, the carbon never running higher than 25 point in the carbonizing type, while in the heat-treated gears the carbon is seldom lower than 35 point. The difference in the final gear is the hardness. The carbonized gear is file hard on the surface, with a soft, tough and ductile core to withstand shock, while the heat-treated gear has a surface that can be touched by a file with a core of the same hardness as the outer surface.

Annealing Work

With the exception of several of the higher types of alloy steels, where the percentages of special elements run quite high, which causes a slight air-hardening action, the carbonizing steels are soft enough for machining when air cooled from any temperature, including the finishing temperature at the hammer. This condition has led many drop-forge and manufacturing concerns to consider annealing as an unnecessary operation and expense. In many cases the drop forging has only been heated to a low temperature, often just until the piece showed color, to relieve the so-called hammer strains. While this has been only a compromise it has been better than no reheating at all, although it has not properly refined the grain, which is necessary for good machining conditions.

Before going into the effects of proper annealing temperatures for the most commonly used steels we will briefly consider the theory of heat treatment. Heat treatment, in the broad sense, is the thermal refinement of the structure of steel, and covers the four operations, namely, annealing, carbonizing, hardening and drawing, or tempering as it is commonly called. All of these operations are based on the fact that in heating a piece of steel the structure undergoes a change at from one to three points on heating and a corresponding number of changes on cooling, these changes being caused by a molecular rearrangement of the carbon and iron. The points are known as "critical points" or "critical ranges" and vary in number according to the composition of the steel. These points on heating are often referred to as "decalescent point," and on cooling as "recalescent point." Carbon exerts the greatest influence on the location of the critical points, with nickel and chromium coming next. A straight carbon steel up to 35-point carbon has three criical points; from 35- to 89-point carbon two critical points are found and over 89-point carbon only one critical temperature is found. Each 1 per cent. of nickel will lower the critical point 20 deg. F., while each 1 per cent. of chromium raises the point 10 deg. F. Of the critical points those found on a rising temperature are higher than the corresponding points on a falling temperature. Rising temperatures are always considered in correctly heat treating a piece of steel. In order to produce the most complete rearrangement of the molecules of carbon and iron and therefore the greatest refinement it is necessary to heat to a temperature slightly in excess of the highest critical point.

Annealing is heating to a temperature slightly above the highest critical point and cooling slowly either in the air or in the furnace. Annealing is done to accomplish two purposes: (1) to relieve mechanical strains and (2) to soften and produce a maximum refinement of grain.

Process of Carbonizing

Carbonizing is the operation of imparting to a low-carbon steel a shell of high-carbon content. This produces what might be termed a "dual" steel, allowing for an outer shell which when hardened would withstand wear, and a soft ductile core to produce ductility and withstand shock. The operation is carried out by packing the work to be carbonized in boxes with a material rich in carbon and maintaining the box so charged at a temperature in excess of the highest critical point for a length of time to produce the desired depth of carbonized zone. Generally maintaining the temperature at 1650-1700 deg. F. for seven hours will produce a carbonized zone $\frac{1}{32}$ in. deep.

Hardening is the heating to a temperature slightly above the highest critical point and cooling suddenly in some quenching medium, such as water or oil. This treatment produces a maximum refinement with the maximum strength.

Drawing is the heating to a temperature below the highest critical point, the temperature used being governed by the results required. This treatment is used to relieve the hardening strains set up by quenching as well as the reducing of the hardness and brittleness of hardened steel.

As the maximum refinement of the grain size of a piece of steel takes place at a temperature at or just slightly above the highest critical point, increasing temperatures over that point correspondingly increases the grain size. The grain size of a piece of steel is gov-

erned by the maximum temperature reached after passing over the highest critical point or by the temperature at which the last mechanical working was given the steel, providing the mechanical work was done at a temperature in excess of the highest critical point.

Annealed steels are called pearlitic, pearlite being the name applied to the microstructure of slowly cooled steels. Pearlite is a mechanical mixture consisting of alternate masses in ferrite (pure iron) and cementite (cementite being a compound made up of 6.6 per cent. carbon and 93.4 per cent. ferrite) with the resultant mixture containing 0.89 per cent. carbon. Pearlite may be present in two forms, lamellar and granular, with the granular occurring either coarse or fine or elongated with bands of ferrite separating the elongated grains of pearlite.

When etched in a weak alcoholic solution of picric or nitric acid and examined under the microscope the ferrite, untouched by the etching solution, appears white, while the pearlite shows up black.

Effect of Proper Annealing

Proper annealing of low-carbon steels causes a complete solution or combination to take place between the ferrite and pearlite, producing a homogeneous mass of small grains of each, the grains of the pearlite being surrounded by grains of ferrite. A steel of this refinement will machine to good advantage, due to the fact that the cutting tool will at all times be in contact with metal of uniform composition and will not be alternately coming in contact with the soft ferrite constituent and the harder carbon particles. While the alternate bands of ferrite and pearlite are microscopically sized, it has been found that with a Gleason or Fellows gear-cutting machine that rough cutting can be traced to poorly annealed steels, having either a pronounced banded structure or a coarse granular structure. A study of the microphotographs of several of the widely used low-carbon steels in gear manufacture will show the condition of the structure direct from the drop hammer, the pronounced banded structure of ferrite and pearlite and the change produced by thorough annealing.

Temperature for Annealing

Theoretically, annealing should be accomplished at a temperature at just slightly above the critical point. However, in practice the temperature is raised to a higher point in order to allow for the solution of the carbon and iron to be produced more rapidly, as the time required to produce complete solution is reduced as the temperature increases past the critical point. Temperatures exceeding the critical point by over 100 deg. F. should never be used on account of the enlargement of the grains of pearlite and ferrite. Microphotographs of a piece of steel annealed at temperatures increasing by 25 deg. from a point below the critical point to the burning point show clearly the effects of temperature on the grain size.

For annealing the simpler types of low-carbon steels the following temperatures have been found to produce uniform machining conditions on account of producing uniform fine-grain pearlite structure:

1.15—0.25 per cent. Carbon Straight Carbon Steel.—Heat to 1650 deg. F. Hold at this temperature until the work is uniformly heated; pull from the furnace and cool in air.

0.15—0.25 per cent. Carbon, 1½ per cent. Nickel, ½ per cent. Chromium Steel.—Heat to 1600 deg. F. Hold at this temperature until the work is uniformly heated; pull from the furnace and cool in air.

0.15—0.25 per cent. Carbon, 3½ per cent. Nickel Steel.—Heat to 1575 deg. F. Hold at this temperature until the work is uniformly heated; pull from the furnace and cool in air.

In the annealing of the higher types of chrome-nickel steel, with the nickel content running about 3 per cent. and the chromium about 1 per cent. the operation is more difficult, as rapid cooling through the upper critical range produces a hardness due to the slight air-hardening properties of steel of this composition. The annealing of this type of steel requires considerably more attention both in the heating and cooling. To produce the best machinability of this steel the following practice will give very satisfactory results:

Heat to a temperature in excess of the critical point about 100 deg. F., holding at this temperature for a considerable time to allow for thorough heating and complete solution of the cementite; cool rapidly, either by pulling from the furnace into air or opening up the furnace doors to a point at which the forgings show no color in daylight; reheat to a point just in excess of the highest critical point and cool slowly in the furnace. The temperatures, length of heating, and time and rate of cooling are dependent on analysis, size of forging and weight of the load of forgings in the furnace.

Care in Annealing

Not only will benefits in machining be found by careful annealing of forgings but the subsequent troubles in the hardening plant will be greatly reduced. The advantages in the hardening start with the carbonizing operation, as a steel of uniform and fine grain size will carbonize more uniformly, producing a more even hardness and less chances for soft spots. The holes in the gears will also "close in more uniformly," not causing some gears to require excessive grinding and others with just enough stock. Also all strains will have been removed from the forging, eliminating to a great extent distortion and the noisy gears generally resulting.

With the steels used for the heat-treated gears, always of a higher carbon content, treatment after forging is necessary for machining, as it would be impossible to get the required production from untreated forgings, especially in the alloy steels. The treatment is more delicate, due to the higher percentage of carbon and the natural increase in cementite together with complex carbides which are present in some of the higher types of alloys. Due to the many analyses of heat-treated gear steel it is impossible to give in this paper specific treatments.

More time should be given to permit complete solution to take place and the rate of cooling watched closely, together with the temperature at which the forgings are pulled from the furnace. For a furnace load weighing 550 lb. of medium-section steel forgings 0.50 per cent. carbon, 0.60 per cent manganese, 3 per cent. nickel, 1 per cent. chromium the following treat-

ment gave very good machining conditions on turning operations as well as on the Fellows gear-shaping machine:

Heat to 1330 deg. F., taking two hours to heat to the temperature. Hold at the temperature for 1½ hours and allow to cool in furnace to 1170 deg. F., taking about one hour to cool. Reheat to 1230 deg. F., consuming ¾ hours to reheat. Hold at 1230 deg. F. for 1¼ hours. Cool slowly in furnace, not faster than 75 deg. for the first hour, until 900 deg. F., then cool in air.

In the heat-treated steels poor machining conditions are present, generally due to incomplete solution of cementite rather than bands of free ferrite, as in the case of casehardening steels. This segregation of carbon, as it is sometimes referred to, causes hard spots which, in the forming of the tooth, cause the cutter to ride over the hard metal, producing high spots on the face of the tooth, which are as detrimental to satisfactory gear cutting as the drops or low spots produced on the face of the teeth when the pearlite is coarse-grained or in a banded condition.

In the simpler carbonized steels it is not necessary to test the forgings for hardness after annealing, but with the high percentages of alloys in the carbonizing steels and the heat-treated steels a hardness test is essential. For this test the Brinell hardness tester is far more accurate than the sclerescope test. However the Brinell test should not be used without the aid of the microscope. To obtain the best results in machining, the microstructure of the metal should be determined and a hardness range set that covers the variations in structure that produce good machining results. By careful control of the heat-treating operation and with the aid of the Brinell hardness tester and the microscope it is possible to continually give forgings that will machine uniformly and be soft enough to give desired production. The following gives a few of the hardness numerals on steel used in gear manufacture that produce good machining qualities:

20 per cent. carbon, 3 per cent. nickel, 1¼ per cent. chromium—Brinell 156-170.

50 per cent. carbon, 3 per cent. nickel, 1 per cent. chromium—Brinell 179-187.

50 per cent. carbon chrome vanadium—Brinell 170-9.

Gear Standardization

By B. F. WATERMAN
Brown & Sharpe Manufacturing Co.

This extract of a paper read at the American Gear Manufacturers' Association at White Sulphur Spring, W. Va., points out the main features of the problem of standardization. The suggestions given are well worth careful consideration as they affect not only the maker of gears but the user as well.

In considering this subject, as applied to the various branches of the gear industry, we will first consider it in a general way, and later as applied to each division as represented by the subcommittees.

How many times in the course of our daily work do we have a problem to solve, the solution of which cannot be based on scientific data, for there may be none at hand, but must be based on our past experience (which may not fill the need of the moment), a good imagination, if we have one, and a guess. It is at this time that a standard method of procedure based on the same similar data would be desirable, and if we were called upon to outline such a one we might do so, but then it would probably be applicable to the conditions of our recent problem only and would not fit into the general scheme of things.

For instance, suppose we were called upon to furnish a pair of worm gears to give a certain reduction at a given speed to transmit a given horsepower continuously for 10 hours without undue heating. How would you go about it? How would your associates go about it? This is nothing more, by the way, than a motor problem which has already been standardized.

It is possible that if a customer were to ask for proposals from every member of this association for a pair of spur gears to transmit a given horsepower between the motor and machine he would find no two alike, with the result that he would probably take that pair offered by the one he thought knew the most about a problem of this kind or he would take the smallest pair, as they would be the cheapest, but in any case he would not have any assurance the design chosen was better than many of the others.

Why this difference? We would answer by saying that no two engineers will use the same strength formula, or if they do, and were even to figure on the same material, the values given the same factors will be different, or one engineer will use additional factors not considered by the other, because his experience may teach him it is necessary.

A compilation of values or a method of determining these values for various materials to be used in connection with some acceptable strength formula might be considered a standard for calculating the strength of spur gears.

There is in the hands of our members enough data of a scientific nature which, if brought together and analyzed, would form the nucleus of a respectable library of standards. One of our first duties should be to collect these standards and these data and from them make revisions of the standards to suit all conditions, if possible, and from the data develop other standards.

Any private standard that has the merit of successful use to recommend it will lend itself to general adoption much easier than some new one developed from whole cloth, therefore we would suggest to each subcommittee starting on its work that it take those already in existence, whether in this industry or out of it, and endeavor to rearrange them if necessary for general acceptance.

What we produce must fill certain standards of quality. What these are must be determined by ourselves and the users of the gears. It would be folly for us to set standards of quality if they do not fit the conditions of

use to which the gears will be put, and there will always be conditions that any standard we make will not fit. These must be taken care of as they arise. Nevertheless, we can adopt those that will fit the majority of cases, and a gear made by representatives of this association should have a certain quality, this quality representing a choice of material and grade of workmanship that will be a credit to us.

To maintain and produce gears of quality and suitability, we should adopt standard specifications which when filled out should state clearly what is required of the gears in question, so that the extreme care and the time that is necessary to produce the best is not expended on work requiring only ordinary workmanship.

There are now so many different materials and qualities of material that the best for each service with the proper treatment, if any is required, should be investigated.

Standards for the proportions of all types of gears might be developed, these to conform as nearly as possible to the various ones now in use by our members and by other large users of gears. A well-proportioned gear is essential in providing a well-designed machine, and while it is not to be expected that anyone who now has patterns will discard them, such a standard would influence the making of patterns in the future. In fact, "the commercial incentive to adopt our standard proportions will be supplied by the consumer asking or even demanding gears which embody such standards."

Nomenclature

It might be well to begin by having a nomenclature committee to authorize a standard set of symbols to represent the factors we use.

Working limits should be adopted to assure our standard of quality, such as amount of runout permissible in the blank and in the cutting; size of hole, whether to be from standard-to-small or large; width of keyway, etc., standard formulas for calculating the strength of all gears with values to cover the various factors used.

It might be interesting to state here that John H. Cooper, in 1879, when investigating the formulas then existing for the strength of spur gears, found 48 well-established rules for horsepower and working strength differing from each other in extreme cases about 500 per cent. We do not think this difference would show in gears offered by members of this association, but it would be possible. It is thought that the Wilfred Lewis formula is now quite generally used, but even here the proper value for strength of material must be used, and it is thought that it devolves on the Hardening and Heat-Treating Committee to furnish us with these data; the values for the strength of various materials under different conditions of treatment, as published in the data sheets of the Society of Automotive Engineers, would form a good working basis for this.

One problem that has not received the attention it should is the question of wear, and while a gear may be amply strong when considered from the breaking point it may not be entirely suitable as to wearing qualities.

It would be well for the committee on worm gears to investigate the many successful drives now in existence and try to deduce some tangible working basis of design. This will not be an easy thing to do, but a start might be made toward this by getting in touch with the engineering societies.

There is a great lack of uniformity in calculating the dimensions of both the worm and the wheel, and also in the method of producing the worms, as well as in selecting the material from which to make them. To those of us who make or use hobs it is known that the hob must be as near like the worm as it is possible to make it.

[The paper included bevel, spur, worm, herringbone and sprocket wheels and suggested that the committee should look into this subject and determine upon some standard specification sheet, where all points will be considered—Editor.]

Swiss Toolmakers Becoming Rich

By Don J. O'Byone

While the greater portion of Europe is at war Switzerland is maintaining a strict neutrality and, incidentally, getting rich. Industrial conditions in this country were never as good as they are now. It is asserted that machine shops have sprung up in the cantons of the little republic overnight, and have called from the farms and hunting grounds thousands of men and women who are now engaged in the busy business of supplying tools of the more delicate kind to the central powers. Where once Switzerland boasted that there were no industrial captains who were great millionaires within its border, there are now a number of them as the result of the war and, of course, the number and the extent of their wealth will continue to increase as long as the war lasts.

Up to the beginning of the war Switzerland had always been looked upon by the world as the home of a thrifty people, a desirable health resort and the distinctive European home of popular liberty and power. The Swiss watch, so well known to people who have passed the quarter-century mark, is remembered as a timekeeper of remarkable accuracy. Its general dependability gave proof that the people who manufactured it were capable of intensive quality production. In a small way the manufacturers of Berne, Luzerne and Zurich produced mathematical and surveying instruments of great accuracy, but they lost sight of modern ideas of lightness, and their wares never found a worthwhile place in the world markets. Another fact that militated against any decided industrial development in Switzerland was the failure of its industrial captains to recognize the possibilities of modern advertising. They produced only for the market that was at their door; they did not invite business.

With the beginning of the war mechanical production in Switzerland received a startling impetus. German, Austrian and other health seekers told of the need of their countries for tools because of the lack of man power, so Swiss production was intensified. It was even stated in some quarters that German and Austrian capital had financed and promoted the republic's entry into an extensive and profitable trade in machinery and tools.

Industrial and commercial Switzerland is waxing efficient and rich. Luzerne, Berne, Zurich and other cities have become great hives of industry. Increasing wealth and improved living conditions are everywhere in evidence, and modest fortunes are growing into great ones.

Fixtures for Special Operations on Spring Shackles

BY A. R. DE KUZELEWSKI

The rotary milling machine is particularly adaptable to the rapid production of small pieces having one plane surface. This article describes fixtures that were designed for the continuous milling or wrought-iron links or spring shackles which were required in large quantities.

THE links illustrated in the line drawings, Figs. 1 and 2, being required in large quantities, the problem of facing off the bosses *A*, *B*, *C* and *D* and sizing the holes necessitated the design of special fixtures for accomplishing the work rapidly and within reasonable limits of accuracy.

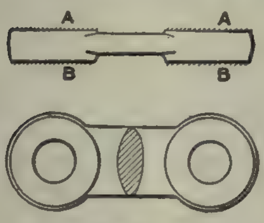


FIG. 1

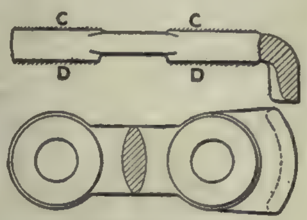


FIG. 2

FIGS. 1 AND 2. THE STRAIGHT AND FLANGED LINKS

The following operation sheet gives the sequence of operations to be performed, and the line drawing, Fig. 3, is a chart of these operations showing the fixtures used and the manner of using them.

In the illustrations, Figs. 4 and 5, are shown the special fixtures made to hold these links while being milled, the operation of milling being performed upon a Becker continuous-milling machine.

These fixtures are arranged to hold 12 pieces, and once the operation is started the cut is continuous until the entire lot is finished, the operator taking out the finished pieces and putting in the forgings as fast as the milled pieces pass the cutter.

In each fixture are six cast-iron bases bolted to a circular table. This in turn is bolted to the rotary platform of the milling machine.

Each of the six bases has a tool-steel jaw screwed and doweled in place at the rear of the base, and each jaw has two notches across its face, being in effect a double V-block on its side. At the opposite, or outer, end of the base a lug, cast solid with the base, extends upward far enough to provide for a screw opposite each V in the rear jaw.

In the fixture shown in Fig. 4 these screws are above the center line of the forging to be milled and bear directly upon the upturned tail of the latter, while in the fixture, Fig. 5, the screws are on the center line of the forgings and movable jaws are interposed between them and the work. In either case advantage is taken of the "draft" of the forging to hold it down firmly on the tops of the hardened-steel plugs, which form the bearing surface for supporting the work.

In Fig. 6 is shown a fixture for drilling the holes in the links. In this fixture the work is supported upon the tops of hollow steel plugs and is clamped endwise between the fixed jaws *A*, *A* and the movable jaws

OPERATION SHEET

Operation Sheet No. L-39, pieces 2302 and 2303 spring shackles.

First Operation—Drop-forge and trim.

Second Operation—Anneal and pickle.

Third Operation—Mill face of bosses on special fixture (4a) using a face-milling cutter. Becker rotary continuous milling machine.

Fourth Operation—Face mill on other side of bosses, using special fixture (5a) and locating work on previously finished bosses.

Note—The third and fourth operations on the straight links are also accomplished on fixture (5a).

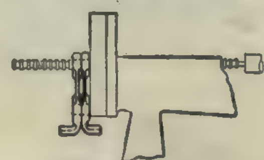
Fifth Operation—Drill holes in links, using the special drill jig (6a).

Sixth Operation—Broach first hole, setting three at a time of the pieces shown in Fig. 1 (of the pieces shown in Fig. 2 only two pieces can be set at a time) Lapointe broaching machine.

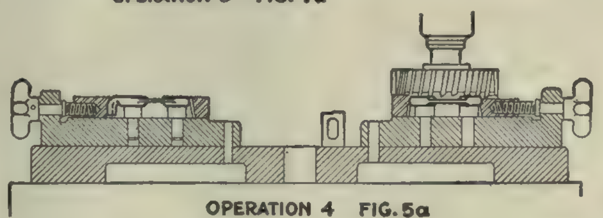
Seventh Operation—Broach second hole, using a special faceplate fixture having a locating plug on which the pieces are set to give the correct spacing.

Note—In this operation the outboard guide on the broaching machine must be used in order to make sure that the broach is held central during the operation.

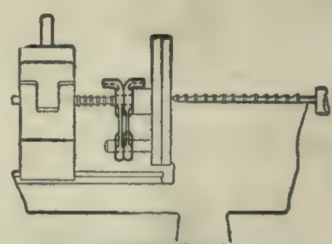
OPERATION 3 FIG. 4a



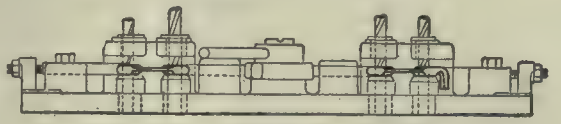
OPERATION 6 ON PIECE FIG. 2



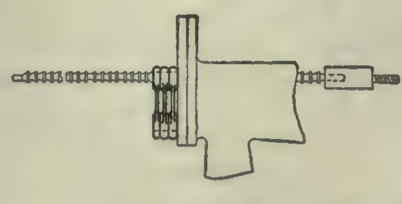
OPERATION 4 FIG. 5a



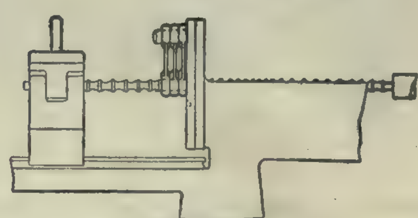
OPERATION 7 ON PIECE FIG. 2



OPERATION 5 FIG. 6a



OPERATION 6 ON PIECE FIG. 1



OPERATION 7 ON PIECE FIG. 1

FIG. 3. CHART OF OPERATIONS

B, B, which are operated by the central cam *C* mounted upon a floating stud to compensate for inequalities in the forgings.

In use the fixture is bolted to the table of a Moline drilling machine and the spindles of the latter set to

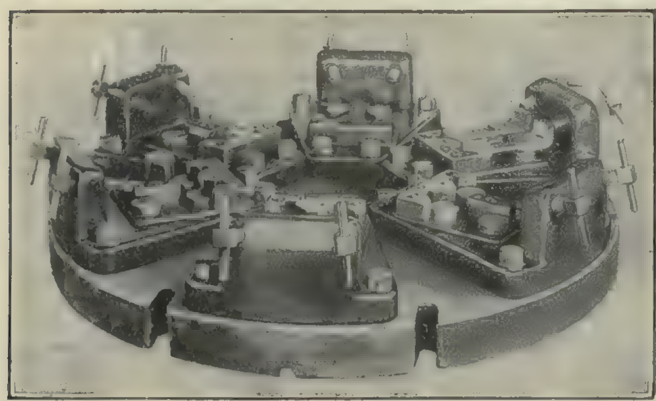


FIG. 4. FIXTURE FOR MILLING FLANGED LINKS

conform to the bushing positions. After being drilled, the forgings pass to the Lapointe broaching machines for operations 6 and 7.

With the flat links, three pieces are broached at once, as shown upon the chart of operations (Fig. 3, operations 6 and 7, piece 1); but with the flanged link the form of the piece precludes the possibility of stacking more than two pieces.

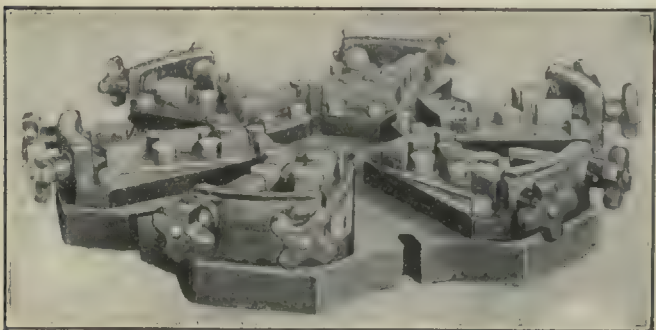


FIG. 5. FIXTURE FOR MILLING STRAIGHT LINK

Special faceplates are fitted to the broaching machines for these operations. In operation 7 the pieces are located by the stud which fits into the hole already

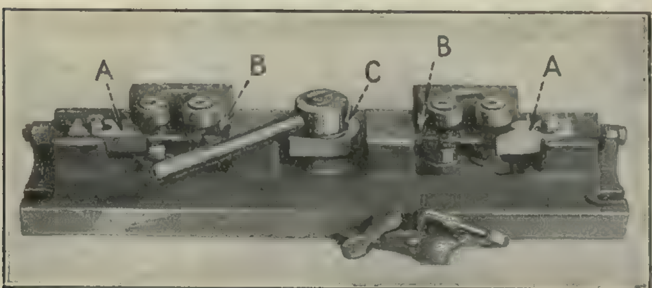


FIG. 6. THE DRILLING FIXTURE

broached in the previous operation, thus insuring accurate spacing. Fig. 3 shows the method of broaching very clearly.

In operation 7 it is necessary to use the outboard bearing on the broaching machine in order to hold the broach to a central position and prevent "drawing" and consequent inaccuracy of spacing.

Making Splined and Keyed Bushings

By Douglas T. Hamilton

Advertising Manager Fellows Gear Shaper Co.

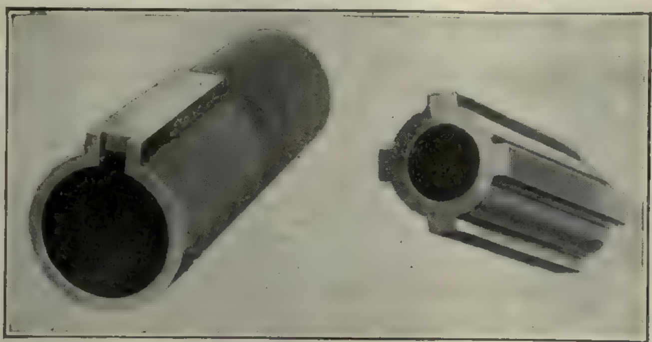
The method of keying thin wall bushings, as outlined by Albert F. Guyler on page 163 of the *American Machinist*, while it may render the bushings a trifle stronger than the usual method followed, but it does not alter materially what may be a very serious defect. We have had many similar propositions referred to us in the past, and we have solved them in the manner illustrated in Fig. 1. This bushing, it will be noticed, has a keyway cut in the hole and the key is made integral with the bushing, the keyway lying inside the key. The manner in which this is accomplished is to generate the entire outer contour of the bushing by means of a gear-shaper cutter, illustrated in Fig. 2.

FIG. 2. METHOD USED IN PRODUCING KEYED BUSHING ON THE FELLOWS GEAR SHAPER

Here it will be noticed that the gear-shaper cutter takes the form of a plain disk with the exception of two points where it is arranged with the required contour to reproduce the key. The method of producing this bushing is similar to that used in cutting gear teeth, the cutter and gear being rotated in unison. Owing to the small diameter of the work, the cutter is made twice the diameter of the blank, and therefore has two "depressions," or forms, which reproduce the key. One-half revolution of the gear-shaper cutter, therefore, produces one piece. By means of the change gearing on the machine the cutter and work are made to revolve at the

proper ratio, and in this way correct generation of the key is accomplished.

This method of producing a key or spline eliminates the serious objection common to the inserted-key method in that it does not weaken the bushing; in fact it strengthens it. Keys and splines up to and including 5



FIGS. 1 AND 3. BUSHINGS WITH ONE INTEGRAL KEY AND FOUR INTEGRAL SPLINES

in. in length can be produced in commercial quantities on the gear shaper with very satisfactory results.

Advantage is taken of this method in the production of other forms of splined work, as, for example, the bushing shown in Fig. 3, which is provided with four splines on its external contour. These splines were produced by means of the gear-shaper cutter shown in Fig. 4. It will be noticed that the cutter has ten "teeth," so that $\frac{4}{10}$ of a revolution of the cutter will produce one bushing. It will also be noticed that the cutter is so made as to produce "relieving grooves" at the bottom of

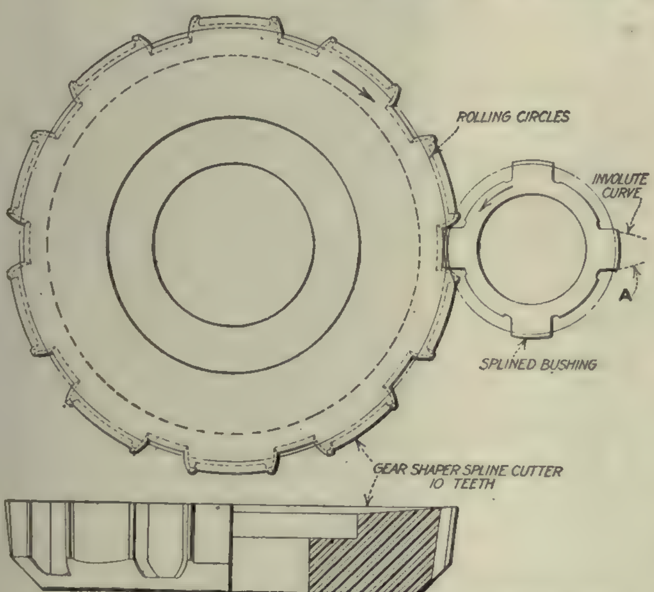


FIG. 4. DIAGRAM OF CUTTER AND BUSHING

the splines to facilitate grinding of the part after hardening when such grinding is necessary.

The part shown in Fig. 4 has straight-sided splines. A better method of producing this part is to make the sides with involute curves, as shown by the dotted lines A. In this case a much better fit can be obtained between both members, for the reason that in the majority of cases, where the size of the work permits, both internal and external members can be generated with the gear-shaper cutter, thus insuring accuracy and interchangeability.

The High-Speed Manager

By F. P. Terry

The new assistant works manager had arrived and quite early got to work on a much overdue order, a part of which consisted of two large cast-iron bases weighing about five tons each, and intended to carry an electric motor and air compressor.

I had an idea that the foreman molder would be making these "in the floor," to use the foundry term, with considerable digging and placing of several cores. I was brought into the trouble because I required these bases before I could give my new chief anything definite as to the date of delivery, and I am sure he had more than a suspicion I was "pulling his leg." He was already armed with the foundry foreman's slip, "One cast tonight; second in fourteen days," which he said must be improved upon, and he requested me to pay a visit with him to the foundry.

"Can't you do better than this?" he said somewhat abruptly to the foundry foreman, who was also addicted to the same vice.

"Well, I perhaps might if you'd been around a fortnight ago with another pattern and core boxes, but yer too late now."

"Well, you are casting one tonight," said the new chief.

"Just so," said the foreman.

"Well, couldn't you lift that one in the morning, and then pour the other in the same mold?"

"Lift your hat a minute and let's see what's underneath it."

"They'll be made that way before long if I am here," said the new chief as he made for the door.

I followed, and from behind I heard, "My Gawd, what next!"

The Coming Railway Demand for Machine Tools

New rolling-stock equipment has been a problem in the railway situation for several years past, due primarily to the question of financing its purchase. Now that all the work has been coördinated under governmental jurisdiction the requirements of the railways are about to be met, and the remedies which they have so long needed are to be applied.

One of the first steps taken to care for these shortages in the most efficient manner has been the standardizing of rolling-stock equipment, which has now been taken care of by the proper department. This work will be done in such a manner as to obtain the maximum degree of efficiency preparatory to rehabilitating the various lines.

Included in the tentative plan of standardizing equipment were the types of locomotive described by Alba B. Johnson, president of the Baldwin Locomotive Works, in his address before the convention of the Chamber of Commerce.

The work for locomotives as well as the vast quantity of freight-car work will without doubt be given to the equipment builders in a short time, and as a result this will create an enormous demand on machine-tool builders for the necessary tools.

It's Different Now

BY RUFUS T. STROHM

Long ago the shops was tended
  By a bully sort of men,
But the good old times is ended
  An' they won't come back again;
For the doors is swingin' open
  To the heathen an' the wop,
An' so help me!—I'm not dopin'—
  Now there's women in the shop.

If a helper dropped a castin'
  An' it smashed him on the toe,
He uncorked his best dod-gastin'
  Just to let the others know;
Now his pain he's got to swaller,
  An' his langwidge has to stop,
For he dassen't cuss an' holler
  When there's women in the shop.

First we laughed and joked right hearty
  At the bloomers an' the caps.
What could this here female party
  Know of gages, mikes an' taps?
But their gumption was surprisin',
  For they learned 'em, sure as pop,
An' the output curve's been risin'
  Since there's women in the shop.

Yes, they're mighty keen an' clever
  An' they're nimble an' they're quick,
An' they have no trouble ever
  Gettin' wise to every trick.
So, although they're shy on muscle,
  They are allus on the hop,
An' us men have had to hustle
  Since there's women in the shop.

The Necessity for Accurate Centers

BY H. DARBYSHIRE

Success often depends upon the minutest details, and this seems particularly true in the field of mechanical precision where an error of 0.0001 is often regarded as inexcusable. This article emphasizes the necessity for perfect centers both in the work and upon the machine.

IN OUR youthful days we had to make center holes, and in later life we have had center holes thrust upon us. Dictionaries give no really valuable information as to the prime purpose of either center holes or centers; probably because dictionaries are compiled by men to whom the engineering trades are partly closed pages.

Just as a knowledge of the alphabet is a necessary fundamental to reading, so is the accuracy of centers and center holes the foundation for good cylindrical work. In days long past center holes were made by stabbing the stock with a primitive kind of punch, usually made from the fag end of an old, round file, this being ground on a grindstone to an uncertain angle. The tool was then ready for use, and with the aid of a blow from a healthy sized hammer a center hole could be made in minimum time. Sometimes a piece would chip off the punch, and the writer has a damaged eye to this day as a result of his early centering practice.

TURNING THE CENTER PUNCH

In my adolescent days I had experienced an unholy joy in robbing the village orchard, and this feeling was renewed when I turned my first center punch at my employer's expense in time and tool steel. My "grey matter" matured in due proportion to the number of center points I burnt off, and the next progressive stage was the prick punch. This tool justified its creation only when one had a natural gift for tempering tools with an acute angle; if one had not that gift, each time the tool was put to use it furnished a fresh excuse to join in the discussion at the shop grindstone while one waited his lawful turn. Workmen who really enjoyed the gossip at the grindstone would do their centering by means of a square center, for when this tool got dulled or chipped patience and a penchant for geometry was necessary to restore it.

These experiences date back some 35 years, but I grieve to say that many machine shops of good repute have not yet got past the practices here described. The introduction of the prick punch brought home to my juvenile mind the value of lubricating center holes, so I formed the habit of drilling a hole in the work, which acted as an oil reservoir, after the center-punch stab. I have long contended that education is attained largely by profiting from the mistakes of others as well as our own, and this is an illustration of the fact.

Ours being a country shop, where tools and accessories were somewhat limited, I felt myself superior to my mates because I had made a half center with which I could face up the work after centering. As this half center fitted the tail spindle of "old Bill's" grinding machine he used to borrow it on special occasions, and one day, having some end mills to face, he ran his wheel into the center by accident, making it less than a half center. Thereupon I made the important discovery that it made a capital coutnersink or center reamer in that condition. From this little incident I derived great profit, as I found for a certainty that a lot of scrap I previously had made was due to defective centers, and I made vows in accordance for my future conduct. There has been much improvement since that time, and we now have at hand a ready means of making good center holes with Slocomb combination center drills or tools of similar character, which will produce them in one operation; but take care you do not leave the broken end in your stock for some one else to find.

CENTER HOLE TROUBLE

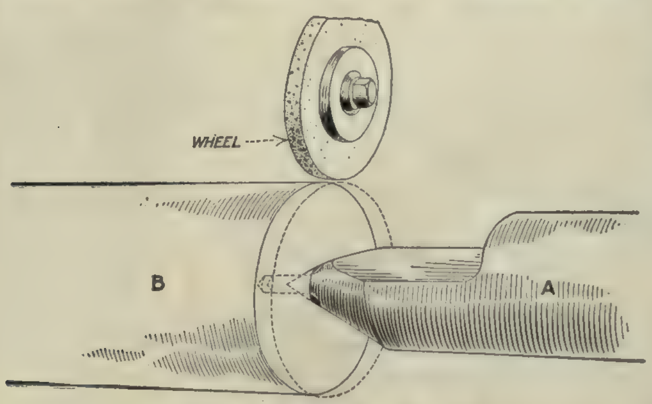
All of the above is, of course, only in respect to center holes in soft materials in which the pressure of the lathe center will correct any small irregularity, provided the lathe center itself be of the correct shape. Most of my troubles with center holes have been concerned with center holes in hardened materials, and if life were not so short I could compile a book of adventures, some of them not without humor, in this particular line. If we turn a spindle or any other detail of a complete machine whose final finishing process is that of grinding, we leave a certain predetermined allowance to be removed by the grinding wheel as a factor of safety to cover any error that may accrue from previous machining processes or from distortions that are almost certain to occur in the hardening process.

Take a cylindrical body 2 in. diameter by 6 in. long, to be finished by grinding; the stock would probably be cut from a 2⅛-in. bar of raw material with an allowance in length to cover the material removed in facing the ends. Center holes would then probably be made with the most modern and precise appliances, and the cylinder turned, leaving a grinding allowance of $\frac{1}{32}$ in. on the diameter. This grinding allowance is left to cover any change of shape which may take place in the hardening process, and as the piece will probably be distorted to some extent by this latter it is only logical to conclude that the center holes will also be distorted by an amount proportionate to their area.

This being so, the first operation after hardening should be to make the center holes round and true, if we want to insure a true cylindrical form in the final finishing operation. It is not sufficient to clean out the center hole with a strip of emery cloth folded to a triangular shape; this may remove the scale but will not rectify the prime error. It is just as easy, takes no more time, and is far more economical in the end to make a good center hole than to make a bad one. Some twenty-two years ago the writer was superintendent of a fairly large grinding plant and had experienced considerable trouble with shop arbors and mandrels. These were kept in the crib and let out for the general use of the shop. We had used these arbors in good faith for

the grinding of bushings, etc., and the inspection department had passed some scathing criticisms concerning the concentricity of our product. As I was somewhat sensitive in those days I made a set of arbors for the sole use of our department and guarded them religiously. They were made from cast-steel bar stock, and after carefully centering they were rough turned, leaving 0.030 in. on the diameter as a finishing allowance. After hardening they were rough ground to within 0.010 in. of finish size, and were then subjected to a mild form of heat treatment to eliminate strain. The centers were lapped with a diamond lap previous to the final grinding.

A few months ago I had occasion to visit this grinding plant and recognized a few of these arbors. Out of curiosity I tested them for truth, and the greatest error found was 0.00025 in. It does not require any more time to lap a center hole than it does to clean it out with emery cloth, and with this latter medium you merely clean it, whereas with the diamond lap you



EFFECT OF WORN CENTERS

polish the center hole and correct at the same time any error that may exist.

These diamond laps are merely stubs of tool steel ground to the correct angle and charged with diamond dust. They may be used in the speed lathe, and it is a good policy to have two or three at hand at all times. If the center hole has been made passably good in the first instance a single lap will hold up for at least a hundred holes.

Center points should of course be kept in good shape. In the old days I was caught tripping so often that I made the repairing of center points a periodical habit, just as we do eating and sleeping. Center points always wear oval in shape in the direction in which the pressure of the cutting tool is exerted on the work supported by them. In a grinding machine, where work has to be duplicated to very close limits, it is essential that the conical and cylindrical form of the center points be correctly maintained. This may seem a little thing, but I have seen many grinder hands driven close to the borderland of lunacy simply because they only partly understood its importance, and I have myself, working as a demonstrator, had my employer's product discredited on occasions and have meekly suffered abuse from distracted factory managers because of overlooking the importance of this small detail.

In the line sketch I have tried to illustrate in a magnified form what takes place when the sizing device of a properly constructed grinding machine gives erratic results. In the first place the depth of center holes in a quantity of similar pieces of work may not be all alike, and so the center points do not have their wear constantly on any one spot. The tail center *A* of a grinding machine is shown in the sketch with the wear of its point exaggerated (I have seen worse examples in practical use). *B* is a piece of work which has been finished to correct size and the sizing device set to duplicate the next piece to a limit of 0.0001 in. Should the next piece have a larger center hole, as shown by dotted lines, its location will be nearer the wheel so that working down to the set sizing stop will make it not only below size, but tapered as well.

The writer has seen many otherwise good mechanics who had a fad in regard to center holes whose ideas of symmetry was offended if the center holes were too large. They are usually found to be men who have rarely had to do work on centers and so cannot appreciate the evil of microscopic center holes.

The weakest points in work supported on center points are the center points themselves, and no question of sentiment should allow them to be weakened more than can be avoided as this can be done only at the expense of time in grinding and the danger of inaccurate results. If you should have a "bee in your bonnet" of this kind leave the size of the center hole to the man who is doing the job if he knows his business, and then, if you have the money and time to waste, reduce the size of the center holes after the job is finished.

New York Gage Laboratory

The Bureau of Standards has established a New York branch gage-testing laboratory. The laboratory is easily accessible from the Pennsylvania or Grand Central stations, it being located on the sixth floor of the Engineering Societies Building, 29 West 39th St.

The establishment of a branch gage laboratory in New York is mainly for the purpose of taking care of exigency gage tests in the New York district.

All gages which are ordered by the War Department for test at the Bureau of Standards and delivery in Washington should be submitted directly to the Bureau of Standards in Washington, D. C.

Available at this branch laboratory are facilities for testing all types of munition limit gages, and equipment has been installed which practically duplicates the various machines and special devices used at the Bureau of Standards in Washington for testing plain plug and ring gages, profile and other forms of gages, and especially screw-thread gages. No charge is made to manufacturers carrying out Government munitions contracts.

Gages may be submitted by mail, express or messenger. When they are shipped, it is recommended that they be sent by registered or insured mail rather than by express, on account of the saving of time.

Persons submitting gages for test are requested to furnish complete information as to the identification and classification of the gages, instructions for test and shipment and also such drawings and specifications as will establish the important dimensions of the gages. If copies of Ordnance Office drawings or other Government gage drawings or part drawings are submitted with the gages it will greatly facilitate the test and permit the sealing of the gages.

How Machine-Tool Builders Can Coöperate in Foreign Trade

By LUDWIG W. SCHMIDT

Some interesting foreign-trade possibilities in the machine-tool business are suggested in this article and are well worth considering by those engaged in exporting.

WITH the passage of the Webb Export Trade Bill it is now possible for American manufacturers to combine to further their export interests without danger of colliding with the provisions of the so-called Sherman Law. The bill, which is officially styled as one "to promote export trade and for other purposes," says that: "Nothing contained in the act, entitled 'An act to protect trade and commerce against unlawful restraints and monopolies approved July 2, 1899, shall be construed as declaring to be illegal an association entered into for the sole purpose of engaging in export trade and actually engaged solely in such export trade, or an agreement made or act done in the course of export trade by such association, provided such association, agreement or act is not in restraint of trade within the United States and is not in restraint of the export trade of any domestic competitor of such association, and provided further that such association does not either in the United States or elsewhere enter into any agreement, understanding or conspiracy, or do any act which artificially or intentionally enhances or depresses prices within the United States of commodities of the class exported by such association, or which substantially lessens competition within the United States or otherwise restrains trade therein."

This law will do nothing else but place American industry on a footing with foreign trade carried on by European countries. Coöperative effort in foreign commerce has been of great assistance to German manufacturers, and the American manufacturer who was compelled to fight the large German foreign-trading corporations in other countries has been at a disadvantage. He will now be able to enter the market under more nearly equal conditions, and most likely the result will show soon.

The advantage of coöperation of the sort now permitted by the Webb Bill is that it will be practicable for the small manufacturer to build up an export organization that would have been impossible if attempted individually. Machinery manufacturers can now coöperate either with others making the same machines or with those who are not competitors, and together they can promote their interests in foreign markets.

Machine-Tool Maker and the Webb Law

Now, how can the manufacturer of machine tools and the manufacturer of machines in general make the best use of their opportunities? There are many ways, and a few practical hints are given in what follows to show the possibilities offered by the act.

Some time ago there was formed in England an association of machine-tool builders. According to *Commerce Reports*, this organization contemplated that each manufacturer should specialize in the manufacture of one machine tool, each to make the tool which he could build best; they would also foster the foreign sales of their machines. It appears that the American machine tool-maker is still prevented from making an agreement to limit the output of his plant to one or a few tools, but there is nothing to prevent several machine-tool builders to agree that in future they will coöperate to sell their machines abroad. They can then agree among themselves that each of the manufacturers participating in the arrangement should build one machine for export only and supply only this to the combine for sale.

Organizing for Foreign Combination

This kind of organization is undoubtedly the most promising as to the possible results, and when perfected it will come nearest to the international export agency, which until now has handled the foreign trade of many of the machine-tool builders of this country. The first step to be taken to form such an organization is to invite a number of machine-tool builders for a general discussion of the question. During the discussion it can be established which of the machines built by the different firms seems to be best for foreign trade and to ascertain with what results these machines so far have been sold abroad, how much each of the participating manufacturers will spend for the common good, and under what conditions he intends to stay in the combination. Finally, there must be discussed the organization of the enterprise itself. This in the case under consideration will most likely be a stock company, the shareholders being the manufacturers forming the organization. How large this company will be and how much capital it will have are questions to be decided according to conditions. Obviously, less capital will be needed for a limited export business than for one more extensive. It also must be determined whether the organization is to act as buyer of the machines it sells or merely as agent.

The capital contribution would best be regarded as an individual investment by each member of the group, but it is difficult to arrange the preliminary investment according to expected sales or the size of the member's enterprise. European organizations treat the initial invested capital as specially privileged, receiving a fixed interest agreed upon and a small dividend participation in the general profits. For all other purposes the acting corporation will have to be organized like any other stock company, with a president, a board, a secretary and a manager. The members of the board most likely will be the representatives of the firms supporting the enterprise.

After the operating company has been organized sales contracts can be made with the members of the organization. In the present case, where it is intended that each member supplies one special machine, the agree-

ment will have to state what kind of machine is to be supplied and the commission to be allowed the central organization for the transaction of sales, as well as to stipulate the amount the member will contribute to advertising his machine, and similar points not agreed upon in the general corporation agreement. The sales offices should be located at a place where export business can be conducted easily, New York probably being the best place.

Operation at the beginning should be under the direction of the board, which should gather together the necessary staff. Here the first advantage of coöperation appears, namely, the engaging of experts, which would not have been possible for the individual firm owing to the high cost. These experts will do the work for each firm exactly as it would be done if they were individually employed.

The business of the organization is conducted on much the same lines as that of any other concern engaged in foreign trade. The advantages for the participating manufacturer, however, are that he is relieved of the work connected with the foreign business and that his expenses are lessened, as to introduce one machine tool in a foreign market is a rather expensive matter.

Great Savings Made in Advertising

The activities of the new organization, of course, will depend on the wishes of its founders. It may have been decided to begin with a general advertising campaign built upon a price list to be issued in the interest of all members. The principal advantage of coöperation in this case is saving expenses. Not only will there be an enormous reduction in the cost of distribution of the advertising material, but its production also will be cheapened under the new arrangement. There is no need to issue 10 or 20 different lists in the interest of as many manufacturers when they can all combine to issue one that will serve the same purpose. Where it costs ten firms $1000 each to mail 10,000 price lists it will now cost only $100, and the money saved in this way can go into the production of the larger price list, the postage saved alone paying for the printing.

The sales argument of the list also gains by coöperation. There is today hardly a machine-tool maker in this country who makes a range of tools necessary to equip a complete factory. Twenty or even ten firms may be able to do so. A list sent out by an organization formed by this number will make it possible to offer to the customer a complete set of tools. Each firm advertises the other, with the result that more business can be obtained because there is no need for the buyer to buy from a number of competing firms.

Following up the sending of the price list the representative of the concern in Buenos Aires, for instance, calls on the customer. This gentleman is a novelty in many respects. It would have been impossible for one machine-tool builder to have a service of special agents all over the world. The best he could do was to appoint a commission agent located in Buenos Aires. Now, however, the toolbuilder has the assistance of the export organization's representative. This man should be well trained in his field because he is well paid. He represents not only one firm and its products, but several, and his sales possibilities are larger than would be the case in the first instance.

When the order is secured it is forwarded to the export organization's office, and when the sale is completed the central office draws its commission for the sale from the member. From the earnings made in this way the running expenses and the salaries of the employees will be paid. At the end of the year an accounting takes place and the profits are distributed according to the agreement.

When firms having similar interests combine they are likely to disagree occasionally, and this might result in differences inside the organization that might impede its usefulness. This should be guarded against in the membership agreement. The experience of other countries, however, has shown that troubles of this kind rarely occur. Some authorities while agreeing on the value of coöperation in foreign trade, advise against coöperation between competitive firms, and doubtless there is just as much to be said in favor of one opinion as of the other. My experience abroad inclines me to believe that it is easier to organize a coöperative association for the sale of one kind of machine, say, for instance, machine tools, than for those differing widely. The upkeep of an export organization that sells machine tools to machine shops, textile machines to textile manufacturers, and shoemaking machines to shoe factories doubles or trebles its cost and cuts the effect of its efforts correspondingly.

Coöperation between noncompetitive firms is the next best to that proposed first, and it is certainly better than no coöperation at all. The methods in this case are the same as those given in the preceding paragraphs, though the technical handling may be different.

Manufacturers need not combine essentially for the purpose of selling. There are many other ways in which coöperation can effectively promote foreign commerce. An example of this is an English organization which was formed for the purpose of fighting competition in a foreign market by publicity. The coöperating manufacturers opened a central advertising office with branches outside Great Britain, and they distribute advertising matter of all kind to interested customers. The work carried on by the organization has brought such excellent results that it is now proposed to form another similar body, which, however, will not be confined to manufacturers of one commodity only but will be open to all interested in the promotion of the foreign trade of Great Britain.

Organizing for a Special Purpose

In the American machinery industry several coöperations of this character are possible. Manufacturers of agricultural machinery might combine for the purpose of propagating the sale of American-made agricultural machines abroad without letting the combination do the actual selling. In this case a fund could be created to be used by the organizing office which would be employed for general propaganda work all over the world. Advertisements could be placed in the agricultural press of South America, Russia, China and other countries, pointing out the advantages to be derived from the use of American agricultural machinery. Also collective exhibitions could be arranged. The same could be done by the American machine-tool builders. The American machine-tool builder today has sales arguments common to all. These could be elaborated upon and put before

the machinery building industry of the world. Such a campaign would help all and would add to the sales of individual manufacturers.

It is often said that organization benefits only big enterprises. The contrary, however, is the fact. In Europe, where the principle of coöperation in foreign trade is firmly established there are many combinations made up entirely of small enterprises. In fact it is just the small enterprise which derives the best advantage by coöperation. The big machinery builder has the means to employ an export organization of his own. His sales justify such an enterprise, and he is able to expend money to improve it. The small manufacturer is not situated so fortunately. By coöperation, however, an organization is placed at his service which offers him all the advantages of the big concern. His foreign advertising will be cut to a minimum, he will enjoy the services of first-class representatives in foreign markets, and it will cost him less than the commission he has paid until now to a commission house which brings him an occasional order.

The following is a typical example of the cost and ordinary current expenses of a manufacturers' coöperative organization for foreign trade and is taken from a a European report:

Capital invested by 10 members, $5,000 each		$50,000
Yearly expenses:		
Office rent	$1,200.00	
Staff of home office	9,600.00	
General expenses of office	2,400.00	
Advertising, including price lists and circulars in two languages	3,800.00	
One foreign representative and traveling expenses	8,600.00	
Extraordinary expenses, cables, etc	3,000.00	
Five per cent. interest on capital	2,500.00	
	$31,100.00	

This would necessitate an approximate turnover of $250,000 on a 15 per cent. commission basis to make both ends meet.

The initial expenses of such an enterprise therefore are not large. They are in fact less than it would cost an individual manufacturer to start his own. Additional capital may be needed in case the venture grows too fast or if it is contemplated to start to work immediately on a large scale. Generally speaking, however, $50,000 should be sufficient, and one year's working capital and a surplus of $19,000 should be enough to set the venture going. Later the organization will pay for itself by way of the commissions it receives for the sales.

Our Shipbuilding Growth

Among the most interesting features of the speech which Edward N. Hurley, chairman of the United States Shipping Board, delivered before the National Marine League were his statements as to what has been accomplished in the direction of output of vessels. According to Mr. Hurley there were 37 steel shipyards in America at the time of our entrance into the war. Since then 81 steel and wood yards have been located, while 18 other yards have been expanded.

We are building in the new and expanded steel yards 235 new steel ship ways, or 26 more than at present exist in all of the steel shipyards of England. As an evidence of our progress Mr. Hurley referred to the record made by a Seattle company which launched an 8800-ton vessel 64 days after the laying of the keel. This ship was delivered to the Fleet Corporation on Jan. 5 and started on her first voyage on Jan. 14.

An Oakland, Cal., concern, Mr. Hurley said, had launched successfully three 9400-ton vessels in a single afternoon.

The total amount of our steel construction on Mar. 1 was 8,205,708 deadweight tons, made up of 5,160,300 deadweight tons under contract with the Emergency Fleet Corporation and 3,045,408 deadweight tons of requisitioned vessels.

Approximately 28 per cent. has been completed. In other words the program for steel ships has advanced 28 per cent toward completion. Of the amount of steel ships under contract and under requisition approximately 8 per cent were actually completed on Mar. 1. This amount of floating tonnage exceeds our total output in 1916, including steel, wooden and sailing vessels, by approximately 50 per cent.

Referring to the German ships in American ports, which were taken over and found to be crippled by their enemy crews, Mr. Hurley said: "With the expenditure of a little less than $8,000,000 we have succeeded in placing in our war service and in the service of the Allies 112 first-class German and Austrian vessels, representing a carrying capacity of nearly 800,000 deadweight tons."

Development of Shipyards

As to the development of our shipyards the 37 old steel yards now have 195 ways as against 162 eight months ago. Other parts of their plants have increased proportionately. Thirty new additional steel shipyards are being erected, with a total of 203 shipbuilding ways. Thus we now have in the aggregate 67 steel shipyards either wholly or partly engaged in Fleet Corporation work. These yards will have a total of 398 steel building ways.

Of these yards 35, with 258 ways, are on the Atlantic and Gulf coasts; 19, with 66 ways, are on the Pacific coast, and 13, with 74 ways, are on the Great Lakes.

In addition the capacity for wooden shipbuilding has been increased until we now have 81 such yards with 332 ways completed or near completion. Mr. Hurley estimates that our output of wooden ships will approximate 2,300,000 deadweight tons annually.

The 332 wooden shipbuilding ways added to the 398 steel building ways give a total of 730 berths on which to build steel and wooden vessels—an increase of 495 within a few months.

The delays that have occurred in the turning out of ships Mr. Hurley attributed largely to the slowing up of railroad transportation, more especially as the method of producing ships today is one of assembling rather than of constructing all the parts at any one point.

Delay has also arisen because of the unprepared condition of the turbine and engine manufacturers.

The first concrete steamship, recently launched, he stated, gave promise of being a success.

As to the number of employees in shipyards Mr. Hurley stated that whereas in 1916 there were less than 45,000 men employed in all the shipyards of the country, on Mar. 2, 1918, the number had increased to 236,000, of whom 170,639 were working on actual shipping construction. In addition the board has recruited a volunteer force of 250,000 highly skilled mechanics who are in readiness for a call.

Zone System for the Distribution of Bituminous Coal

By order of the Fuel Administration the distribution of bituminous coal for the year beginning Apr. 1, 1918, will be controlled by a zone system, which is intended to reduce the burden on the railroads, facilitate shipment of coal, and keep all the mines working at full capacity.

The factor that loomed largest in the fuel crisis of last winter was the lack of adequate transportation facilities. Under the plan of distribution then followed, a consumer in any part of the country was free to order his coal supply from any producing district, regardless of the length of haul involved. As a consequence, it often happened that cars and locomotives were engaged in delivering coal to distant regions that could have been served far more quickly from fields near by.

Obviously, this complete freedom of choice as to the source of coal used led to cross-hauling in addition to the utilization of railroad equipment in unnecessarily long hauls, the result being a great waste of transportation power. To prevent this needless waste and make possible an increased production to meet the war demands, the United States Fuel Administration, in conjunction with the Director General of Railroads, has announced a zone system for the control of bituminous-coal distribution for the year beginning Apr. 1, 1918.

The zone system was adopted only after prolonged conferences with coal producers, jobbers and consumers, as well as with the traffic and operating officials of the railroads. Briefly explained, it divides the country into a number of zones, each of which must obtain its coal supply from mines that are relatively near, thus preventing abnormal and wasteful transportation movements, insuring more nearly equal distribution of cars to the mines and more steady employment of mine labor.

Of course, so radical a change in the methods of conducting the coal business will cause some inconvenience to producers and consumers, and will involve additional expense in some cases. For example, the producers of Pocahontas coal may no longer ship their output to Chicago and Western points by rail; as a result, they must find new markets in the East. Those plants in and around Chicago that have been burning West Virginia coal will be compelled to substitute Illinois coal, which can be obtained with less than half as long a haul. As the two fuels are of very different characters, changes in the boiler settings and methods of firing will have to be made, which will entail expense.

It is the hope of the Fuel Administration, however, that the consumer and the producer will bear these unavoidable inconveniences in the realization that the readjustment of the distribution of coal is for the welfare of the nation. In other words, they are appealed to on the grounds of patriotism.

There are exceptions to the conditions imposed by the zone system. Certain industries require coals of particular quality or characteristics, as, for example, by-product, gas, blacksmith and metallurgical coals. If a consumer needs coal of one of these kinds and is unable to obtain it from the producing districts that are permitted to ship into the zone in which he is located, permits will be issued to allow the special-purpose fuel to be brought in from other districts.

The zone system does not affect the following bituminous coal:

1. Coal for railroad fuel, for which special arrangements will be made by the Fuel Administrator and the Director General of Railroads.
2. Coal for movement on inland waterways, which is in no way restricted by the system.
3. Coal delivered to Canada, which is subject to regulations of the Fuel Administrator.

To enable the consumer of bituminous coal to determine the districts from which he may obtain his fuel and to show the producer the zones in which he may sell his output, the map has been prepared.

It will be seen that the entire territory of the United States has been divided into a large number of irregular zones or sections, colored differently so that they may readily be distinguished one from another, and each marked with a key number. Each of these separately numbered zones has certain definite boundary lines and is restricted to the use of coals from certain districts. The Key to Consuming Zones gives a complete list of all the zones shown on the map, states the districts from which they may obtain coal, and defines the boundaries of each zone.

If a consumer wishes to find out what coals are available for his use, he locates on the map the zone in which he lives and notes its number. Then, in the Key to Consuming Zones, under that zone number, he will find the list of producing districts from which he can obtain coal. In case there is any doubt as to the number of the zone in which he lives, reference to the boundaries given in the key will at once decide the point. Following this key is a list of the meanings of the abbreviations and terms used in the key.

The Key to Producing Districts is intended to show the producer the several zones in which he may market his product. He knows the district in which his mine is located, and on referring to this key he finds the numbers of the zones, as shown on the map, into which the output from his mine may be sent.

A wall map of large size, showing the same zoning in fuller detail, may be obtained from the Coal Zone Map Co., Glen Echo, Md.

KEY TO CONSUMING ZONES

ZONE NO. 1

RESTRICTED TO FOLLOWING COALS—North Dakota, South Dakota, docks.

BOUNDARIES—Northern and Western: Lake Superior and Canada; North Dakota state line and South Dakota state line to Ortonville, Minn. **Southern and Eastern:** From Ortonville via C. M. & St. P. Ry. through Granite Falls and Benton Junction to Minneapolis, thence via M. St. P. & S. S. M. Ry. through Chippewa Falls and Abbotsford to Amherst Junction, thence via G. B. & W. R. R. to Kewaunee, Wis.; western banks of Lakes Michigan and Huron.

ZONE NO. 2

RESTRICTED TO FOLLOWING COALS—Illinois (summer only), docks, North Dakota, South Dakota, Iowa (to points in Iowa only).

BOUNDARIES—Northern: From Kewaunee, Wis., via G. B. & W. R. R. to Amherst Junction, thence via M. St. P. & S. S. M. Ry. through Abbotsford and Chippewa Falls, Wis., to Minneapolis, Minn., thence via C. M. & St. P. Ry. through Benton Junction and Ortonville, Minn., to the Minnesota-South Dakota state line. **Western:** Minnesota-South Dakota state line. **Southern:** Commencing at South Dakota-Minnesota-Iowa state line east to the C. R. I. & P. Ry. line running through Gordonsville, Minn., and Northwood, Iowa, thence south via that line to Mason City, Iowa, thence east via C. M. & St. P. Ry. through McGregor, Iowa, Madison and Watertown to Milwaukee, Wis. **Eastern:** Lake Michigan from Kewaunee to Milwaukee, Wis.

ZONE NO. 3

RESTRICTED TO FOLLOWING COALS—Illinois, Kentucky (Western), Indiana, docks.

BOUNDARIES—Northern and Western: From Milwaukee, Wis., via C. M. & St. P. Ry. to Waukesha, thence via M. St. P. & S. S. M. Ry. to Illinois-Wisconsin state line. **Eastern and Southern:** From Milwaukee, Wis., via Lake Michigan (west bank) to Illinois-Wisconsin state line, thence via that line to M. St. P. & S. S. M. Ry.

ZONE NO. 4

RESTRICTED TO FOLLOWING COALS—Illinois, Kentucky (Western), docks.

BOUNDARIES—Northern: Via C. M. & St. P. Ry. from Milwaukee, Wis., through Watertown to Madison, Wis. **Southern:** Via C. M. & St. P. Ry. from Milwaukee, Wis., through Milton Junction to Madison, Wis.

ZONE NO. 4A

RESTRICTED TO FOLLOWING COALS—Illinois, docks.

BOUNDARIES—Northern and Western: From Milwaukee, Wis., via C. M. & St. P. Ry. through Milton Junction to Madison, Wis., thence via I. C. R. R. to Dixon, Ill. **Eastern and Southern:** From Milwaukee, Wis., via C. M. & St. P. Ry. through Elkhorn to Beloit, Wis., thence via C. & N. W. Ry. through Belvidere and Sycamore to Dixon, Ill.

ZONE NO. 5

RESTRICTED TO FOLLOWING COALS—Iowa, Kansas, Illinois, Missouri, Oklahoma, Arkansas.

BOUNDARIES—Northern and Eastern: From Sioux City, Iowa, via C. M. & St. P. Ry. through Rock Valley and Spencer to Nora Junction, thence via C. R. I. & P. Ry. to Cedar Rapids, thence via C. M. & St. P. Ry. through Sigourney to Ottumwa, thence via C. R. I. & P. Ry. to Keokuk, Iowa, thence via Missisipi River to Missouri-Arkansas state line. **Western and Southern:** From Sioux City, Iowa, via C. M. & St. P. Ry. through Manilla and Adel to Des Moines, Iowa, thence via C. B. & Q. R. R. to Albia, thence via W. Ry. to Moravia, Iowa, thence via C. M. & St. P. Ry. to Chillicothe, Mo., thence via W. Ry. to Moberly, thence via M. K. & T. Ry. through New Franklin to North Jefferson City, thence via western boundary of Cole, Miller and Pulaski Counties to St. L. S. F. Ry., thence via St. L. S. F. Ry. through Springfield and Neosho to Missouri-Oklahoma state line, thence south to Arkansas-Missouri-Oklahoma state line, thence east via Arkansas-Missouri state line to the Mississippi River.

ZONE NO. 6

RESTRICTED TO FOLLOWING COALS—Illinois, Kentucky (Western).

BOUNDARIES—Northern and Western:—From Arthur, Ill., via P. C. C. & St. L. R. R. to Decatur, Ill., thence via I. C. R. R. through Centralia to Cairo, Ill., thence via Mississippi River to Memphis, Tenn. **Eastern and Southern:** From Arthur, Ill., via C. & E. I. R. R. through Marion to Joppa, Ill., thence via Ohio River to Cairo, Ill., and thence via I. C. R. R. through Clinton and Fulton, Ky., and Dyersburg, Tenn., to Memphis, Tenn.

ZONE NO. 6A

RESTRICTED TO FOLLOWING COALS—Illinois, Kentucky (Western), docks.

BOUNDARIES—Northern: From Madison, Wis., to Woodman, Wis., via C. M. & St. P. Ry. **Southern:** From Madison, Wis., to Woodman, Wis., via C. & N. W. Ry.

ZONE NO. 7

RESTRICTED TO FOLLOWING COALS—Illinois, Iowa (to points in Iowa only).

BOUNDARIES—Northern and Eastern: From Nora Junction, Iowa, via C. M. & St. P. Ry. to Woodman, Wis., thence via C. & N. W. Ry. to Madison, Wis., thence via I. C. R. R. to Freeport, Ill., thence via I. C. R. R. to Dixon, Ill., thence via C. & N. W. Ry. through Nelson to Peoria, thence via P. C. C. & St. L. R. R. to Decatur, thence via I. C. R. R. through Centralia to Cairo, Ill. **Southwestern:** From Nora Junction, Iowa, via C. R. I. & P. Ry. to Cedar Rapids, thence via C. M. & St. P. Ry. to Ottumwa, thence via C. R. I. & P. Ry. to Keokuk, Iowa, thence east of the Mississippi River to Cairo, Ill.

ZONE NO. 8

RESTRICTED TO FOLLOWING COALS—Illinois, Indiana.

BOUNDARIES—Northern and Eastern: From Dixon, Ill., via I. C. R. R. to Decatur, Ill. **Western and Southern:** From Dixon, Ill., via C. & N. W. Ry. through Nelson to Peoria, Ill., thence via P. C. C. & St. L. R. R. to Decatur, Ill.

ZONE NO. 9

RESTRICTED TO FOLLOWING COALS—Illinois, Indiana, Kentucky (Western).

BOUNDARIES—Northern and Western: From Waukesha, Wis., via C. M. & St. P. Ry. to Beloit, Wis., thence via C. & N. W. Ry. through Belvidere, Sycamore, DeKalb, to Dixon, Ill., thence via I. C. R. R. to Decatur, Ill., thence via P. C. C. & St. L. R. R. to Arthur, thence via C. & E. I. R. R. through Mt. Vernon to Joppa, Ill. **Eastern and Southern:** From Waukesha, Wis., via M. St. P. & S. S. M. Ry. to Wisconsin-Illinois state line, thence via this line to Lake Michigan, thence via Lake Michigan to Michigan City, Ind., thence via C. I. & L. Ry. to San Pierre, thence via N. Y. C. R.R. to Wheatfield, thence via C. & E. I. R. R. through Brazil and Otter Creek Junction through Vincennes to Evansville, Ind., thence both sides of the Ohio River, Evansville, Ind., to Joppa, Ill.

ZONE NO. 10

RESTRICTED TO FOLLOWING COALS—Indiana, Illinois (Danville district on Wabash Ry. only). Kentucky (Western, to Jeffersonville and New Albany only).

BOUNDARIES—Northern and Western: From San Pierre, Ind., via N. Y. C. R.R. to Wheatfield, thence via C. & E. I. R.R. through Brazil, Otter Creek Junction and Vincennes to Evansville, Ind. **Eastern and Southern:** From San Pierre, Ind., via C. I. & L. Ry. to New Albany, Ind., thence along northern bank of Ohio River to Evansville, Ind.

ZONE NO. 11

RESTRICTED TO FOLLOWING COALS—Virginia (L. & N. R.R.), Tennessee (M. R.R.), West Virginia (Southern), Illinois, Indiana, Kentucky (Eastern and Western).

BOUNDARIES—Southeastern: From San Pierre, Ind., via N. Y. C. R.R. north to South Bend, Ind., thence via M. C. R.R. to Michigan-Indiana state line. **Western and Northern:** From San Pierre, Ind., north to Michigan City, thence along Lake Michigan and Indiana-Michigan state line to M. C. R. R. from South Bend, Ind., to Niles, Mich.

ZONE NO. 12

RESTRICTED TO FOLLOWING COALS—Indiana, Illinois (Danville district on Wabash Ry. only).

BOUNDARIES — Northeastern — From Monon, Ind., via C. I. & L. Ry. to Indianapolis, Ind., thence via C. C. C. & St. L. Ry. through Greensburg to North Vernon, Ind., thence via P. C. C. & St. L. R.R. to Madison, Ind. **Southwestern:** From Monon, Ind., via C. I. & L. Ry. to Louisville, Ky., thence via Ohio River to Madison, Ind.

ZONE NO. 13

RESTRICTED TO FOLLOWING COALS—Kentucky (Western).

BOUNDARIES—Northern and Eastern: From Cairo, Ill., along Ohio River (north bank) to Louisville, Ky., thence south via L. & N. R.R. from Louisville through Bowling Green, Ky., including Glasgow and Scottsville branches, to Kentucky-Tennessee state line. **Western and Southern:** From Cairo, Ill., via I. C. R.R. through Fulton, Ky., to Kentucky-Tennessee state line, thence east via state line to L. & N. R.R. running from Franklin, Ky., to Mitchellville, Tenn.

ZONE NO. 14

RESTRICTED TO FOLLOWING COALS—Indiana, Kentucky (Eastern), West Virginia (Northern and Southern), Virginia (L. & N.), Tennessee (M. R.R.), Michigan, Ohio (on G. R. & I. Ry. only).

BOUNDARIES—Northern and Western: From Mackinaw City, east bank of Lake Michigan, to Benton Harbor, Mich., thence via C. C. C. & St. L. Ry. to Niles, thence via M. C. R.R. to Michigan-Indiana state line. **Eastern and Southern:** From Mackinaw City via G. R. & I. Ry. and branches to Michigan-Indiana state line, thence west via state line to M. C. R.R. running from Niles to South Bend, Ind.

ZONE NO. 15

RESTRICTED TO FOLLOWING COALS—Illinois, Indiana, Kentucky (Eastern and Western), West Virginia (Northern and Southern), Virginia (L. & N.), Tennessee (M. R.R.), Michigan.

BOUNDARIES—Northern and Western: From Benton Harbor, Mich., via Lake Michigan to Indiana-Michigan state line. **Eastern and Southern:** From Benton Harbor, Mich, via C. C. C. & St. L. Ry. to Niles, thence via M. C. R.R. to Indiana-Michigan state line, thence west via state line to Lake Michigan.

ZONE NO. 16

RESTRICTED TO FOLLOWING COALS—Indiana, Illinois (Danville district on Wabash Ry. only), Kentucky (Eastern), West Virginia (Southern).

BOUNDARIES—Northern: Michigan-Indiana state line from G. R. & I. Ry. west to M. C. R. R. running from Niles, Mich. to South Bend, Ind. **Western:** Via N. Y. C. R. R. South Bend to San Pierre, thence via C. I. & L. Ry. through Monon to Indianapolis, thence via C. C. C. & St. L. Ry., Indianapolis to Greensburg, Ind. **Eastern:** G. R. & I. Ry. from Michigan state line south to Richmond, Ind., thence via P. C. C. & St. L. R. R. to Greensburg, Ind.

ZONE NO. 17

RESTRICTED TO FOLLOWING COALS—Virginia (L. & N. R.R.), Kentucky (Eastern), Tennessee (M. R.R.), West Virginia (Southern).

BOUNDARIES—From Cincinnati north via P. C. C. & St. L. Ry. to Richmond, Ind., thence west to Rushville, Ind., thence south via C. C. C. & St. L. R.R. through Greensburg, thence east to Cincinnati, O.

ZONE NO. 18

RESTRICTED TO FOLLOWING COALS—Virginia (L. & N. R.R.), Kentucky (Southern), Tennessee (M. R.R.).

BOUNDARIES—Northern and Western: Cincinnati, Ohio, via C. C. C. & St. L. Ry. through Greensburg, to North Vernon, Ind., thence via P. C. C. & St. L. R.R. to Madison, Ind. **Eastern and Southern:** North bank Ohio River, Cincinnati, Ohio, to Madison, Ind.

ZONE NO. 19

RESTRICTED TO FOLLOWING COALS—Kentucky (Eastern), Tennessee (M. R.R.), West Virginia (Southern, also Eastern, to points on C. & O. Ry. from Catlettsburg, Ky., to Cincinnati, Ohio).

BOUNDARIES—Northern and Eastern: From Louisville, Ky., via Ohio River and Big Sandy River to Kentucky-Virginia-West Virginia state line. **Western and Southern:** From Louisville, Ky., to Lebanon Junction to Bowling Green, Ky., to Mitchellville, Tenn., including Glasgow and Scottsville (Kentucky) branches, thence via Kentucky-Tennessee state line and Kentucky-Virginia state line via Tug River to Big Sandy River.

ZONE NO. 20

RESTRICTED TO FOLLOWING COALS—Virginia (L. & N. R. R.). Kentucky, (Eastern), Tennessee (M. R.R.), West Virginia (Northern and Southern), Indiana, Illinois (Danville district on Wabash Ry. to points in Indiana only), Ohio, Michigan.

BOUNDARIES—Southern and Eastern: From Richmond, Ind., east via P. C. C. & St. L. R. R. to Ohio state line, thence north via state line to Michigan state line, thence via N. Y. C. R. R. to Jackson, Mich., thence via M. C. R.R. to Lansing, thence via P. M. Ry. through Ionia to Howard City, Mich. **Western:** From Howard City, Mich., via G. R. & I. Ry. through Fort Wayne to Richmond, Ind.

ZONE NO. 21

RESTRICTED TO FOLLOWING COALS—Virginia (L. & N. R.R.), Kentucky (Eastern), Tennessee (M. R.R.), West Virginia (Northern and Southern), Ohio, Michigan.

BOUNDARIES—Northern and Eastern: From Mackinaw City, Mich., along the eastern boundary of Michigan (lower peninsula) and Ohio to Toledo, Ohio, thence via C. C. C. & St. L. Ry. through Bellefontaine to Dayton, Ohio. **Western and Southern:** From Mackinaw City, Mich., via G. R. & I. Ry. to Howard City, thence via P. M. Ry. through Ionia to Lansing, Mich., thence via M. C. R.R. to Jackson, thence via N. Y. C. R.R. to Indiana-Michigan-Ohio state line, thence south along state line and P. C. C. & St. L. R. R. running from Richmond, Ind., to Dayton, Ohio.

ZONE NO. 22

RESTRICTED TO FOLLOWING COALS—Virginia (L. & N. R.R.), Kentucky, (East-

ern), Tennessee (M. R.R.), West Virginia (Southern), Ohio.

BOUNDARIES—From Cincinnati, Ohio, north via C. C. C. & St. L. Ry. to Dayton, Ohio, thence via P. C. C. & St. L. R.R. west to Richmond, Ind., thence southeast via P. C. C. & St. L. R.R. to Cincinnati, Ohio.

ZONE NO. 23

RESTRICTED TO FOLLOWING COALS—Kentucky (Northeastern). West Virginia (Northern and Southern, also Eastern, along main lines of C. & O. Ry. and N. & W. Ry. to Columbus and Cincinnati, Ohio) Ohio.

BOUNDARIES—Northern and Eastern: From Toledo, Ohio, via south bank of Lake Erie to Sandusky, Ohio, thence via P. C. C. & St. L. R.R. through Columbus, thence via N. & W. Ry. through Circleville to Chillicothe. **Western and Southern:** From Toledo, Ohio, via C. C. C. & St. L. Ry. through Springfield to Dayton, Ohio, thence via B. & O. R. R. through Washington C. H. to Chillicothe, Ohio.

ZONE NO. 24

RESTRICTED TO FOLLOWING COALS—Kentucky (Northeastern), West Virginia (Southern, also Eastern, along main lines of C. & O. Ry. and N. & W. Ry. to Columbus and Cincinnati, Ohio), Ohio.

BOUNDARIES—Northern and Eastern: From Dayton, Ohio, via B. & O. R.R. through Washington C. H. to Chillicothe, thence via N. & W. Ry. to Waverly, thence via C. & O. Northern Ry. to Portsmouth. **Western and Southern:** From Dayton, Ohio, via C. C. C. & St. L. Ry. to Cincinnati, Ohio, thence via north bank of Ohio River to Porstmouth, Ohio.

ZONE NO. 25

RESTRICTED TO FOLLOWING COALS—West Virginia (Northern, also Eastern, along main lines of C. & O. Ry. and N. & W. Ry. to Columbus and Cincinnati, Ohio), Ohio.

BOUNDARIES—Northern and Eastern: From Bucyrus, Ohio, via T. & O. C. Ry. to Thurston, Ohio, thence via Z. & W. Ry. through Fultonham to Zanesville, thence via Z. & W. Ry., K. & M. Ry. to Athens. **Western and Southern:** From Bucyrus, Ohio, via P. C. C. & St. L. R.R. to Marion, Ohio, thence via H. V. Ry. to Columbus, thence via N. & W. Ry. to Chillicothe, thence via B. & O. Ry. to Athens, Ohio.

ZONE NO. 26

RESTRICTED TO FOLLOWING COALS—Ohio.

BOUNDARIES—Northern and Eastern: From Sandusky, Ohio, via south bank of Lake Erie to Lorain, thence via W. & L. E. Ry. through Wellington to Pittsburgh Junction, thence via P. & W. V. Ry. through Mingo Junction to Ohio River. **Southern and Western:** From Sandusky, Ohio, via P. C. C. & St. L. R.R. to Bucyrus, Ohio, thence via T. & O. C. Ry. to Thurston, thence through Zanesville to Athens, thence via K. & M. Ry. through Athens to Middleport, thence via Ohio River (north bank) to P. & W. V. Ry. opposite Mingo Junction.

ZONE NO. 27

RESTRICTED TO FOLLOWING COALS—Pennsylvania, Ohio.

BOUNDARIES—Northern and Western: Along south bank Lake Erie from Conneaut, Ohio, to Lorain, Ohio, thence via W. & L. E. Ry. through Wellington to Pittsburgh Junction, thence via P. & W. V. Ry. through Mingo Junction to Ohio River. **Eastern and Southern:** From Conneaut, Ohio, via Pennsylvania-Ohio state line to East Liverpool, Ohio, thence via Ohio River to P. & W. V. Ry. at a point opposite Mingo Junction.

ZONE NO. 28

RESTRICTED TO FOLLOWING COALS—No change contemplated in this plan, except that low-volatile coal in the Pocahontas, Tug River and New River districts on the N. & W. R. R. and the C. & O. Ry. and the Virginian Ry., and Clinch Valley districts in Tazewell and eastern Russell Counties along the N. & W. R. R., also high-volatile east of Charleston, W. Va., on C. & O. Ry. and east of Iaeger, W. Va., on N. & W. R. R. will be restricted to the District of Columbia, (except C. & O. Ry.) Virginia, (including tidewater terminals) also points in West Virginia on the direct line of the C. & O. Ry. and N. & W. R. R. east and west bound and Virginia Ry. east bound.

BOUNDARIES—All territory east and northeast of Ohio, Kentucky and Virginia, including New England.

ZONE NO. 29

RESTRICTED TO FOLLOWING COALS—Ohio, West Virginia (Northern, also Eastern, to points on the direct lines of the C. & O. Ry. and N. & W. Ry.).

BOUNDARIES—Northern and Eastern: From Chillicothe, Ohio, via B. & O. R.R. to Athens, thence via K. & M. Ry. to Middleport, thence via Ohio River (north bank) to Ironton, Ohio. **Western and Southern:** From Chillicothe, Ohio, via N. & W. Ry. to Waverly, thence via C. & O. N. Ry. to Portsmouth, thence via Ohio River (north bank) to Ironton, Ohio.

ZONE NO. 30

RESTRICTED TO FOLLOWING COALS—No change.

BOUNDARIES—All territory west of the following state lines: North Dakota, South Dakota, Nebraska, Kansas, Oklahoma and Texas.

ZONE NO. 31

RESTRICTED TO FOLLOWING COALS—North Dakota, Wyoming, Montana and other fields east of the Rocky Mountains, docks.

BOUNDARIES—All territory in North Dakota west of the Missouri River.

ZONE NO. 32

RESTRICTED TO FOLLOWING COALS—North Dakota, South Dakota, Wyoming, Montana, docks.

BOUNDARIES—Northern, Western and Southern: North boundary of North Dakota to Montana, thence south to and via Missouri River to Mobridge, S. D., thence via C. M. & St. P. Ry. through Aberdeen to Bigstone City, S. D. **Eastern:** East boundary of North Dakota, thence via Minnesota-South Dakota state line to Bigstone City, S. D.

ZONE NO. 33

RESTRICTED TO FOLLOWING COALS—South Dakota, Wyoming, Montana and other fields east of the Rocky Mountains, North Dakota, docks.

BOUNDARIES—Northern and Eastern: From Montana-North Dakota-South Dakota state line to the Missouri River, thence via Missouri River to South Dakota-Nebraska state line. **Western and Southern:** Western and southern state boundary of South Dakota.

ZONE NO. 34

RESTRICTED TO FOLLOWING COALS—North Dakota, South Dakota, Wyoming, Montana, Illinois (summer), docks.

BOUNDARIES — Southwestern: From Mobridge, S. D., via Missouri River to Sioux City, Ia. **Northern and Eastern:** From Mobridge, S. D., via C. M. & St. P. Ry. through Aberdeen, S. D., to Bigstone City, S. D., thence via Minnesota-South Dakota state line and Iowa-South Dakota state line to Sioux City, Ia.

ZONE NO. 35

RESTRICTED TO FOLLOWING COALS—Iowa, Kansas, Missouri, Arkansas, Oklahoma, Colorado and other fields east of the Rocky Mountains, Wyoming.

BOUNDARIES—Entire state of Nebraska.

ZONE NO. 36

RESTRICTED TO FOLLOWING COALS—Kansas, Missouri, Iowa, Arkansas, Oklahoma, Colorado (Southern).

BOUNDARIES—Entire state of Kansas.

ZONE NO. 37

RESTRICTED TO FOLLOWING COALS—Oklahoma, Missouri, Arkansas, Kansas, Colorado, New Mexico, Texas.

BOUNDARIES—Entire state of Oklahoma.

ZONE NO. 38

RESTRICTED TO FOLLOWING COALS—New Mexico, Colorado, Texas.

BOUNDARIES—All Texas territory west of Pecos River.

ZONE NO. 39

RESTRICTED TO FOLLOWING COALS—Colorado, New Mexico, Arkansas, Oklahoma, Texas.

BOUNDARIES—Northern and Eastern: From New Mexico-Oklahoma-Texas state line east along northern border of Texas to Arkansas-Louisiana-Texas state line, thence south to Logansport, La., thence via H. E. & W. T. Ry. to Houston, via G. H. & H. R.R. to Galveston, thence Gulf of Mexico to Rio Grande River. **Southwestern:** From New Mexico-Oklahoma-Texas state line to Pecos River, thence via Pecos River to Rio Grande River thence via Rio Grande River to the Gulf of Mexico.

ZONE NO. 40

RESTRICTED TO FOLLOWING COALS—Kentucky (Western), Alabama, Texas.

BOUNDARIES—Northwestern: From Logansport, La., via H. E. & W. T. Ry. to Houston, Texas, thence via G. H. & H. R. R. to Galveston. **Eastern and Southern:** From Logansport, La., along Louisiana-Texas state line to the Gulf of Mexico.

ZONE NO. 41

RESTRICTED TO FOLLOWING COALS—Arkansas, Illinois (summer), Iowa, Kansas, Missouri, Oklahoma, docks.

BOUNDARIES—Northern and Western: From Minnesota-Iowa state line directly south of Gordonsville, Minn., to Iowa-Minnesota-South Dakota state line, thence directly south along Iowa-South Dakota state line to Rock Valley, Ia. **Eastern and Southern:** From Iowa-Minnesota state line directly south of Gordonsville, Minn., via C. R. I. & P. Ry. to Mason City, Ia., thence via C. M. & St. P. Ry. to Rock Valley, Ia.

ZONE NO. 42

RESTRICTED TO FOLLOWING COALS—Arkansas, Iowa, Kansas, Missouri, Oklahoma.

BOUNDARIES—Northeast: From Sioux City, Ia., via C. M. & St. P. Ry. through Manilla and Adel to Des Moines, thence via C. B. & Q. R. R. through Chariton to Albia, thence via W. Ry. to Moravia, Ia., thence via C. M. & St. P. Ry. through Seymour to Missouri-Iowa state line. **Western and Southern:** From Sioux City, Ia., via Missouri River (east bank) to Iowa-Missouri state line, thence via Missouri state line. north boundary, to C. M. & St. P. Ry. line running south from Seymour, Ia.

ZONE NO. 43

RESTRICTED TO FOLLOWING COALS—Iowa, Arkansas, Kansas, Missouri, Oklahoma.

BOUNDARIES—Northeastern and Southern: Iowa-Missouri state line from Missouri River to C. M. & St. P. Ry. running south from Moravia, Ia., through Chillicothe, Mo., thence via W. Ry. through Huntsville to Moberly, thence via M. K. & T. Ry. through New Franklin to North Jefferson City, thence via western boundary of Cole, Miller and Pulaski Counties, Mo., to St. L. S. F. Ry. thence via St. L. S. F. Ry. through Lebanon, Springfield, to Missouri-Oklahoma state line. **Western:** Western boundary of Missouri.

ZONE NO. 44

RESTRICTED TO FOLLOWING COALS—Arkansas, Illinois, Kansas, Missouri, Oklahoma, Texas.

BOUNDARIES—Northern and Eastern: From Arkansas-Missouri-Oklahoma state line east to Mississippi River, thence via Mississippi River (west bank) to Memphis, Tenn. **Western and Southern:** From Arkansas-Missouri-Oklahoma state line south to C. R. I. & P. Ry. running from Howe, Okla., through Mansfield, Danville and Little Rock, Ark., to Memphis, Tenn.

ZONE NO. 45

RESTRICTED TO FOLLOWING COALS—Alabama, Arkansas, Illinois (only on lines of St. L. S. W. Ry. and St. L. I. M. & S. Ry), Kansas, Missouri, Oklahoma, Kentucky (Western), Texas.

BOUNDARIES—Northern and Eastern: From Arkansas-Oklahoma state line via C. R. I. & P. Ry. running from Howe, Okla., through Mansfield, Danville and Little Rock, Ark., to Memphis, Tenn., thence via Mississippi River (west bank) to Arkansas-Louisiana state line. **Western and Southern:** South along Arkansas-Oklahoma state line from C. R. I. & P. Ry. Howe, Okla., to Mansfield, Ark., to Arkansas-Louisiana-Texas state line, thence east along Arkansas-Louisiana state line to the Mississippi River.

ZONE NO. 46

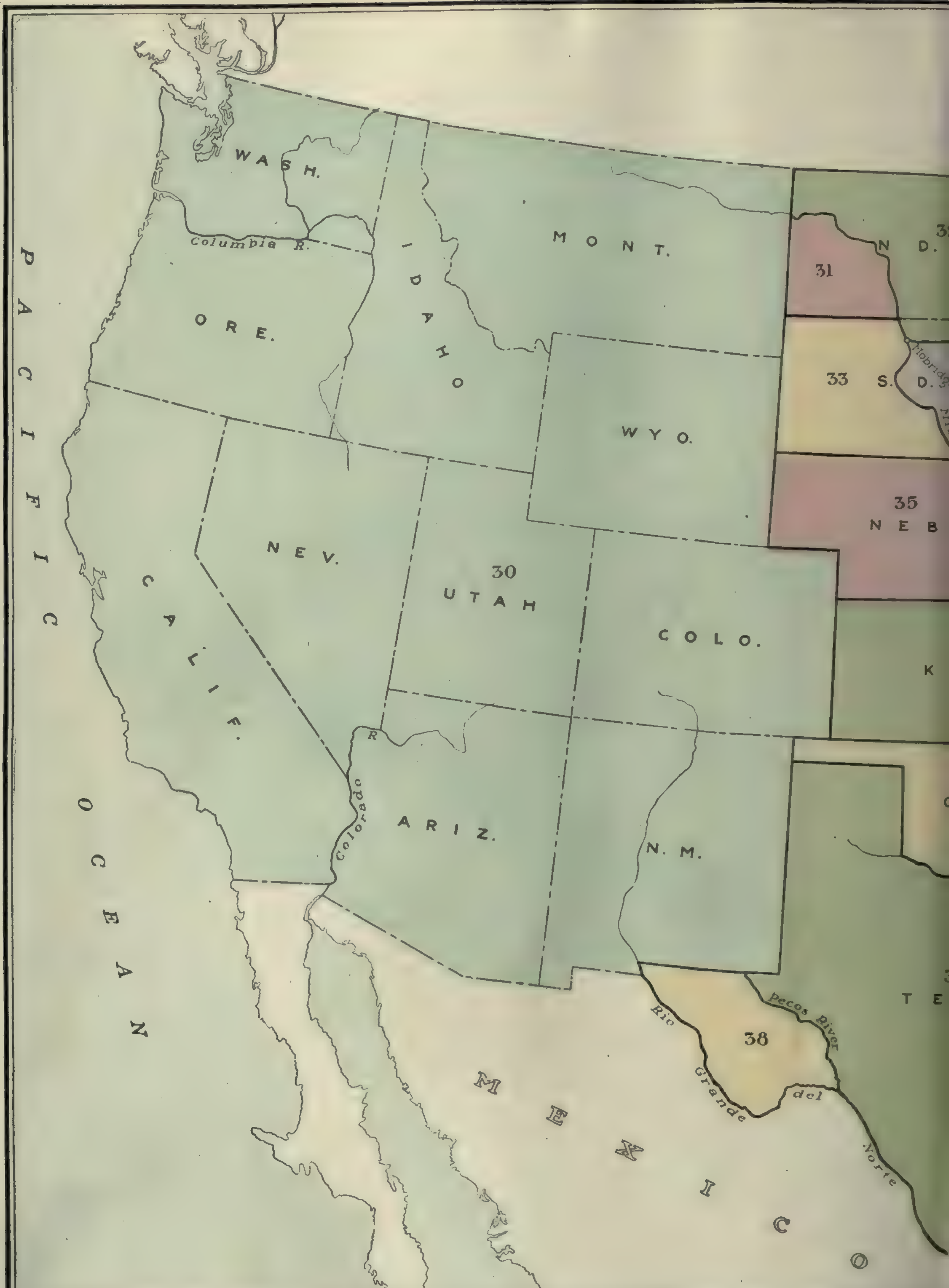
RESTRICTED TO FOLLOWING COALS—Alabama, Arkansas, Illinois (only on lines of St. L. S. W. Ry. and St. L. I. M. & S. Ry.), Kentucky (Western), Texas.

BOUNDARIES—Northern and Eastern: From Arkansas-Louisiana-Texas state line east to the Mississippi River, thence along Mississippi River (west bank) to the Gulf of Mexico. **Western and Southern:** Louisiana-Texas state line to the Gulf of Mexico, thence to Mississippi River.

ZONE NO. 47

RESTRICTED TO FOLLOWING COALS—Kentucky (Western).

BOUNDARIES—Northern and Eastern: From Kentucky-Tennessee state line south of Fulton, Ky., east to L. & N. R. R. passing south through Mitchellville, Tenn., through Nashville and Columbia to Iron City, Tenn., including Scottsville and Hartsville, Ky., branches. **Western and Southern:** From Kentucky-Tennessee state line south of Fulton, Ky., via I. C. R. R. to Memphis, thence east via N. C. & St. L. Ry. to Perry-



Map Showing Districts in Which

...om Various Sources Is Available

Supplement to American Machinist, May 16, 1918

ville, thence along Tennessee River (east bank) to Alabama-Mississippi-Tennessee state line, thence via Alabama-Tennessee state line to Iron City, Tenn.

ZONE NO. 48

RESTRICTED TO FOLLOWING COALS—Alabama.

BOUNDARIES—Northern and Eastern: From Memphis, Tenn., via N. C. & St. L. Ry. to Perryville, thence via Tennessee River (west bank) to Alabama-Mississippi-Tennessee state line. **Western and Southern:** From Memphis to Arkansas-Mississippi-Tennessee state line, thence east along Mississippi-Tennessee state line to the Tennessee River.

ZONE NO. 49

RESTRICTED TO FOLLOWING COALS—Alabama, Kentucky (Western).

BOUNDARIES—Northern and Eastern: Tennessee-Mississippi state line and Alabama-Mississippi state line. **Western and Southern:** East bank Mississippi River to the Gulf of Mexico.

ZONE NO. 50

RESTRICTED TO FOLLOWING COALS—Kentucky (Southern), Virginia (all Black Mountain and Stonega districts in Lee, Dickenson, Wise, and western Russell Counties of Virginia), Kentucky (Western), Tennessee, Georgia.

BOUNDARIES—Northeastern: From Columbia, Tenn., via L. & N. R. R. to Baugh, Tenn. **Western and Southern:** From Columbia, Tenn., via L. & N. R. R. through Lawrenceburg to Iron City, thence east via Alabama-Tennessee state line to Baugh, Tenn.

ZONE NO. 51

RESTRICTED TO FOLLOWING COALS—Alabama, Kentucky (Southern), Virginia (all Black Mountain and Stonega districts in Lee, Dickenson, Wise, and western Russell Counties of Virginia), Tennessee, Georgia.

BOUNDARIES — Northern: Tennessee-Alabama state line. **Southwestern and Eastern:** Tennessee River.

ZONE NO. 52

RESTRICTED TO FOLLOWING COALS—Alabama.

BOUNDARIES—Northern and Eastern: Tennessee River to Alabama-Georgia state line, thence south along state line to Apalachicola River, thence via said river to the Gulf of Mexico. **Western and Southern:** Alabama-Mississippi state line to the Gulf of Mexico.

ZONE NO. 53

RESTRICTED TO FOLLOWING COALS—Kentucky (Southern, also Western, to points on N. C. & St. L. and T. C. R. R. Nashville to Old Hickory and Hermitage, Tenn. inclusive), Virginia (all Black Mountain and Stonega districts in Lee, Dickenson, Wise, and western Russell Counties of Virginia, also Clinch Valley district in eastern Russell and Tazewell Counties), West Virginia (Eastern, also Southern, on C. & O. Ry. east of Charleston and N. & W. Ry. east of Iaeger, W. Va.), Georgia, Tennessee.

BOUNDARIES—Northern and Eastern: From Mitchellville, Tenn., east along Tennssee-Kentucky state line to Virginia state line, thence via L. & N. R. R. to Norton, thence via N. & W. R. R. through Roanoke, Petersburg (and branches of N. & W. R. R. at Petersburg) to Norfolk, thence south to Virginia-Carolina state line. **Western and Southern:** From Mitchellville, Tenn., via L. & N. R. R. through Nashville and Columbia to Baugh, Tenn., including Scottsville, Ky., branch, thence along Alabama-Tennessee-Georgia state line, thence via North Carolina-Tennessee state line, thence via North Carolina-Virginia state line to the Atlantic Ocean.

ZONE NO. 54

RESTRICTED TO FOLLOWING COALS—Kentucky (Southern), Tennessee, Virginia (all Black Mountain and Stonega districts in Lee, Dickenson, Wise, and western Russell Counties of Virginia), Alabama, Georgia.

BOUNDARIES—State of Georgia and all of Florida east of Apalachicola River.

ZONE NO. 55

RESTRICTED TO FOLLOWING COALS—Kentucky (Southern), Virginia (all Black Mountain and Stonega districts in Lee, Dickenson, Wise, and western Russell Counties of Virginia), Tennessee, Georgia, West Virginia (Eastern).

BOUNDARIES—Northern and Eastern: From Georgia-North Carolina-South Carolina state line to the line of the Sou. Ry. running south from Charlotte, N. C., through Chester to Columbia, S. C., thence via S. A. L. Ry. to Denmark, thence via Sou. Ry. to Charleston, S. C. **Western and Southern:** South Carolina-Georgia state line to the Atlantic Ocean.

ZONE NO. 56

RESTRICTED TO FOLLOWING COALS—Kentucky (Southern), Tennessee, Virginia (all Black Mountain and Stonega Districts in Lee Dickenson, Wise and western Russell Counties of Virginia, and Clinch Valley districts in Tazewell and eastern Russell Counties along the N. & W. Ry.). West Virginia (Eastern, on C. & O. Ry. and N. & W. Ry. and Virginian Ry.).

BOUNDARIES—All of North Carolina, and that portion of South Carolina on and east of the line of the Sou. Ry. Charlotte, N. C., through Chester to Columbia, thence via S. A. L. Ry. to Denmark, thence via Sou. Ry. to Charleston, S. C.

ZONE NO. 57

RESTRICTED TO FOLLOWING COALS—No change contemplated. Coal to be supplied generally from low-volatile fields.

BOUNDARIES—That portion of Virginia on and north of the N. & W. R.R. Graham, Va., to Norfolk, Va., including branches at Petersburg.

EXPLANATION OF ABBREVIATIONS AND TERMS USED

B. & O.	Baltimore & Ohio R. R.
C. & C.	Coal & Coke Ry.
C. & E. I.	Chicago & Eastern Illinois R. R.
C. & N. W.	Chicago & Northwestern Ry.
C. & O.	Chesapeake & Ohio Ry.
C. & O. N.	Chesapeake & Ohio Northern Ry.
C. B. & Q.	Chicago, Burlington & Quincy R. R.
C. C. & O.	Carolina, Clinchfield & Ohio Ry.
C. C. C. & St. L.	Cleveland, Cincinnati, Chicago & St. Louis Ry.
C. I. & L.	Chicago, Indianapolis & Louisville Ry.
C. M. & St. P.	Chicago, Milwaukee & St. Paul Ry.
C. R. I. & P.	Chicago, Rock Island & Pacific Ry.
E. R. R.	Erie R. R.
G. B. & W.	Green Bay & Western R. R.
G. H. & H.	Galveston, Houston & Henderson R. R.
G. R. & I.	Grand Rapids & Indiana Ry.
H. E. & W. T.	Houston East & West Texas Ry.
H. V.	Hocking Valley Ry.
I. C.	Illinois Central R. R.
K. & M.	Kanawha & Michigan Ry
K. & W. V.	Kanawha & West Virginia R. R.
L. & N.	Louisville & Nashville R. R.
L. F.	Long Fork R. R.
M. C.	Michigan Central R. R.
M. K. & T.	Missouri Kansas & Texas R. R.
M. R. R.	Middlesborough R. R.
M. St. P. & S. S. M.	Minneapolis, St. Paul & Sault Ste. Marie Ry.
N. & W.	Norfolk & Western Ry.
N. C. & St. L.	Nashville, Chattanooga & St. Louis Ry.
N. Y. C.	New York Central R. R.
P. & W. V.	Pittsburgh & West Virginia Ry.
P. C. C. & St. L.	Pittsburgh, Cincinnati, Chicago & St.Louis Ry.
P. Co.	Pennsylvania Co.
P. M.	Pere Marquette Ry.
Q. & C.	Queen & Crescent Route.
S. A. L.	Seaboard Air Line Ry.
Sou. Ry.	Southern Ry.
St. L. I. M. & S.	St. Louis, Iron Mountain & Southern Ry.
St. L. S. F.	St. Louis-San Francisco Ry.
St. L. S. W.	St. Louis-Southwestern Ry.
T. & O. C.	Toledo & Ohio Central Ry.
T. C.	Tennessee Central R. R.
V. Ry.	Virginian Ry.
W. & L. E.	Wheeling & Lake Erie Ry.
W. M.	Western Maryland Ry.
W. Ry.	Wabash Ry.
Y. & O. R.	Youngstown & Ohio River R. R.
Z. & W.	Zanesville & Western Ry.
Summer	From Apr. 1 to and including Sept. 30.
Winter	From Oct. 1 to and including Mar. 31.

KENTUCKY

Eastern	All mines in eastern Kentucky on Sou. Ry. (Q.&C.), L. & N. C. & O., N. & W. and L. F.
Northeastern	Sandy Valley & Elkhorn Ry. L. F., C. & O., and N. & W in Thacker, Big Sandy and Elkhorn districts.
Northern	L. & N. in Hazard and Elkhorn districts.
Southern	Sou. Ry. (Q.&C.) and L. & N. in Harlan, Jellico and Southern Appalachian districts.
Western	L. & N. and I. C. west of Louisville, Ky.

WEST VIRGINIA

Eastern	C. & O. and N. & W. in low-volatile fields of Pocahontas, Tug River and New River districts.
Northern	K. & M., K. & W. V. and C. & C. west of Dundon.
Southern	C. & O. and N. & W. in Kanawha, Kenova and Thacker districts.

KEY TO PRODUCING DISTRICTS

Location of Producing Districts	Numbers of Consuming Zones to which restricted
Alabama	40, 45, 46, 48, 49, 51, 52, 54.
Arkansas	5, 35, 36, 37, 39, 41, 42, 43, 44, 45, 46.
California	30.
Colorado	30, 31, 33, 35, 36, 37, 38, 39.
Docks[1]	1, 2, 3, 4, 4A, 6A, 31, 32, 33, 34, 41.
Georgia	50, 51, 53, 54, 55.
Illinois (summer)	2, 34, 41.
Illinois	3, 4, 4A, 5, 6, 6A, 7, 8, 9, 10[2], 11, 12[2], 15, 16[2], 20[2], 44, 45[2], 46[2].
Indiana	3, 8, 9, 10, 11, 12, 14, 15, 16, 20.
Iowa	2[4], 5, 7[4], 35, 36, 41, 42, 43.
Kansas	5, 35, 36, 37, 41, 42, 43, 44, 45.
Kentucky:	
Eastern	11, 14, 15, 16, 17, 19, 20, 21, 22.
Northeastern	23, 24.
Southern	18, 50, 51, 53, 54, 55, 56.
Western	3, 4, 6, 6A, 9, 10, 11, 13, 15, 40, 45, 46, 47, 49, 50, 53[5].
Maryland	57.
Michigan	14, 15, 20, 21.
Missouri	5, 35, 36, 37, 41, 42, 43, 44, 45.
Montana	30, 31, 32, 33, 34, 35.
New Mexico	30, 35, 37, 38, 39.
North Dakota	1, 2, 31, 32, 33, 34.
Ohio	14[6], 20, 21, 22, 23, 24, 25, 26, 27, 28[7], 29.
Oklahoma	5, 35, 36, 37, 39, 41, 42, 43, 44, 45.
Oregon	30.
Pennsylvania	27, 28, 57.
South Dakota	1, 2, 32, 33, 34.
Tennessee (M. R. R.)	11, 14, 15, 17, 18, 19, 20, 21, 22.
Tennessee	50, 51, 53, 54, 55, 56.
Texas	37, 38, 39, 40, 44, 45, 46.
Utah	30, 31, 33, 35, 36.
Virginia (L. & N.)	11, 14, 15, 17, 18, 20, 21, 22.
Virginia[8]	50, 51, 53, 54, 55, 56.
Virginia[9]	53, 56.
West Virginia:	
Eastern	19, 23[10], 24[10], 25[10], 29[10], 53, 55, 56.
Northern	14, 15, 20, 21, 23, 25, 29.
Southern	11, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 53.
Wyoming	30, 31, 32, 33, 34, 35.

[1]South bank Lake Superior and west bank Lake Michigan.

[2]From Danville district on Wabash Ry. only.

[3]Only on lines of St. L. I. M. & S. and St. L. S. W. Rys.

[4]To points in Iowa only.

[5]To points on N. C. & St. L. and T. C. Nashville to Hermitage and Old Hickory, Tenn., inclusive.

[6]On G. R. & I. only

[7]From mines in Columbiana County, O., only.

[8]All Black Mountain and Stonega districts in Lee, Wise, Dickenson and western Russell Counties.

[9]Clinch Valley districts in Tazewell and eastern Russell Counties.

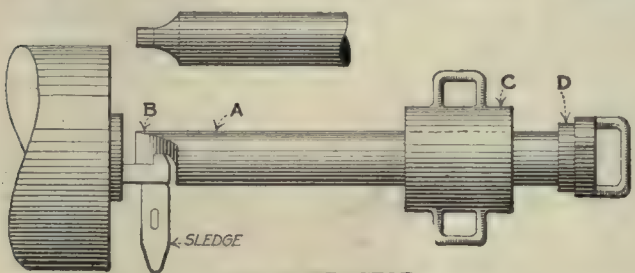
[10]Along lines of C. & O. and N. & W. to Cincinnati and Columbus, O.

IDEAS FROM PRACTICAL MEN

A Key Extractor

By A. P. M. Wilking

Almost any master mechanic knows how difficult it is sometimes to extract a head key, especially when the key has not been removed for a long time or is rusted in. Most devices for this purpose are liable to bend



KEY EXTRACTOR

the key in forcing it out. The tool shown herewith gives practically a straight pull. The bar *A* is made either of round or square steel stock and has a nose *B* which catches behind the head of the key. *C* is a cast-iron or forged block with one or two handles, which slides over the bar and is used to ram against the shoulder *D*.

One advantage of this device is that it can be used in confined spaces.

How Would You Make This Casting?

By M. E. Duggan

On page 164 of the *American Machinist* Mr. Maplethorpe makes a part reply to the above query by saying that "a sprue about 8 in. in diameter should be provided, and this must be kept well filled during the pouring operation to insure the core being kept central." I would like to ask Mr. Maplethorpe if he has ever seen a broken section of such a casting that showed the chamber in central position, and further, with his method, what assurance has he that the core is centrally set in the first place or that it remains central during the pouring operation? My experience, covering a period of 30 years, convinces me that it is impossible by the method in question to insure that the walls of the casting will be of equal thickness on all sides. The question is not how to produce a sound casting, but rather how to keep the core central, and what I wish to know is how can this be accomplished with certainty without the necessity of calling a special meeting of the board of directors to devise ways and means of making the pattern and mold.

Now let us look at this job from another angle. On page 156 Mr. Brophy says: "If a piece has got to be hardened, harden it; but if it will work as well without hardening, do away with the extra expense." I say if this piston must be cast with a solid end, cast it solid; but if by altering the bottom, or solid end, the piece will answer every requirement, and at the same time allow the production of a good, sound casting every time, with assurance that the chamber will be

THE RIGHT WAY TO MAKE THE MOLD

central, let us make it that way, and cut out all the trouble and guesswork.

A glance at the illustration will show the correct method of doing this. The hole in the bottom of the casting can be easily tapped and plugged.

An Auxiliary Cope Flask

By William C. Nelson

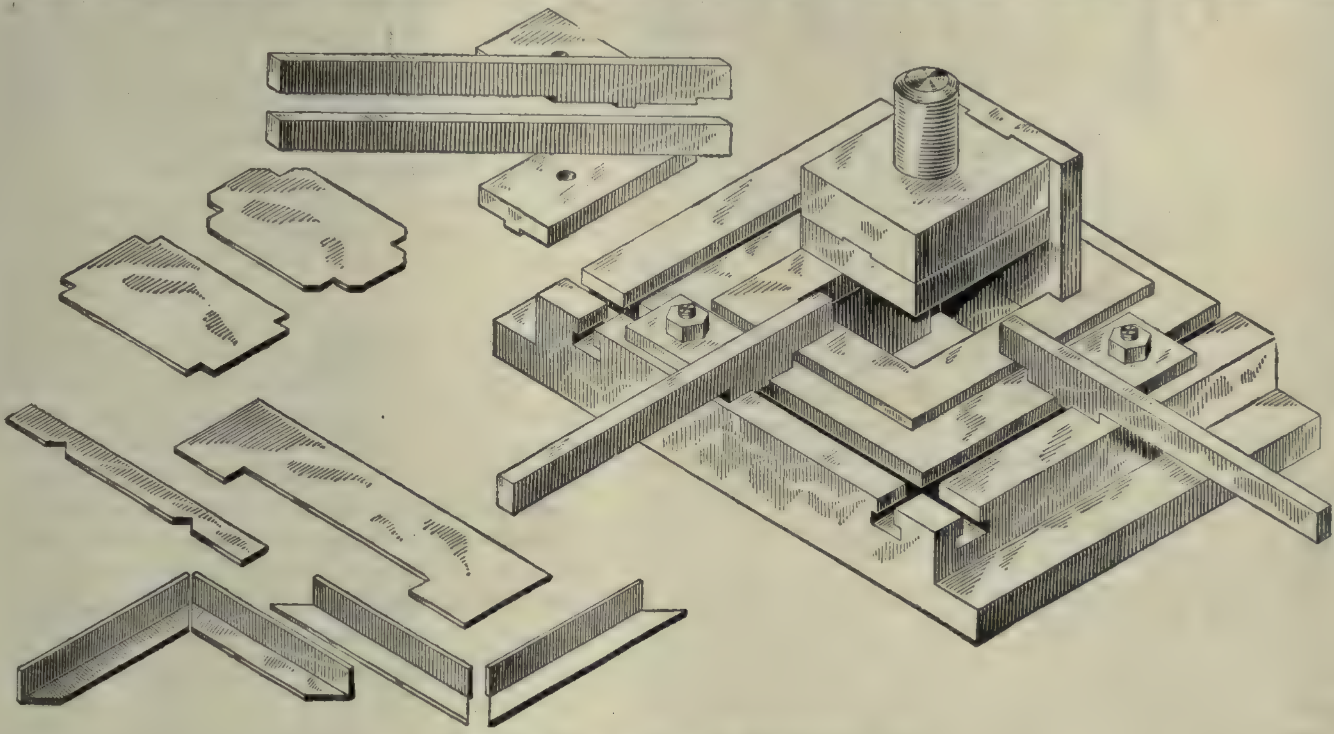
On page 589 of the *American Machinist*, under the title of "An Auxiliary Cope Flask," an article by M. E. Duggan states that a pattern should be made so that as little of it as possible should be in the cope. He further states that nine out of ten patternmakers would make the same error he did, and in his plan of changing the molding of this piece he is doing the very thing he started his article with, "making as little of it as possible in the cope." To prove this, his cross-ribs measure 3 ft. x 8 in., making 288 sq.in. of surface to each rib. In the two ribs together he has 4 sq.ft. of surface. Now the long rib, 9 ft. 4 in. x 7 in. equals 5 sq.ft. 64 sq.in., and leaving out of question the bars in the cope flask it should be made in the drag as he finally decided.

Straight or Angular Notching Die

By Frank A. Tibbals

The illustration shows a handy 4-in. notching die which should be found very useful in any plant making sheet-metal goods. This die can be used for mitering angles for steel furniture frames; also for notching pans, trays and a variety of work of a similar character.

There are four gages: two straight and two of a 45-deg. angle, which will accommodate a wide range of straight and 45-deg. work. The guide, which backs up the punch, is an important feature, as a great deal of the cutting is done on one edge of the die.



A STRAIGHT OR ANGULAR NOTCHING DIE

The die is made in four pieces, each 1 in. thick. They are recessed in the holder. The punch is tongued in the cast-iron punch holder and is removable for grinding. Samples of the work turned out by this tool are shown in the illustration.

Adjustable Bar for Boring Taper Holes

By Alexander Tadensz

Some years ago the writer was working in a small general-repair shop, where we occasionally had work to be bored taper, and as the taper was not always the same we had considerable difficulty in shifting centers to get the taper required. The boring bars were fitted with various-sized plugs in both ends, which made it a somewhat complicated problem to determine the right pair of centers to use for a given taper, and, further, the chances were against there being any centers for the desired taper in the bar, in which case it was necessary for one to become a "plugger" oneself and spend two or three hours in getting a bar ready.

I suggested to the foreman the desirability of adjustable centers, and receiving his permission proceeded to fit all the bars with adjustable center plates, as shown in Fig. 1. A bar being strapped crosswise on the milling-machine table, parallel with the machine spindle, the dovetail slot was cut across its end by means of angular cutters, and the recess milled out to clear the lug on the center plate as shown in Fig. 2. The holes were drilled and tapped for gib screws *A* and adjusting screws *B*. The center plate *C*, the shape of which is clearly shown in the sections, was made from a piece of tool steel, as was also the gib *D*.

When these parts had been fitted to place and the screws put in, the bar was swung up in the lathe with one end in the steadyrest, a center drilled and reamed, and the rough ends of the center plate turned off flush with the periphery of the bar. Two more centers were drilled and reamed in the center plate ½ in. in either direction from the true center. The center line of the center plate must of course be parallel with a line from the point of the cutting tool passing through the center.

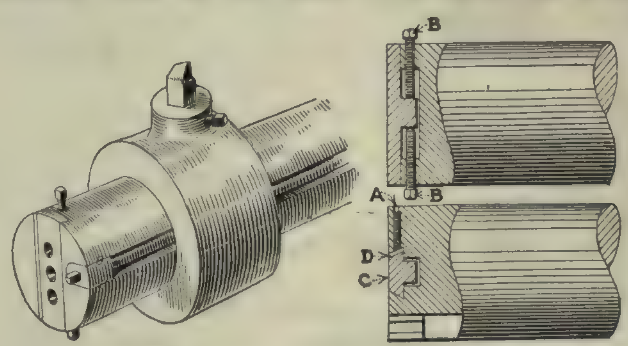


FIG. 1 FIG. 2

FIGS. 1 AND 2. ADJUSTABLE BORING BAR AND DETAILS

The first bar fitted with this plate was 24 in. in length, and had ½-in. adjustment of the center plate in either direction; therefore by using the center opposite the cutting tool and the limit of adjustment in the same direction, tapers of 1 in. per foot could be bored. A further range could easily be provided by making additional centers in the plate.

The Great Need of a

THE necessity for machine tools and the fact that they are really back of all other production has been very clearly shown during the past year. The demand for machine tools for the building of Liberty motors alone emphasized the fact that without them no modern war program could be carried out.

As yet, however, there has been no definite machine-tool program based on the broad, general need of these very necessary machines for all the variety of materials which must be produced. And as a result this fundamental industry on which all production depends is neither as stable nor as efficient as it should be.

HERE, as in other lines of work connected with the war, we can follow or at least study, the work of Great Britain to advantage. The Ministry of Munitions recognized the great importance of the machine-tool industry to the country and took steps to organize it thoroughly. Placing Alfred Herbert, probably the best known machine-tool manufacturer in Great Britain, at the head of this machine-tool board it gave him wide powers in the handling of the machine-tool situation, making him and his staff almost machine-tool dictators of all Great Britain.

This board directs the whole machine-tool activities of the country in a way that has proved extremely beneficial to all concerned. It directs, or at least consents, to the purchase of every machine tool which may be needed for essential industries. It prevents new firms from going into building machines with which the market is already well supplied and prevents the ordering of machines which may be scarce when a more common machine will answer for the work in hand.

The need of such a board is seen when we learn that over two thousand men are necessary to handle all the details of this branch of the Ministry of Munitions which are in their care. These men know the location of every machine tool in all Great Britain, and can in case of necessity take machines from one shop and place them where they can render greater service to the country. The preferences of the individual have given way to the greater need of the country as a whole.

WE already have the basis for such a service in this country, and it is highly desirable that a similar board should be established at an early date. The Machine Tool Section of the Council of National Defense has, under the able guidance of George Merryweather, collected a mass of useful data of a similar kind. This list includes the location of practically every large machine tool in the United States, its size, the name of the maker and the age of the machine. This was collected so as to be of service in laying out the machine-tool program for the making of heavy ordnance which is so sorely needed. It has not, however, been utilized to anything like the extent of which it is capable in rendering valuable service at this time. In fact, there are some departments which do not seem to know of the existence of this data, although every effort has been made to bring it to their attention.

The establishment of some such board in this country would go far toward stabilizing the machine-tool industry and greatly increasing its usefulness to the Government. And unless this is done we shall encounter not only serious delays in the big-gun program but very unsatisfactory conditions in the machine-tool industry.

WITHOUT criticising the delay in deciding upon the types of big guns to be built, as that is perhaps a strictly military question, there seems to be little excuse for not outlining as fast as possible the machines

Machine-Tool Board

which are to be needed in the manufacturing program. This can certainly be done even without knowing the exact design of the gun itself. For if there is no knowledge of what machines are to be used and no orders placed it will take months to secure the machines needed for the making of the big guns.

THE machine-tool builders of this country are not only willing but anxious to help in every possible way. They will submit to any just and reasonable plan of apportioning the work which will insure the best results in winning the war. There will be no quibbling as to individual preferment or profits. But they ask, and they have a right to ask, that something definite in the way of a program be decided upon quickly. Some of the machine-tool shops are not running at their maximum efficiency because they do not know what will be needed, and they can get no definite assurances of any kind.

A COMMITTEE of machine-tool builders can easily be secured which will coöperate in every way with every Government department which requires machine tools. Such a committee would arrange to so divide up the work as to utilize the capacity of the different shops to the best advantage. Shops which could build large machines would doubtless concentrate on this work so far as their equipment will permit and leave much of the building of small machines to the smaller shops.

A capable machine-tool board seems to be the most logical way of handling the situation. This should be selected with great care by those who understand the real needs of the case as well as the available production of machine tools of various kinds. Orders should be placed with careful regard to all the conditions involved and should be given only to concerns whose present capacity is large enough to fill the order, unless it can be positively shown that by so doing the machines can be delivered more quickly. And this is unlikely from almost every point of view.

The well-established concerns should be made to utilize their full capacity before smaller builders or those engaged in other work are allowed to enlarge their shops to handle the new work, especially when such enlargement is to be made at Government expense.

WITH an adequate board and a program for a machine-tool reserve, and this should include machines for all branches of the army and navy, we should do away with rush orders in one shop and no orders in the next; with overtime and layoffs, and the unsettled feeling which always goes with such uncertainty. This reserve need not include small machine tools at all, unless conditions change materially, as these can now be purchased from stock in most cases. There is certainly no need of ordering them in large quantities, as was recently proposed, and from builders who have sprung up as a result of war conditions.

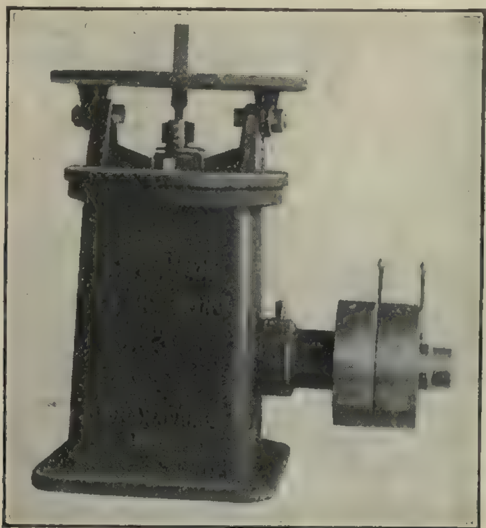
THE machine-tool builders are not asking for any favors. They have given freely of their valuable men at the call of the Ordnance Department and they will respond whenever and whatever the call may be. They are only asking for the opportunity to be of more service than they can possibly be under the present lack of a definite program regarding the needs of the Government for the machines they build.

And considering the fact that no heavy guns can be turned out until the machines for making them are built, is it too much to ask that this vital question be given immediate consideration? Not for the sake of the machine-tool builders, but that they may render greater service in the one great object which is nearest to all our hearts—the winning of the war.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Advance Filing Machine

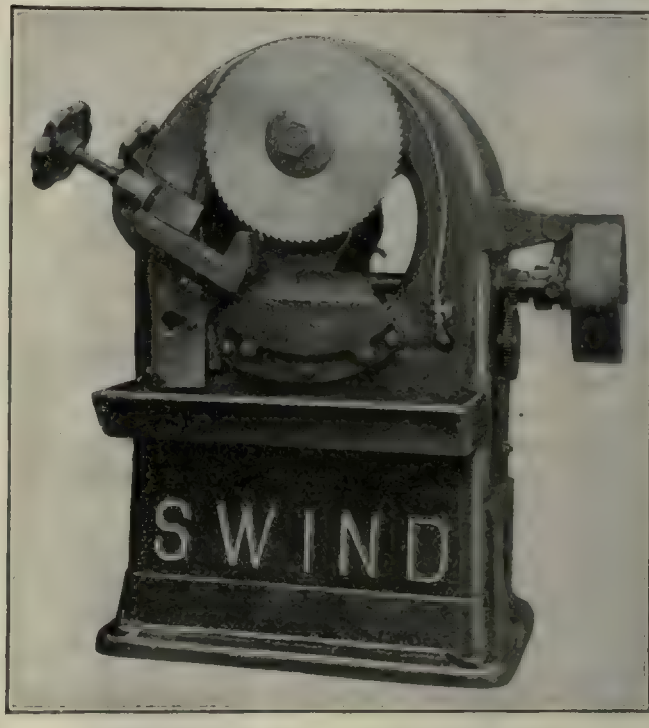
The illustration shows a bench-type die-filing machine that has recently been placed on the market by the Advance Engineering Co., 848 Massachusetts Ave, Indianapolis, Ind. The machine is of compact construction and the moving parts are balanced and inclosed. All bearings and wearing surfaces are of bronze and are replaceable in case of wear. The table may be tilted to an angle of 10 deg. on either side of the central or vertical position, and may also be turned around on the base so that the driving pulleys can be located on either side or at the rear of the machine as desired. The spindle is provided with a special clamping device, by means of which a $\frac{1}{8}$ x $\frac{3}{4}$-in. flat file may be used on the machine, the files ordinarily used being of the $\frac{1}{8}$-in.-round or $\frac{1}{4}$-in.-square variety. The machine is $11\frac{1}{2}$ in. high, has a stroke of 1 in., weighs 40 lb., and runs at about 500 r.p.m. for ordinary work.



ADVANCE DIE-FILING MACHINE

Swind Metal-Sawing Machine

The illustration shows the improved No. $3\frac{1}{4}$ cold-metal sawing machine that is being manufactured by the Swind Machinery Co., Widener Building, Philadelphia, Penn. The machine is automatic in action and will handle work up to $3\frac{1}{4}$-in. rounds. The machine is driven direct from the line shaft by means of a single pulley. The oscillatory, cylindrical carrier contained in the frame of the machine is provided with an eccentrically mounted saw spindle, the carrier being rotated by means of a rack and pinion which automatically feed the saw to the work. The drive is of the single-clutch-pulley type operating the drive shaft which extends longitudinally through the frame of the machine. The shaft is journaled at both walls of the frame and is secured in position by means of thrust collars. Power is transmitted through a worm and worm gear mounted on the drive shaft and is connected to the saw spindle by spur gearing. The automatic feed comprises a stationary-rack bar carried by the frame, a pinion shaft journaled in the carrier with a ratchet wheel on one end all actuated by a bell-crank lever pivoted to the rear and wall of the carrier and eccentrically connected by means of a link which is fixed on the rear end of the saw spindle. A bearing cap at the upper end of the link is transversely slotted, permitting suitable feed adjustment for actuating the duplex pawls engaging the



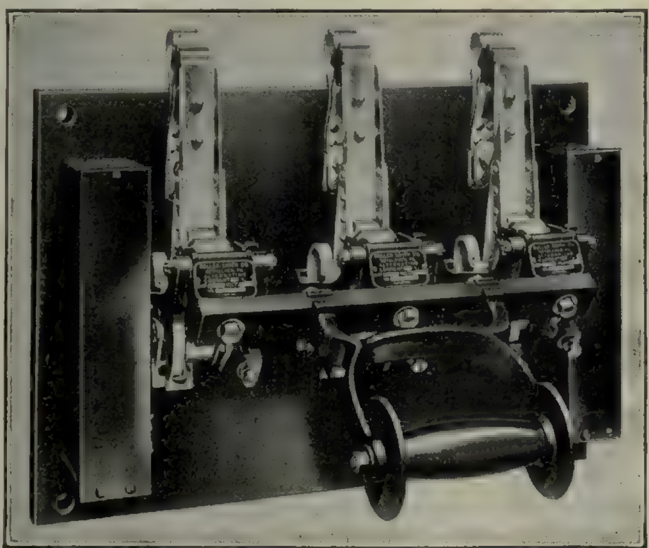
SWIND NO. $3\frac{1}{4}$ METAL-SAWING MACHINE

Floor space, 30 x 18 in.; capacity up to $3\frac{1}{4}$ in. rounds; size of saw, 14 x $\frac{3}{16}$ in.; net weight, 1100 lb.; size of cylindrical carrier, $18\frac{1}{2}$ in. in diameter by 10 in. wide.

ratchet wheel which rotates the carrier. The automatic knock-off mechanism consists of a bell-crank lever with an adjustable screw which disengages the pulley clutch when the cutting operation is completed. A handwheel serves to bring the carrier to its initial position. The oil pump is geared directly to the driving shaft and the lubricant is conveyed to the saw by means of flexible tubing. The oil reservoir is contained in the base, the front of which is open to permit the removal of chips or oil. Pads are provided for mounting a motor in case this type of drive is desired.

Roller Smith Self-Timing Circuit-Breakers

The Roller Smith Co., 233 Broadway, New York City, is now manufacturing a line of self-timing circuit-breakers, one of which is shown in the illustration. This is of the 60-amp., 250-volt, three-pole type, with rigid arm, plain-overload circuit-breaker, two self-timing attachments and wall mounting. The breaker itself is of standard construction, tending always to trip instantaneously with the load for which it is adjusted applied. Interposed in the path of its trip armature is a pivoted hook-shaped barrier under two independent controls. One control is thermal. The expansion of a metal rod heated at the same rate the motor is heated by the passage of the same current which drives the motor retracts

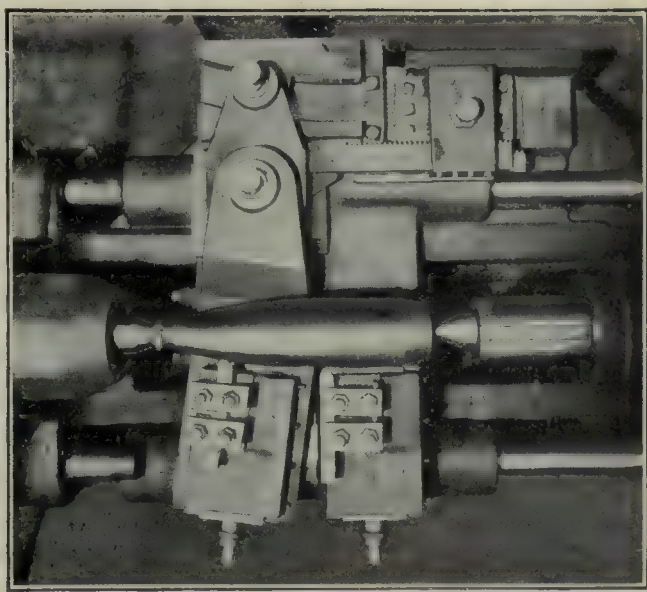


SELF-TIMING CIRCUIT-BREAKER

the barrier and allows the breaker armature to trip if the heating is excessive, no matter how that excess comes about. This thus cares for the starting current and the variable motor-loading-protection requirements. The other control is electromagnetic, instantaneously retracting the barrier and allowing instantaneous trip if a heavy overload occurs. This takes care of the requirement that there shall be no delay should mechanically dangerous loads be suddenly applied. Both controls are adjustable, that is to say, both maximum current which may continuously flow and emergency overload trip values may be independently varied by the purchaser if desired. As sent out, however, they are set to cover the characteristics of the average motor of their normal ampere capacities and require no further adjustment. The breakers are built for a large number of alternating or direct currents and voltages, and are made for plain-overload, overload combined with one under-voltage or shunt trip coil, or for overload combined with two under-voltage or shunt trip coils. They are also built with varying numbers of poles as required.

Amalgamated Shell-Turning Attachment

One of the problems in shell turning has been to obtain a smooth and proper degree of curvature on the shell nose. The lathe attachment here illustrated has been designed to solve this difficulty. The noses of certain types of shells are turned on curvatures of different radii, depending upon the size of the shell. When turning this curved surface in the modern shell shop it has been customary to use a lathe with a profile attachment, so that as the carriage was fed along the tool was guided for the proper cut. This method has



SHELL-TURNING ATTACHMENT

a disadvantage in that the angle that the cutting edge of the tool presents to the work is constantly changing as the tool progresses along the curve.

To correct this condition D. M. Derrom, the work's manager of Winslow Bros. Co.'s shell plant, Chicago, has devised a carriage which is being put on shell lathes built by the Amalgamated Machinery Corporation, Chicago. This is a development of the carriage shown in the *American Machinist* on page 483, Vol. 46. It has two cutting tools, so that while one tool is following the curve of the profile another tool is cutting the straight part of the shell body and a double action is obtained which lets the operator complete two operations in the time usually required for one.

Two pivot points, one under the center line of the shell and the other back of it, are provided, because it would be impractical to build an extension arm long enough to reach the extreme radius point. The rear arm is arranged to carry a block which runs in a true profile form.

Two racks operated by pinions from a rack attached to the lathe bed are provided to feed the pivot blocks along at the proper rate to keep the tool at the correct angle at all times and to turn the correct nose profile.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., May 11, 1918—The huge orders recently placed for cars and locomotives should have a beneficial effect on the machine-tool industry which is beginning to suffer from the lack of information regarding ordnance requirements. This should also tend to afford a market for some of the smaller sizes of machine tools now being produced in excess of the demand and which are not likely to be needed for the big-gun program.

Just how soon the orders for machine tools will come is not easy to say, but it is difficult to see how orders for 30,000 cars and 1025 locomotives can help being reflected in machine-tool equipment. The influence of these orders is also likely to be felt when Mr. McAdoo gets around to ordering machine equipment for the railroad shops. This has been one of the sources of great disappointment to the machine builders for a number of years. The needs of the shops are well known, but orders for machinery as well as rolling stock were put off on the plea of requiring advanced rates before purchasing. The advance in rates, however, did not bring forth the orders, and both shop equipment and rolling stock continued to depreciate. The breakdown of the roads last winter was largely because of this condition. New locomotives and new cars demand new shop equipment, especially when the old is in such bad shape, so this order for railway equipment should help to stabilize the machine-tool industry.

> THE machine-building industry of the United States of America demands a full, fair and nonpartisan investigation of the charges made in connection with the aircraft program. The reputation of the industry is at stake as well as that of the individuals concerned. It is time to lay all the cards on the table.

This does not mean that the machine-tool industry is asking to be coddled or is suggesting special favors. A stabilized basic industry benefits the whole country—and machine-tool building is an honest-to-goodness basic industry. Only the ore and coal industries precede it, and these would be of little value to modern civilization without the machine tool which works and shapes the ores to our uses.

If the men responsible for any of the supplies for our army and navy could be made to understand that none of the products they need can be supplied without the aid of machine tools of some kind or other they would be as anxious to see the industry in a stable condition as we are.

This stability can be secured by giving preference to the well-established builders of standard machines instead of encouraging new "war-baby" shops for any reason whatever. These shops have played their part in some cases and have been of value in helping production when it was needed. But they have no claim on orders which can be filled by the standard, old-established shops. The war babies have presumably made sufficient profit to cover all of their overhead charges. But in any case there should be but one consideration—what is best for the country as a whole, both now and after the war. None of us should ask or receive consideration for anything which benefits us as individuals and is not calculated to favor the country after the war.

We have been talking about ships as being the "neck of the bottle," but the steel situation has become a sort of cork which floats into the neck and prevents us pouring out a full-sized stream. For the ships cannot be built without steel, and the same can be said of all other implements of war. The big guns, shells, rifles, trucks and airplanes all depend on steel in some form or other.

The movement for controlling the use of steel has at last taken shape, many feeling that it might well have been done before. The use of steel in nonessential industries is to be curtailed, and rightly so. The new theater now building in Washington might very well have been stopped before it was begun. The use of concrete for shop buildings, even for essential industries, should be carefully considered, as every ton that can be saved should go to the building of ships and heavy guns. And there is every reason to believe that Mr. Baruch has the situation well in hand.

The wails of the automobile builders should not be allowed to divert a single ton of steel from more useful purposes. One of the best-known plants has practically given up building pleasure cars for the period of the war—and more should follow. Some touring cars and runabouts are as necessary as trucks, but the num-

ber to be built should be limited to war needs and none should be built for joy riding. England and France have built practically no pleasure cars for three years, and the sooner we get on a strictly war basis the better. This does not mean that plants should be shut down until their material is used up—or their capacity is needed—but no steel should be wasted on nonessentials.

There is also another way in which steel can be conserved, and that is by reducing wastage to the lowest possible point. The preventing of spoiled work, the cutting out of uses of metal which are not absolutely necessary, the saving of steel and other materials, all play their part in winning the war.

Avoid Hysteria About Airplanes

Whatever may be the outcome of the airplane investigations it is well to bear in mind that in some cases at least the daily press of various localities has been known to have axes which required considerable grinding. The attempts to throw discredit on the authority of some of the investigators is unwarranted because I have personally seen the credentials in the case most under discussion.

It should also be remembered that much of the criticism of the Liberty motor is inspired by those interested in other motors. Nor should it be thought that no other motors are being tested out even now. The Liberty motor is a development of the Packard airplane motor, which had over half a million dollars' worth of experience behind it. It is not a perfect motor. There is no perfect motor anywhere. But if the men who would rather have no motors than have one which is not perfect can be induced to keep their hands off for awhile we can turn out considerably more than a hundred a day in a very short time. We are turning out a fair number already.

This also seems a good time to answer some of the critics who ask why we didn't build Sunbeam and Rolls-Royce engines instead of the Liberty. I have it on the best of authority that the Sunbeam was rejected on the advice of the British officials who had used these motors and that the Rolls-Royce company very generously cancelled a contract which ran into the millions because it could only supply a comparatively small number of motors a year even with a large factory in this country. The Liberty was chosen because it could be manufactured much more rapidly than any of the others. A thorough investigation will do no harm and may do much good, but let it be impartial, nonpartisan and fair to all concerned.

Now that the lid is off of the airplane situation it may be well to call attention to several phases of the question which do not appear on the surface. As I pointed out in a previous letter there are many ways in which large sums of money could be spent and wasted without any logical basis for graft. It is not difficult to see the same trend in all the various activities. The machine-gun delay was very similar. It was decided to have no machine guns until the Browning gun could be produced, just as the best planes available here were not utilized in the hope of getting a better one. And the unfortunate thing is that the getting of a better one was not given to the most experienced men.

To be more specific, the experience of the largest company was almost entirely ignored, although they had built more airplanes than anyone else in this country. They have built and are building many airplanes for the navy while the Signal Corps was attempting to improve the Bristol fighter. And the first design submitted was so "improved" that it would not go together and hold the motor properly. It has now been altered so that we will probably have several hundred of them in the air before the summer closes.

This is again very similar to the machine-gun experience. The army tested the Lewis gun and condemned it. The navy tested it and ordered a large number. In a similar way the navy has been utilizing the experience of the builders and is securing new airplane equipment every week.

It is not enough to look for graft or disloyalty in trying to find a reason for the delays which have occurred. The policy or attitude of mind which has shown itself at every turn must also be considered.

The separation of the Signal Corps from the manufacturing of aircraft is a needed step. But we must be fair enough to this department to state that they themselves asked for this separation before the present program was started. They evidently realized that manufacturing on a large scale was not within the proper field of men trained in Signal Corps work.

If any one thing can be blamed for the delay it may well be laid to the lack of decision which prevented positive orders being given for both motors and planes. Any new product requires many changes, but in cases of urgent need we are often compelled to take machines which are not 100-per-cent. efficient until we can improve on them. But we do not put off all production until that time arrives. We may prefer beefsteak and mushrooms, but we eat war bread and cheese rather than go without.

Many of these constant changes are laid to the Research Council, whose personnel is charged with being thoroughly impractical in many cases. Specifications for airplane instruments which emanate from this body seem to bear out this complaint, as they are often far from practical. All of these defects, however, sink into the background when there is a man at the head with a vision as to the necessities of the case and backbone enough to overthrow petty obstacles to getting things done because perfection has not been reached. Those who know John D. Ryan say he is such a man.

Men Wanted by Bureau of Mines

Important chemical and other technical engineering work necessary for the prosecution of the war is being carried on by the Bureau of Mines Experiment Station at Washington, D. C. The services of trained men of the following classifications are urgently needed: Bacteriologists, biologists, chemists (inorganic, organic, physical, electro), chemical engineers, draftsmen, electrical engineers, instrument makers, laboratory assistants, laborers, machinists, physiologists, plumbers, steamfitters, stenographers and skilled labor of various kinds.

If your training fits you for any of these occupations write for application forms to the Bureau of Mines, American University Experiment Station, Washington, D. C.

Personals

W. F. Wright has been appointed assistant purchasing agent of the Louisiana & Arkansas R. R., with office at Texarkana, Ark.

A. J. Beuter, formerly representative of the Baldwin Locomotive Works at San Francisco, Cal., has been transferred to Portland, Ore.

W. B. Stokes has been appointed master mechanic of the Wrightsville & Tennille R. R., with office at Tennille, Ga., succeeding **M. G. Brown.**

Thomas Spratt, formerly assistant purchasing agent of the Norfolk & Western R. R., with office at Roanoke, Va., has assumed the duties of purchasing agent.

W. R. Gilpin, formerly road foreman of engines on the Union Pacific, with office at Evanston, Wyo., is now general air-brake inspector with headquarters at Omaha, Neb.

E. Burton Smith, formerly affiliated with the Westinghouse Lamp Co., Bloomfield, N. J., is now associated with the International Arms and Fuse Co., Inc., Bloomfield, N. J.

Thomas B. Dickerson is now acting superintendent of shops of the Central Railroad of New Jersey with office at Elizabeth, N. J. He succeeds **G. L. Von Dorn,** resigned.

T. W. McBeath, formerly traveling foreman of the Canadian Government Railways, with office at Moncton, N. B., has been appointed master mechanic, with office at Moncton.

T. Devaney, formerly general foreman of the locomotive repair shop of the Toledo, St. Louis & Western R. R., has been appointed master mechanic, with office at Frankfort, Ind.

C. O. Davenport, formerly road foreman of engines of the Chicago, Burlington & Quincy R. R., with office at Alliance, Neb., has been made master mechanic, with office at Sterling, Colo.

R. A. Wentworth, until recently superintendent of the Saco-Lowell Shops, Lowell, Mass., has assumed the duties of assistant superintendent of the U. S. Cartridge Co. of the same city.

R. H. Dunbar, formerly mechanical engineer of the American Tube and Stamping Co., Bridgeport, Conn., has accepted a position with the Providence Engineering Corporation, Providence, R. I.

W. H. Winterrowd, formerly assistant chief mechanical engineer of the Canadian Pacific, has been made chief mechanical engineer, with office at Montreal, Que., succeeding **W. F. Woodhouse.**

John E. Lovely, formerly connected with the Vermont Farm Machine Co., Bellows Falls, Vt., is now with the Jones & Lamson Machine Co., Springfield, Vt.

V. J. Mohler is now factory manager of the Moore Motor Vehicle Co., having offices at Danville, Ill. He was assistant manager of factories of the C. J. Tagliabue Manufacturing Co., Brooklyn, N. Y.

Charles T. Merrill, formerly assistant chief draftsman of the Draper Corporation, Hopedale, Mass., has entered the engineering department of the James Hunter Machine Co., North Adams, Mass.

J. W. Reynolds has been appointed blacksmith foreman of the Southern Pacific R. R., with office at Tucson, Ariz., succeeding **J. G. Ayers,** who was promoted to a similar position at Portland, Ore.

Dwight K. Bartlett, until recently assistant treasurer of the Builders' Iron Foundry, Providence, R. I., is now with the Electro Bleaching Gas Co. and the Niagara Alkali Co., with headquarters in New York.

E. C. Anderson, formerly mechanical engineer of the Colorado & Southern R. R., with headquarters at Denver, Colo., is now assistant mechanical engineer of the Chicago, Burlington & Quincy R. R., with office at Chicago, Ill.

M. J. Powers, formerly master mechanic of the Denver & Rio Grande R. R., Colorado lines, with office at Denver, Colo., has been appointed superintendent of motive power of the Colorado Midland, with office at Colorado Springs, Colo.

H. P. Anderson, formerly mechanical engineer of the Missouri, Kansas & Texas R. R., has been made superintendent of motive power, with headquarters at Densiion, Tex. He succeeds **F. W. Taylor,** who has been promoted to be general manager, with headquarters at Parsons, Kan.

J. M. Riordan, recently sales engineer of the Grant Lees Gear Co., Cleveland, Ohio, and formerly representing the Fellows Gear Shaper Co., Springfield, Vt., in the central states, is now connected with the sales organization of the Cleveland Milling Machine Co., 18511 Euclid Ave., Cleveland, Ohio.

Erford J. Peebles has resigned his position as production engineer of the New Haven Clock Co., New Haven, Conn., to take a position with C. E. Knoeppel & Co., New York. He has been assigned to industrial-engineering duties for the Emergency Fleet Corporation, United States Shipping Board, Washington, D. C.

A. L. Roberts, formerly mechanical engineer of the Lehigh Valley R. R., was recently promoted to be master mechanic, with office at Wilkes-Barre, Pa., and **J. P. Laux,** formerly master mechanic, with office at Sayre, Penn., has been transferred to South Easton, Penn., and **E. J. Kleinkauf,** formerly general foreman at South Easton, has been appointed master mechanic at Sayre, succeeding Mr. Laux.

Business Items

S. A. Potter Tool and Machine Works is the new name of the De Mant Tool and Machine Co., Inc. The company is located at 79 East 130th St., New York.

The Aborn Steel Co., Inc., 22 Clarke St., New York, has opened an office in 520 Marine Bank Building, Buffalo, N. Y. The Buffalo Section is in charge of D. J. Mahoney as district manager for the Aborn Co. and the Century Steel Works.

The American Graphite Co., a subsidiary of the Joseph Dixon Crucible Co., Jersey City, N. J., at its annual election elected the following officers: George T. Smith, president; George E. Long, vice president; J. H. Schermerhorn, treasurer; Harry Dailey, secretary. The directorate is the same as that of Joseph Dixon Crucible Co.

The Joseph Dixon Crucible Co., Jersey City, N. J., at its annual and regular meeting of the stockholders on Monday, Apr. 15, the following officers were elected: George T. Smith, president; George E. Long and J. H. Schermerhorn, vice presidents; Harry Dailey, secretary; William Koester, treasurer; Albert Norris, assistant secretary and assistant treasurer. George T. Smith, William G. Bumsted, J. H. Schermerhorn, George E. Long, Edward L. Young, Harry Dailey and Robert E. Jennings, directors.

Trade Catalogs

Pure Sheet Nickel. Driver-Harris Co., Harrison, N. J. This is an extensive bulletin on the subject of sheet nickel.

Ball Bearings for Fractional Horsepower Motors. The Norman Co. of America, 1790 Broadway, New York City. Folder $3\frac{1}{2}$ x $6\frac{1}{2}$ inches.

"Nickrome." Driver-Harris Co., Harrison, N. J. Bulletin on "Nickrome" wire-mesh containers for heat treating and acid cleaning processes.

Loway Adjustable Stock Support. A. F. Way Co., Inc., Hartford, Conn. Circular. $4\frac{1}{4}$ x $7\frac{1}{4}$. Describes an adjustable support for supporting the ends of long rods, etc., while being worked upon.

Link-Belt Roller Chain. Link-Belt Co., Philadelphia, Chicago, Indianapolis. Book No. 358. Pp. 16; 6 x 9 in.; illustrated. This book gives preliminary information on recent roller-chain developments.

The Modern Motor-Driven Scraping Outfit. Modern Manufacturing Co., 75 Third St., Bridgeport, Conn. Circular. Pp. 4; $8\frac{1}{2}$ x 11 in. This circular gives a description of a motor-driven scraper outfit which is designed to do away with hand-scraping work on aluminum and brass castings. The burrs are held in a hand piece and are driven through a flexible shaft. They are made in a number of different styles and sizes so as to get into corners or other irregularities in the work.

Ludlum Steel. Ludlum Steel Co., Watervliet, N. Y. Catalog. Pp. 156; $4\frac{3}{4}$ x $6\frac{3}{4}$ in. Cloth bound. This catalog contains information concerning the manufacture of steel and the use of various alloy elements. It deals with the effects of the alloys, change of properties, grain size, structure of steel, etc. It also gives correct forging and hardening temperatures for the various steels. The language employed throughout the catalog is that of the shopman and not the metallurgist. This catalog and treatise on the allotrophy of steel and the alloying of steel is for distribution free of charge.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City. The May meeting, at which the subject of labor turnover will be discussed, will be held on Tuesday, May 21. G. R. Woods of the Allied Machinery Co. of America will be chairman of the meeting.

American Society of Mechanical Engineers. Spring meeting at Worcester, Mass., June 4, 5, 6 and 7, with headquarters at the Hotel Bancroft.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The next convention and exhibit of the Georgia Retail Hardware Association will be held at Savannah, Ga., June 4, 5 and 6, 1918, with the Savannah Hotel as headquarters. Exhibits and convention sessions will be held in the new municipal auditorium on Barnard St. Walter Harlan, 44 Boulevard Circle, Atlanta, Ga., is secretary of the association.

The National Gas Engine Association will hold its eleventh annual meeting at the Hotel Sherman, Chicago, Ill., June 3 and 4. The headquarters of the association are at Lakemont, N. Y.

The spring convention of the National Machine Tool Builders' Association for 1918 will be held Thursday and Friday, May 16 and 17, at the Marlborough-Blenheim Hotel, Atlantic City, N. J. Charles L. Taylor of Hartford, Conn., is secretary.

A joint convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held at Cleveland, Ohio, May 15-17. Among the important subjects to come up for action will be Government control of fuel, transportation and shipping of materials and price fixing. The coöperation of labor in war activities will also be discussed at length.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers, 29 West 39th St., New York. Summer meeting to be held at Dayton, Ohio, June 17-18. Complete war program, at least half of it being devoted to the actual demonstration of war apparatus. All meetings will be held at Triangle Park, a dinner being served Monday evening and luncheons each noon. Reservations may be secured at hotels Miami, Holden, Algonquin, Phillips and Bechel, or by writing the Dayton S. A. E. Committee, 137 North Ludlow St., Dayton, Ohio.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

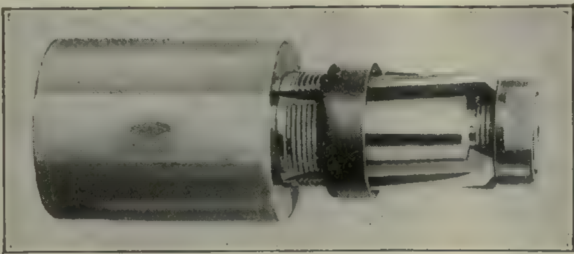
Western Society of Engineers, Chicago, retary, 1735 Monadnock Block, Chicago, Ill. Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, sec-

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Condensed-Clipping Index of Equipment

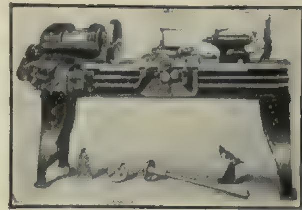
Clip, paste on 3 x 5-in. cards and file as desired

Reamers, Expanding
Wetmore Mechanical Laboratory Co., Milwaukee, Wis.
"American Machinist," May 2, 1918



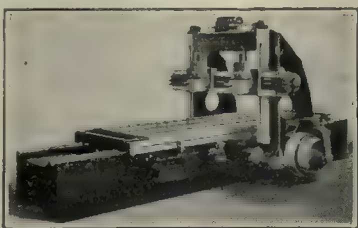
An expanding reamer of the floating type to fit a 3-in. turret hole for finish-sizing fuse holes on 155-mm. shells. Is self-centering and the blades are set on a left-hand angle. Expansion is accomplished by means of two ground nuts, and the blades may be removed and replaced without taking the tool apart. Centers are provided.

Lathe
Willard Machine Tool Co., Cincinnati, Ohio
"American Machinist," May 2, 1918



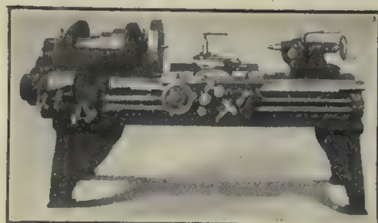
This company has made a number of improvements in the Willard lathe since taking over the Willard Machine and Tool Co. A quick-change box has been incorporated, being bolted to the front of the bed. Its alignment is assured by means of tongues machined to the bed. One lever operating the tumbler gear gives 40 different feeds, while a second lever gives three gear ratios and reverse. Other feeds may be obtained by changing the gears at the end of the bed. All gears in the feed box are of steel, and shafts are supported at both ends. A new headstock has been incorporated. It has a bearing of 21½ in. on the bed. Carriage bearing on Vs, 18 in. Taper gibs are used on all sliding surfaces and micrometer dials are used throughout.

Planing Machine, 36-Inch
Liberty Machine Tool Co., Hamilton, Ohio.
"American Machinist," May 2, 1918



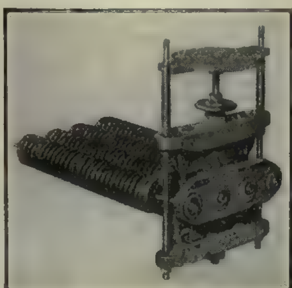
The bed extends to the floor and the top is closed in between the Vs, except through the gearing section, which is reinforced with girths. Bearings are provided with bronze wearing surfaces and wick oiling is used. Housings are of box section, extend to the floor and are secured in place with taper plugs and bolts. Pads are provided in order that motor brackets can be attached at any time. The feeds may be changed while the machine is in motion, and an index dial enables the operator to set the feed to the required amount.

Lathe, 16-In. Production
Hamilton Machine Tool Co., Hamilton, Ohio
"American Machinist," May 2, 1918



Swing over shears, 18½ in.; swing over compound rest, 11¾ in.; length between centers with 6-ft. bed, 36 in.; front spindle bearing, 3⅛ x 5¼ in.; rear spindle bearing, 2½ x 3¾ in.; hole through spindle, 1½ in.; spindle nose threaded, 2 11/16 x 6 U. S. S.; ratio of back gear, 10 to 1; tail spindle, 2 1/16 in. diameter, 10-in. traverse; spindle speeds, 6 to 450 r.p.m.; threads cut 2 to 112, including 11½; revolutions of spindle for 1 in. of carriage travel, 7 to 392; length of carriage bearing on shears, 27 in.; size of tools, ⅝ x 1 in.; capacity of steadyrest, 5½ in.; weight with 6-ft. bed, 3480 lb.

Pressure Toggle for Presses
R. F. King, Monadnock Block, Chicago, Ill.
"American Machinist," May 2, 1918



This pressure toggle is for the purpose of regulating the pressure exerted on the work during the stroke of the press. The device may be so adjusted that the pressure will remain constant during the entire stroke or so that the pressure will increase or decrease toward the latter end of the stroke. The device is attached to the bolster plate with two rods and is left stationary, while the plate supporting the drawing pins is moved up or down for adjustment to the length of the pins by means of the handwheel. Blanking or other push-through work may be done without removing the toggle. Built in two sizes, 5000- and 10,000-lb.

Drilling Machine
Buckeye Tool and Machine Co., New Philadelphia, Ohio
"American Machinist," May 2, 1918

Height, 94 in.; drills to center of 27 in.; maximum distance spindle to base, 50 in.; maximum distance spindle to table, 33 in.; traverse of table on column, 18½ in.; movement of head on column, 22 in.; movement of spindle in head, 12 in.; diameter of spindle, 2 to 2⅛ in.; diameter of sleeve, 3⅜ in.; diameter of column, 9 in.; slot in spindle nose, ⅜, ½ in.; diameter of table, 22 in.; feeds, six, 0.006 to 0.048 in. per spindle revolution; speeds, eighteen, 16 to 500 r.p.m.; size of pulleys, 12 x 4 in.; floor space, 30 x 40 in.; weight 2500 lb.; taper in spindle, Morse No. 4.

Light Holder, "New York Universal"
Light Holder Manufacturing Co., 79 East 130th St., New York City
"American Machinist," May 9, 1918

This device is for holding electric lights in such position as to allow workmen to illuminate the work to best advantage. Made in several styles, designed to be supported from the floor, bench or other machine parts. By means of swivel movements and telescoping rods a universal adjustment is secured. A spring yoke is provided at the end for holding the ordinary lamp socket. The bases are interchangeable so that various style holders may be used.

Furnace, Bench No 118
The Johnson Gas Appliance Co., Cedar Rapids, Iowa
"American Machinist," May 9. 1918

Suitable for machine-shop and toolroom work. The fuel used is gas, and it is claimed that a temperature of from 1400 to 1800 deg. F. is obtainable without the use of a forced-air blast. The plate in the front of the furnace is removable, which is also true of the melting pot placed in the top. The side door can be dropped so that all of the heat can be concentrated in the chamber, and the heating of long rods is permitted by opening the side doors on the hood and passing the work directly through. The furnace will heat 20 lb. of soft metal at a time or soldering irons up to 14 lb. to the pair.

WEEKLY PRICE GUIDE O

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	$38.00
No. 2X, New York	34.25	.....	43.00
No. 2 Northern Foundry, Chicago	33.00	37.00	42.00
*Bessemer, Pittsburgh	36.15	37.25	44.95
*Basic, Pittsburgh	32.00	33.95	42.00
No. 2X, Philadelphia	34.25	33.75	42.50
*No. 2, Valley	33.00	33.95	42.00
No. 2 Southern Cincinnati	35.90	35.90	40.90
Basic, Eastern Pennsylvania	32.75	33.75	38.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4.195	$4.195	$5.00	$4.20	$5.00	$4.20	$4.50
Soft steel bars	4.095	4.095	4.75	4.20	5.00	4.10	5.00
Soft steel bar shapes	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Plates, ¼ to 1 in. thick	4.445	4.445	7.00	4.20	7.00	4.45	6.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$3.60
Warehouse, New York	4.70	4.25
Warehouse, Cleveland	4.10	4.00
Warehouse, Chicago	4.10	3.90

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	5.00	6.445	6.445	9.00	6.385	7.75	6.45	7.50
*No. 26 black	4.90	6.345	6.345	8.90	6.285	7.65	6.35	7.40
*Nos. 22 and 24 black	4.85	6.295	6.295	8.85	6.235	7.60	6.30	7.35
Nos. 18 and 20 black	4.80	6.245	6.245	8.80	6.185	7.55	6.25	7.30
No. 16 blue annealed	4.45	5.645	5.645	8.50	5.585	7.20	5.65	6.70
No. 14 blue annealed	4.35	5.545	5.545	8.40	5.485	7.10	5.55	6.60
No 10 blue annealed	4.25	5.445	5.445	8.30	5.385	7.00	5.45	6.50
*No. 28 galvanized	6.25	7.695	7.695	10.25	7.635	9.00	7.70	9.00
*No. 26 galvanized	5.95	7.395	7.395	9.95	7.335	8.20	7.40	8.70
No. 24 galvanized	5.80	7.245	7.245	9.80	7.185	8.55	7.40	8.55

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 10%	List plus 25%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 5%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Current	One Year Ago
New York	$15.00	$13.00
Chicago	15.00	10.00
Cleveland	18.50	12.30

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 3/32 and No. 10	
⅛	
No. 12	
5/64, No. 14 and 1/16	
No. 18	
No. 20	

Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

***Special Welding Wire**

⅛	33.00
5/32	30.00
3/16	38 00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel	7.50	8.00	7.50
Spring steel (crucible analysis	11.00	11.25	11.00
Coppered bessemer rods	9.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel	9.00	8.25	8.50
Floor plates	6.19½	6.00	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
BUTT WELD					
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD. EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			
LAP WELD. EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	41.9%	26.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	37.9%	23.9%

Malleable fittings. Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	33.00
Tin, in 5-ton lots	98.00	85.00	65.00
Lead	6.62½	7.25	10.50
Spelter	7.25	7.50	9.75

*Government price.

ST. LOUIS

	Current	One Month Ago	One Year Ago
Lead	6.42½	7.10	10.50
Spelter	7.00	7.25	9.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	31.50-33.00	32.00	44.00	35.00	42.00	31.50	43.00
Copper wire (carload lots)	32.00	32.00	39.50	34.00	41.00	31.00	40.00
Brass sheets	30.75	30.75	45.50	30.00	43.00	30.00	43.50
Brass pipe base	36.50	36.50	47.50	41.00	50.00	40.00	47.50
Solder ½ and ½ (case lots)	62.00	62.00	39.50	51.25	36.50	60.00	35.50

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	28.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

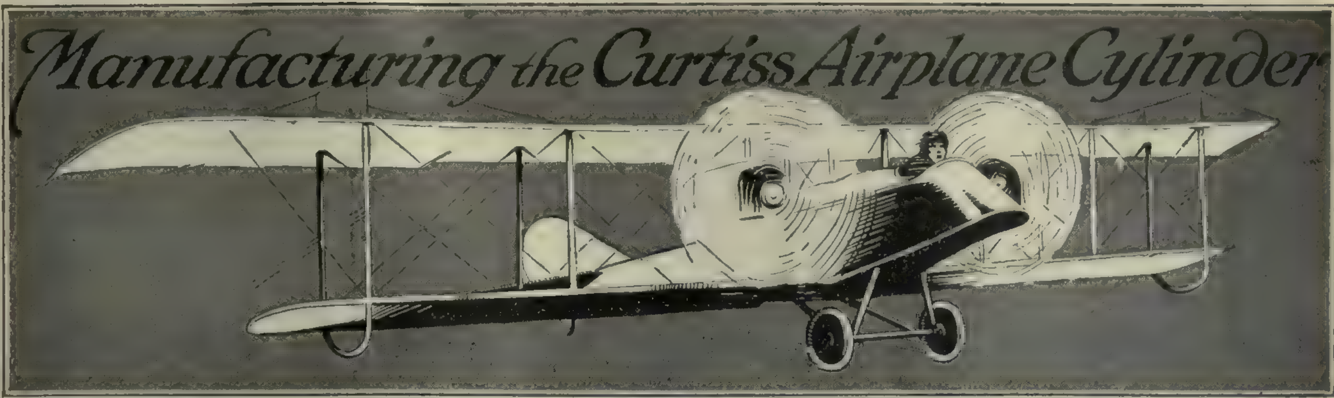
Carload lots f.o.b. mill 19.00

	In Casks Current	In Casks One Year Ago	Broken Lots Current	Broken Lots One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	20.00	23.00	20.50	23.25
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	13.50	22.00
Chicago	14.00	27.00
Cleveland	15.00	36.00

Manufacturing the Curtiss Airplane Cylinder



By G. D. RANGER

Factory Manager Standard Gauge Steel Co.

Now that so much interest is centered in the manufacture of airplane engines a description of successful methods installed by men at the Standard Gauge Steel Co., Beaver Falls, Penn., for the production of one type of Curtiss airplane cylinder may be of assistance to those contemplating the manufacture of similar cylinders. The following article covers the operations in their sequence, but for obvious reasons omission has been made of specific sizes and other data.

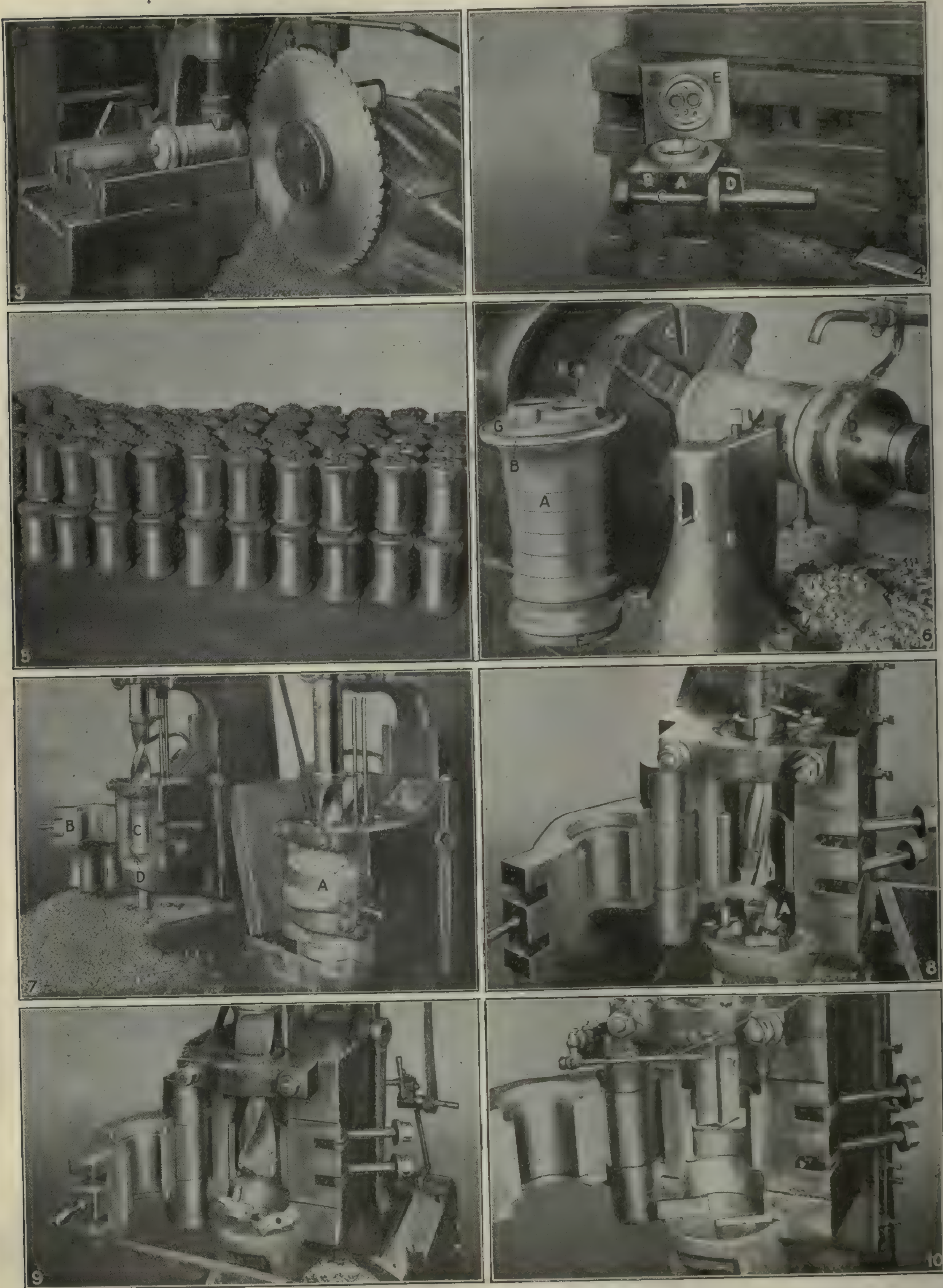
THE rough blanks ready for making the cylinder forgings are shown in Fig. 1. These are cut from long bars, of which six at a time are placed in the furnace to heat preparatory to drawing out the tong holds. In Fig. 2 the cylinder forgings are shown as they come from the rolling die. The rolling dies are used in a 4500-lb. steam hammer. The forge men turn or roll the forging after each stroke of the hammer, anywhere from 40 to 350 strokes being necessary to finish the work in this operation. The tong holds and extruded shank caused by rolling are then cut off by a cold saw, as shown in Fig. 3. The forging is then ready for upsetting and forging the head, in which the valve seats are formed. The die for this operation is shown in Fig. 4. The part that holds the body is made in halves *A* and *B*, which are held together by a hinge at the back and a bar *C* and wedge *D* at the front. The upper die *E*, which is carried by the steam-hammer ram, makes the impression for the cylinder head. In Fig. 5 are shown the finished forgings for the cylinders, which when annealed are ready for the first machine operation. It may be mentioned in passing that these forgings in the rough weigh a trifle over 100 lb. each and that the finished cylinder weighs about 9 lb The loss in scrap is therefore a trifle over 90 per cent.

At *A*, in Fig. 6, is shown one of the cylinder forgings ready for the rough-turning operation, the object of which is to remove the flash *B* on the cylinder head. This operation is done on an ordinary engine lathe provided with a four-jawed chuck *C*, a revolving tail center *D* and special toolpost *E*. The pilot *F* is gripped by the chuck while the revolving tail center *D* sets on the bulge *G* on the head of the cylinder. During this operation the body of the cylinder is also brought to nearly uniform size so that it will fit the chuck used on the drilling machine in the next operation. In our work we use one of the commercial cutting compounds for lubricating the cut.

The cylinder forgings now pass to the drilling operations shown in Figs. 7, 8, 9 and 10. These operations are carried on in Colburn and Baker drilling machines. The first drill is 2¼ in. in diameter, the second 3½ in., and the third 4¾ in. The final operation on these machines is finishing the bottom of the inside of the cylinder with the bottoming tool shown in Fig. 10. The bodies of the drills are of special carbon steel with inserted bits of high-speed steel. There was at first some trouble caused by the breaking of the feed mechanism, owing to the heavy duty imposed upon the drills. This was overcome by the introduction of a safety device in

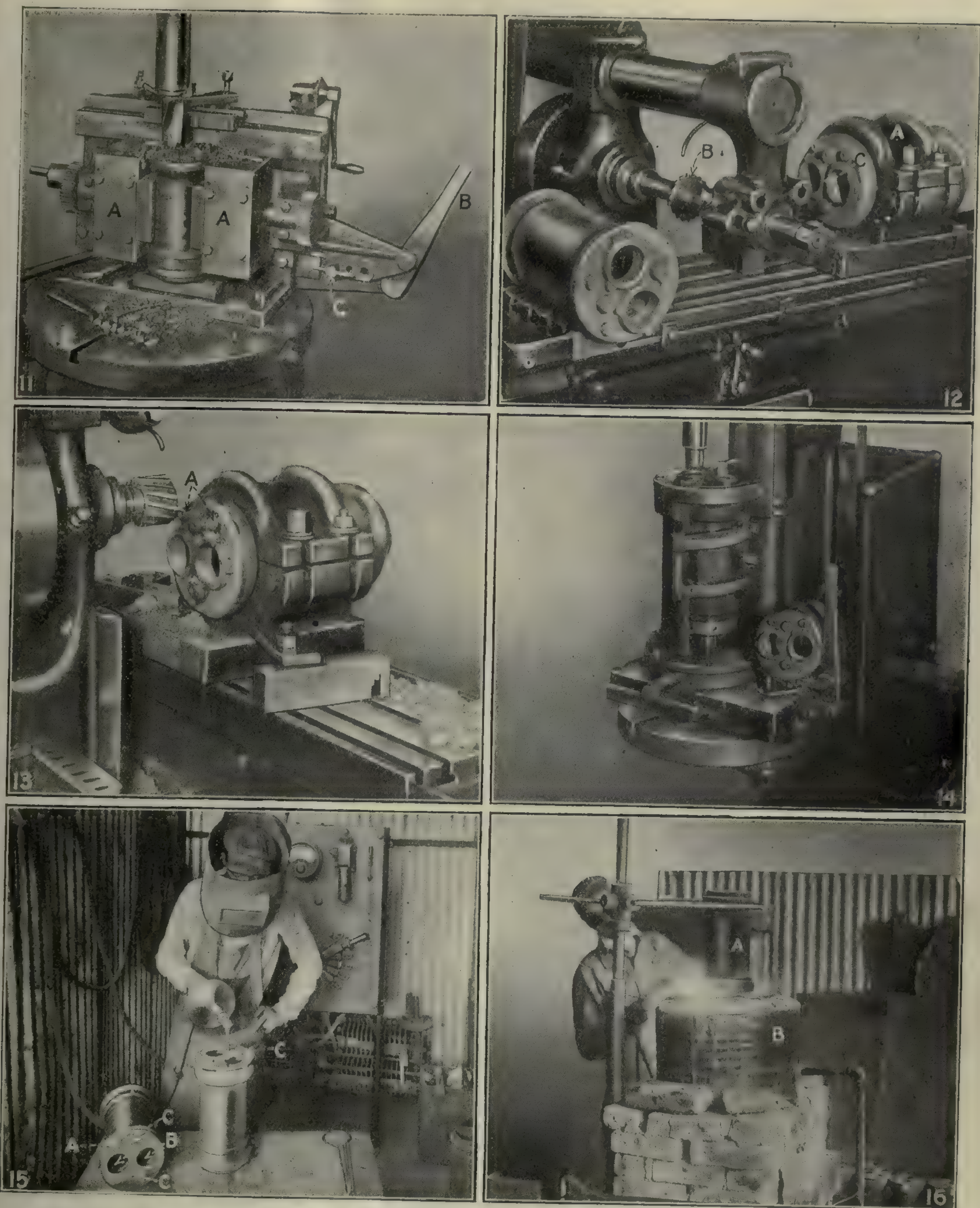
FIGS. 1 AND 2—ROUGH AND FINISHED FORGINGS

Fig. 1—Rough blanks cutoff and tong holds forged. Fig. 2—Forgings as they come from the rolling dies



FIGS. 3 TO 10. CUTTING OFF HEADING DIES, DRILLING OPERATIONS

Fig. 3—Cutting off the scrap ends. Fig. 4—The heading die. Fig. 5—Forgings in the rough (weight, 100 lb. each). Fig. 6—Rough turn and remove flash. Fig. 7—Drilling the cylinder bore. Fig. 8—Bottoming tools for first hole. Fig. 9—Drill with high-speed tip for larger hole. Fig. 10—Bottoming tool.



FIGS. 11 TO 16. DRILLING, MILLING, WELDING AND BRAZING

Fig. 11—Drilling valve openings. Fig. 12—Milling between valve flanges. Fig. 13—Milling ends of rocker-arm bosses. Fig. 14—Hollow-milling vertical flanges around valve openings. Fig. 15—Welding the top plate. Fig. 16—Brazing the top plate.

the form of a shearing pin, and since its adoption there has been no trouble with broken feed mechanisms.

Referring to Fig. 7 in the foreground at *A* is shown a chuck, closed, with a cylinder forging in place and the drill in operation. At *B* is shown the chuck and at *C* the forging. It will be noted that guide bushings are provided for the drills close to where the drill enters the work. The cylinder rests on a space block *D*, so that there is no possibility of the drill pressure forcing the forging vertically out of its correct position in the chuck. Such displacement would result in holes of various depths in the forging.

Figs. 8 and 9 show the two types of inserted bits used. The one in Fig. 8 is for bottoming the first drilled hole; that shown in Fig. 9 is for drilling the larger hole, and the one shown in Fig. 10 is for bottoming the larger hole. Figs. 8 and 10 clearly show the construction of the chuck, and in Fig. 8, at *A*, the height block on which the cylinder rests will be readily seen.

The valve openings are drilled in the next operation, shown in Fig. 11. The forging is held in a vise, the jaws *A* of which are opened and closed by a right-and-left-hand screw. The drill is guided in this operation by the vertical flanges of the valve openings forged in the cylinder head. The vise and work are traversed on a slide at the back by means of the lever *B*. The index pin *C* locks the slides and work in position for drilling.

On completion of this operation the rough-drilled work goes to the heat-treating department. After being heat treated the work is set up on the clamp jig *A*, Fig. 12, and located, as shown, with relation to the cutter *B* to mill the space *C* between the flanges of the valve openings. The object of this is to insure proper circulation of cooling water when the cylinder is completed.

The next operation is milling the top of the rocker-arm bosses *A*, Fig. 13. For this operation the same jig is used as that shown in Fig. 12. The vertical flanges which surround the valve openings are finished on their outsides by a hollow-milling operation, shown in Fig. 14. This operation in our works is termed "rousting." For this an index jig is used in a vertical drilling machine. The object of this operation is to prepare the work for the reception of a plate in the next operation. This plate is of ¼-in. boiler steel, and forms the outer wall of the water jacket at the top of the cylinder. The plate *A*, Fig. 15, is provided with two large holes *B*, fitting the hollow-milled vertical flanges completed in the previous operation, and two smaller holes for the reception of the bosses, which later will be drilled and tapped for the spark plugs. The operator is shown welding the plate in place by means of a G.E. electric arc-welding outfit. The object of thus welding the plates is to insure their holding in position without the use of a jig during the subsequent operation of brazing which insures a watertight joint between the top plate and the cylinder. The work next undergoes a brazing operation as shown in Fig. 16. The work *A* is supported, as shown, so that the part to be brazed can be preheated by the air and gas torches within *B*. The operator tests the opening between the two valve flanges with the flame of his torch; that is to say if the flame passes through, the opening is clear. The plate where it comes in contact with the cylinder is thoroughly brazed with copper wire, borax and boric acid being used as fluxes. The work is now pickled to remove scale and burnt borax.

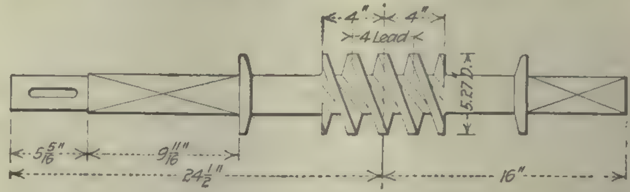
Cutting a Worm of Rapid Lead

By C. T. Brunson

After reading of some of the methods employed by others in cutting screw threads of very coarse pitch, when the lathe available is not especially adapted to this class of work, the writer desires to describe the means he used to accomplish this purpose.

The cut shows the pieces required, the threaded portions of which were a trifle over 5¼ in. in diameter with double Acme thread of 4-in. lead. The only lathe available was a 32-in. Pond with a four-pitch lead screw and a rather weak train of change gears; therefore the problem assumed formidable proportions until the following method was evolved.

The forgings were rough turned all over and then finish turned at all points between the faces of the collars, leaving the outside ends ⅛ in. large. We next made a bushing 14 in. long by 5 in. in diameter and bored it



THE WORM TO BE CUT

to a slip fit over the long end of the forging, drilling and tapping it for ten ⅝-in. hollow-head setscrews. The bushing was then cut with a double square thread of 4-in. lead, the same as the worm to be cut.

With this master screw, as it had now become, in place on one of the forgings a casting suitably chambered to receive babbitt was placed over the screw and bolted to the carriage and a babbitt nut cast around the master screw.

With this arrangement we were able to proceed with the thread cutting in a very satisfactory manner, even less trouble being experienced than if a lathe with suitable lead screw and gearing had been used, for if the dog slipped no harm was done as the work and the master screw stopped or revolved together.

After one thread of the worm was cut it was necessary only to run the nut off the master screw and enter it upon the other lead in order to cut the other thread. As the smallest diameter of the nut would go over the tail spindle this could be done without releasing the work from the centers.

Summer Meeting of Society of Automotive Engineers

The Society of Automotive Engineers, 29 West 39th St., New York, will hold its summer meeting at Dayton, Ohio, June 17-18, 1918. The program will be a war one from beginning to end, and instead of consisting chiefly of technical papers at least half of it will be given over to the demonstration and exhibition of war apparatus. Airplane engines from all the countries at war will be exhibited. There will be demonstrations of machinery for the manufacture of airplane propellers, airplane wings and for firing machine guns in synchronism with propeller blades; there will also be exhibitions of formation flying, night flying, etc. A dinner will be held on Monday evening with President Kettering as toastmaster, and a number of men will be present from the French front. All meetings will be held at Triangle Park and luncheon will be served each day. The Dayton S. A. E. Committee, 137 North Ludlow St., Dayton, Ohio, will be glad to give assistance in securing hotel accommodations for members. The committee on arrangements is David Beecroft, chairman, Herbert Chase, F. E. Moskovic, F. E. Place and Carl F. Scott.

The Relining of Guns at the Watervliet Arsenal

Part Three

By E. A. Suverkrop

THE following is a series of extracts from the findings of a board convened at Watertown arsenal pursuant to Special Order No. 153, War Department, July 1, 1907, and Special Order No. 300, War Department, December, 1907. The extracts comprise appendices A and B referred to in the two preceding articles.

APPENDIX A

Referring to the rupture of 12-in. gun No. 41, model 1888, MI½; 10-in. gun No. 55, model 1888, MII, and 8-in. gun No. 1, model 1888, the board said in part:

Ten-inch gun No. 55, model 1888, MII, had been fired only 101 rounds when the rupture occurred, although many of these rounds were fired at an excessive pressure. The rupture consisted of a crack beginning at the muzzle end and extending to about 57 in. from this point and there intersecting another crack, making an angle with the first of about 70 deg. The second crack had a total length in the direction of the axis of the gun of approximately 76 in., 36 in. of which was immediately in the rear of the abrupt curve which joined the first crack and coincided with the forcing side of the land; the rear portion changed direction and crossed both land and grooves. The wide angle at the intersection indicated that they were of separate origin. This was substantiated by examination of the fracture, which showed that this crack originated near the bore at the first shoulder from the muzzle while the second originated near the bore at the second shoulder. A third crack extended from a point about 55 in. from the muzzle to the rear, a total distance of approximately 73 in. The first 52 in. of this crack coincided with the forcing side of the land. All of these cracks extended through the wall of the tube. Other similar cracks also existed and coincided with the forcing side of the land. This investigation showed the danger to be expected from unrestricted thermal cracks. The effect of the thermal cracks on the ductility of the metal was marked, the expansion of the mandrel ring containing the defective metal being only 0.1 per cent. at the time of the rupture, whereas the mandrel test of the adjacent metal in which the defective metal was removed developed an elongation of 14.9 per cent., the ring still being unbroken. The 8-in. gun mentioned had been fired 388 rounds and disclosed numerous thermal cracks. The principal section of rupture in the muzzle portion of this gun followed the forcing side of the land for a distance of nearly 8 feet.

Method of determining the effect upon a compound section of a 10-in. gun, model 1888, after it has been heated to a temperature of 700 deg. F., and cooled on the exterior.—In Fig. 4 is illustrated a section of a 10-in. gun, model 1888, MII, cut off just in the rear of the trunnions. The locations of the holes in which the temperatures were taken are shown.

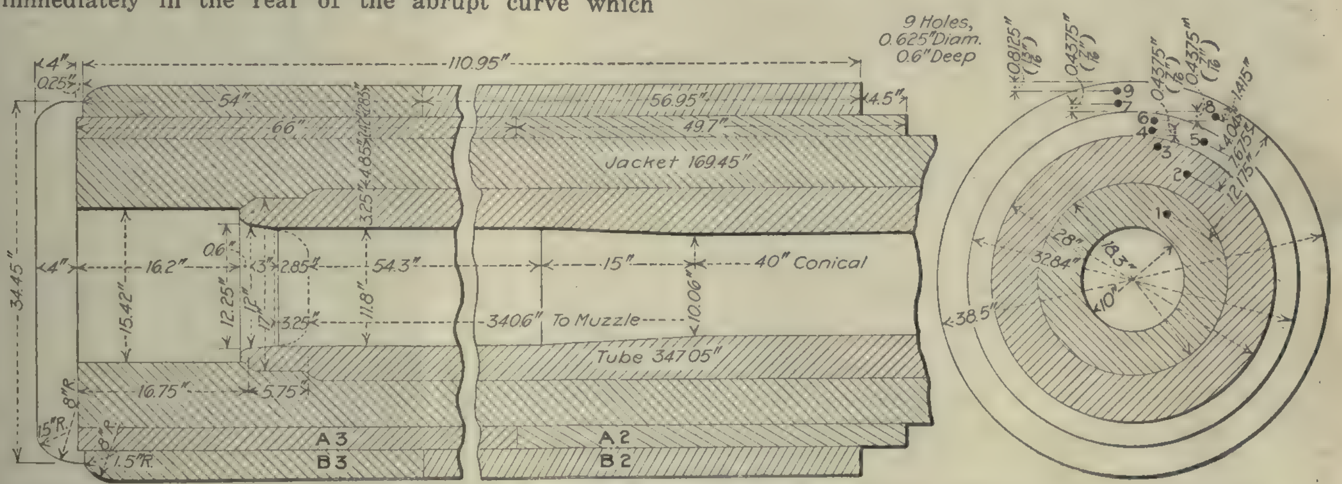


FIG. 4. SECTION OF 10-IN. GUN

1. Section to be star gaged 1 in. apart for its total length.

2. Section to be measured 2 in. apart on exterior diameter.

3. All diametrical measurements to be made at right angles to each other.

4. The total length of section to be marked 5 in. apart to note any extension after cooling.

5. Section to be heated to a temperature of 700 deg. F. for nine hours. After removal from furnace it will

be placed muzzle upward within the shrink pit on a stand provided.

6. Four rings will be used for cooling, which will be placed together and as near the top of the section as possible. To prevent water from coming in contact with the thermometers or entering their recesses a galvanized-iron sheeting will be placed upon the muzzle end of the section.

7. The thermometers to be placed in the four holes designated by the officer in charge of the tests before the water is turned on, and asbestos packed between the thermometer recesses to prevent any effect from the outside atmosphere. Simultaneous readings will be made before the water is turned on and differences noted.

8. Readings will be made every minute thereafter unless orders to the contrary are given.

9. The inside diameter of the section will be taken by the inspector before the water is turned on at a distance of 6 in. from the muzzle end. These measurements will be repeated every minute and tabulated.

10. After the gun is cooled the outside will be measured and the inside star gaged at the corresponding points taken before the test was made. Any change in the length of the section will likewise be noted.

11. Careful observation will be made while the water is being applied to note any openings which may occur between the respective hoops of the compound cylinder.

Appendix B

Experiments conducted at Watervliet Arsenal to determine the effect of cooling the exterior of a built-up gun during shrinkage operations.—When the looseness (previously mentioned) of D1 hoop on 12-in. navy guns Nos. 62, 65 and 66 was discovered steps were immediately taken to investigate the causes of this condition. The physical qualities of this hoop when delivered by the manufacturers were as indicated by the following figures:

Marks	Elastic Limit	Tensile Strength	Elongation	Contraction	Character
M. I.	68,240	102,880	19.5	40.67	Dense gray lipped
C.	68,240	102,880	20	39.16	Irregular gray
O.	70,280	103,890	20	43.74	Dense gray lipped

It was thought that heating the guns to 700 deg. and cooling on the exterior caused the outer D1 hoop to contract to such a degree that its elastic limit was passed before the interior mass of metal had become sufficiently affected by the cooling to permit the whole body to come down together. The manner of applying water on

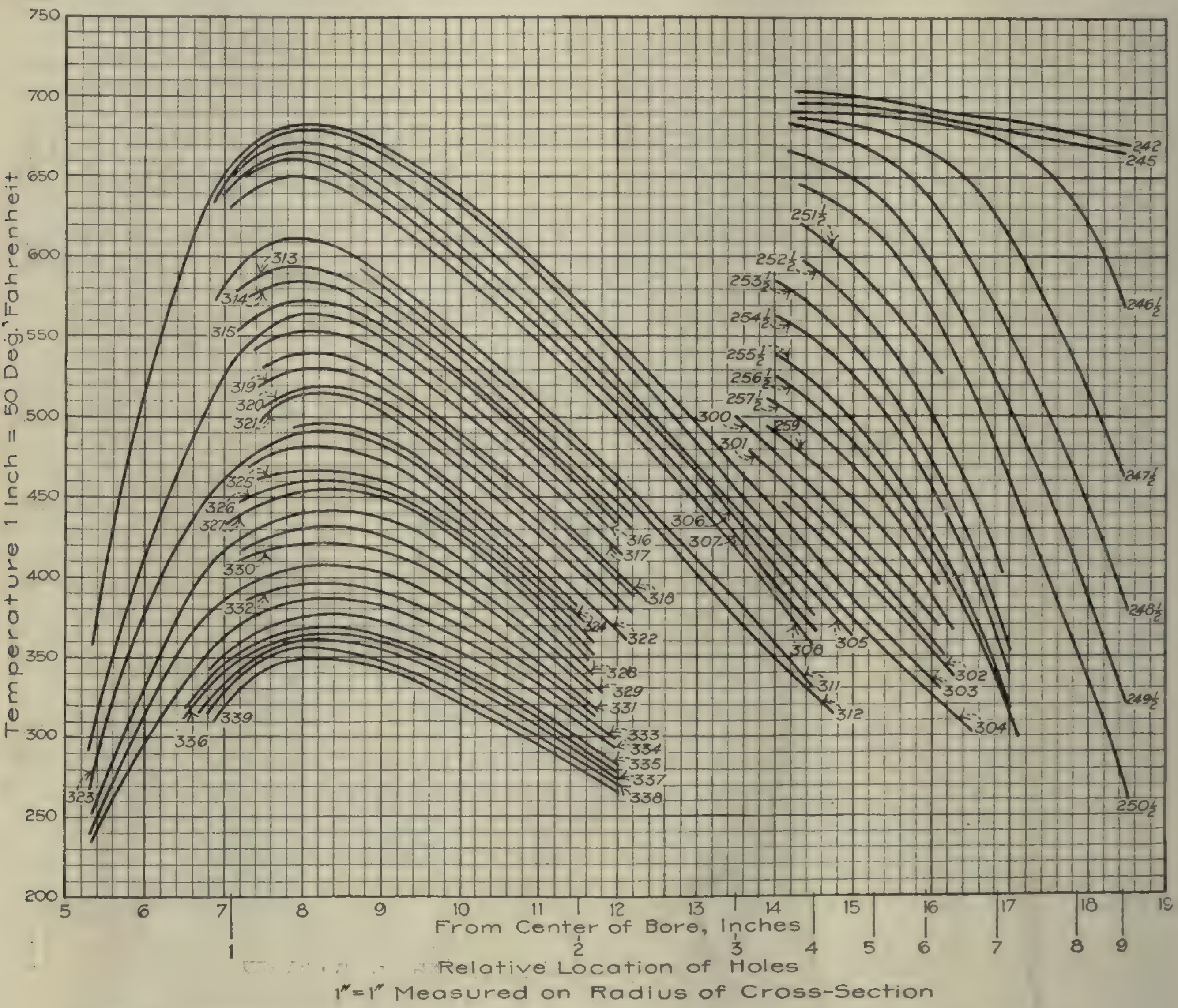


FIG. 5. TEMPERATURES IN THE GUN METAL WHEN COLD WATER WAS APPLIED TO EXTERIOR

the navy gun was duplicated on an available section of a 10-in. gun, model 1888, MII, No. 55. This gun had developed a cracked tube and had been returned to this arsenal. The primary idea was to note the change in temperature of a hot mass of metal upon the application of cold water. It was especially desired to note the change in temperature, if any, between the layers of metal, and for this reason holes 6 and 7 and 3 and 4, Fig. 4, were drilled as close as possible to adjoining surfaces. Readings were made one minute apart where possible. As soon as the temperature in any particular hole dropped below the 300-deg. mark (which was the minimum mark on the thermometer) the thermometer was removed and a record obtained in some other available hole. The results are shown in Fig. 5 on which the abscissæ represent to scale the location of the holes and the curves the temperatures throughout the metal obtained by taking simultaneous readings. The interior temperatures were deduced from exterior measurements taken at the time of reading the thermometers.

After the section of the gun was completely cold it was noted that the forward exterior hoop, or the B2 hoop, had lost its shrink on the A2 and A3 hoops located beneath it to such a degree that afterward, when the section was annealed at 1000 deg. F., this hoop started to slip from the body of the section. The exterior hoops seemed to be generally loose. The star gaging of this piece, after it had been heated to 700 deg. F. and cooled as above described, showed that the bore from the breech end to a point 6 in. from the forward end had decreased in diameter 0.003 to 0.006 in. At a point 6 in. from the forward end the diameter was normal. From this point to the forward end the bore had enlarged slightly. This latter increase might be explained by the number of holes drilled in this end, which weakened the hoops and allowed them to enlarge. The exterior diameter of the hoops increased an average amount of 0.013 in. The greatest increase at any point was 0.0213 in. There was no change in longitudinal dimensions.

Place of Shrinkage

A parting out was made through the exterior B2 hoop 5 in. from its forward end. This piece was easily slipped off, showing that all of the original shrinkage had been destroyed. The piece was placed in the furnace and annealed at 800 deg. for four and one-half hours. This was to ascertain whether there would be any change in the diameter of this section. Owing to the peculiar manner in which this section was treated, causing an increase in diameter, it was thought that perhaps there might be a tendency to return to its original dimensions. After this annealing it was measured on the interior and exterior. The results were as follows:

The interior decreased in diameter on an average of 0.012 in., while the exterior decreased a corresponding amount. This ring was eventually annealed at 1000 deg. for seven hours and fifteen minutes, after which it was left to cool in the furnace. The results after cooling were as follows: The interior diameter did not change, while the exterior increased 0.003 in. This ring was afterward heated to 800 deg. and cooled by quenching on the inside with cold water to see if any change would result. Under this treatment the interior diameter enlarged approximately 0.003 in. and the exterior a corresponding amount.

Another ring 1 in. in thickness was cut from the muzzle end of the B2 hoop still remaining on the section and test specimens were obtained. This short cylinder was easily slipped off.

Standard test specimens were obtained. The physical qualities resulting were as follows:

No.	Elastic Limit	Tensile Strength	Elongation	Contraction	
1	59,000	103,000	20.5	46.6	Average modulus of elasticity, 28,000,000
2	61,000	105,700	20.5	44.5	
3	60,000	101,150	25.5	48.3	
4	60,000	102,150	22.5	49.5	

It was noted when the first slotting cut was made in this ring, and when it was approximately $\frac{1}{16}$ in. from being entirely cut through, that the remaining metal was crushed, showing that there were heavy strains of elongation in the piece.

Another ring $\frac{1}{2}$ in. in length was similarly cut from the B2 hoop, punched and accurately measured, as indicated in Fig. 6. It was then placed in a vertical boring mill and ring *A*, Fig. 6, removed. The piece was again accurately measured and ring *B* removed. This was continued until the four rings were separated, extra care being taken that the punch marks were protected during machining to insure correct measurements. The resulting measurements are recorded. It will be observed that the interior metal was under an elongation strain corresponding to a stress of 16,140 lb. per sq.in. while the exterior metal was compressed 15,683 lb. per sq.in. This would probably have been greater had it been possible to cut rings of less radial thickness, but owing to the difficulty of taking measurements and the possibility of introducing cutting strains this was not thought advisable.

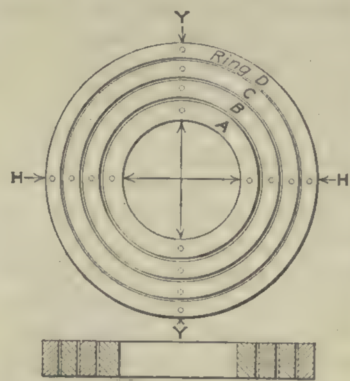


FIG. 6. SLICE CUT FROM OUTER HOOP

The remaining section of the 10-in. gun was placed in the furnace and annealed at 1000 deg. F. for seven and a half hours at the same time as the 5-in. cylinder previously mentioned. The object of this was to note whether the exterior hoops would tend to decrease in diameter and regain some of their original shrinkage. After cooling, the B2 hoop was so loose that when it was removed from the furnace it slipped longitudinally from the hoop it covered. The B2 and B3 hoops had generally become smaller on their exterior under this treatment, the amounts being 0.01625 in. at 10 in., 0.009 in. at 18 in., 0.006 in. at 24 in., 0.0055 in. at 36 in. and 0.0015 in. at 75 in., all measurements being made from the muzzle end of the section. The interior diameter of the section did not change appreciably at the only place measured, which was at about 12 in. from the muzzle end. The remainder of the bore was not gaged. It will be noted that the exterior and bore attempted under this annealing to come back to their original dimensions.

Unfortunately the exterior of the D1 hoop of the 12-in. navy gun No. 62 was not measured before the

shrinkage of the liner, as nothing unusual was anticipated and it was not thought necessary. After the shrinkage of the liner the measurements were taken and they were found to be all less than the prescribed diameters, the greatest discrepancy being 0.025 in. The prescribed exterior diameter, according to the drawing, is 48.5 in., but there is often a tolerance given, so that this dimension cannot be accurately relied upon. As soon as it was noted that the error could not be corrected by physical methods, such as annealing or cooling on the inside, it was decided to remove the D1 hoop of this gun. The gun was placed in the furnace, the upper part of which was removed. A sufficient number of mufflers on the lower section were removed in order to cause the flame from the burners to strike the hoop. Four burners were used, and after they had been in operation for 42 min., while the gun was being moved upward and downward and turned so as to get a uniform heat, the hoop dropped off. It was started by pounding on the side with heavy rods, but it is thought that this only expedited its release. Provision was made beforehand to permit it to drop only a short distance, when it was caught on timbers resting on top of the heavy mufflers. After removing the D1 hoop the exterior was again measured, and the results showed that the D1 hoop had enlarged a maximum of 0.0055 in. at the breech end and 0.007 in. at the extreme muzzle end. The middle of the hoop had decreased 0.006 in. The dimensions between the middle and ends of the hoop were graded between these results. The interior of the hoop was star gaged, and the results showed that the hoop had lost nearly all of its original shrinkage of 0.041 in. The bore of the hoop exceeded the diameter of the shrinkage surface by amounts varying from 0.02 in. at the breech end to 0 at 28 in. from this end. From this point to a point 69 in. from the breech end there was a slight shrinkage, the maximum being approximately 0.0045 in. There was no shrinkage from this latter point to the muzzle end of the hoop, the diameter of the bore exceeding that of the shrinkage surface at one point by 0.0145 in. Thus it will be seen that the original shrinkage of this hoop had been almost completely lost. The hoop was then annealed at 1000 deg. F. and left to cool in the furnace. The bore decreased in diameter over its total length 0.021 in. at the breech end, 0.004 in. at the middle and 0.011 in. at the muzzle end, with proportional amounts between. The exterior decreased in diameter 0.0185 in. at the breech end, 0.005 in. at the middle and 0.0145 in. at the muzzle end with proportional amounts between.

Condition of C4 Hoop

The C4 hoop on gun No. 62 (the same gun) was also thought to be loose over all, and was known to be loose at its muzzle or locked end. It was removed from the gun in a similar manner, requiring 1 hr. and 10 min. to effect its removal.

The original shrinkage was 0.048 in. to 0.05 in. for this hoop. The shrinkage found to exist after its removal varied from 0.02 in. to 0.0375 in., except at its forward or locked end, where the diameter of the bore exceeded that of the shrinkage surface. This was the thin end of the hoop and was particularly susceptible to the action of the cold water. The original prescribed shrinkage was probably relieved somewhat when this hoop was turned after assembling, as considerable metal was removed from the gun at this locality.

Gun No. 65 had its D1 hoop removed for a similar reason. It required 39 min. to effect its removal. It was found that a considerable shrinkage had still been retained by this hoop, being at some localities as much as 0.0255 in. The retained shrinkage was less toward the muzzle and breech ends of the hoop and greatest in the middle.

The D1 hoop on gun No. 66 was next removed. It required 1 hr. and 26 min. to effect its removal. It had retained a large percentage of its original shrinkage. The bore of the hoop at its middle point was 0.032 in. less than its shrinkage surface. The retained shrinkage reduced toward the breech to 0.023 in. and toward the muzzle to 0.005 in. The increase in diameters of the bores of guns Nos. 65 and 66 after their hoops were removed was marked.

All of these hoops were bored true, the shrinkage surfaces turned down and the original shrinkage met by winding one layer of ⅛-in. square gun wire over the section covered by the hoops. The hoops were then again shrunk on and the guns issued for service.

An Emergency Reamer

By M. L. Lowrey

In the small job shop we get some strange work to do and have to do the best we can with the available equipment. Recently a seemingly impossible thing was so sucessfully accomplished in our shop that I think it worthy of notice in the *American Machinist.* In a hurry-up repair job it was necessary to ream four 3.005 in.-diameter holes in a gray-iron casting about 8 in. thick. These could be a plus-or-minus limit of 0.001 in. in diameter, but the holes must be round and straight. The casting, because of its size and shape, could not be handled in any lathe or boring mill we had, nor could the holes be bored with a bar without a lot of extra work, so I decided to drill and ream them. As we did not have an expanding reamer a mild-steel taper mandrel was fitted to a worn-out 3-in.-shell reamer, the mandrel being turned about 3 in. further than it would go into the reamer. A split bushing was then made to fill up the chamber in the center of reamer so that with this split bushing in place the hole in the reamer was a true taper hole.

The bushing was then sprung into the reamer, and both being brought to a good red heat the taper mandrel was driven in as quickly as possible until the reamer was stretched as much as was thought to be necessary. The reamer was then tempered, a new bar made for it, and it was ground to fit a collar that had been bored to 3.005 in. A test collar was then reamed, which proved to be right size. I did not grind the hole in the reamer nor the face of the flutes as would have been done if there had been sufficient time. By the time the reamer was ready the first hole in the casting had been drilled and reamed with a 3-in. standard reamer. The oversize reamer was then put through and the other holes machined in like manner. On installing this casting (in a hydraulic press) the job was found to be perfectly satisfactory and it was done in much less time than was anticipated.

Strains and Overexertion

BY CHESLA C. SHERLOCK

No inconsiderable amount of industrial loss is due to strains and overexertion. Workmen are daily suffering injuries from these causes, and because of their frequency employers are often at a loss to know just what duty is imposed upon them in regard thereto by the law.

THERE has always been more or less contention in the courts over the liability of an employer for injuries suffered by an employee through strain, or overexertion. This contention has not materially changed since the advent of the workmen's compensation acts, due to the wording of the acts themselves.

The court and commissions, in construing the compensation acts, have been called upon to determine whether or not a strain, or overexertion, producing incapacity is an accident within the meaning of the word used in the acts. In a Wisconsin case the court held that a violent straining of the muscles, resulting in a rupture or other bodily hurt from overphysical exertion in performing work, is included within the term accident used in the workmen's compensation laws. Therefore muscular spasm caused by the straining of the muscles of the right side while attempting to lift a heavy cement block is an accident within the meaning of the Wisconsin act.

Some difficulty arises in cases where it is shown that prior to the strain, or overexertion, the workman suffered from weakness or disease. Thus a workman may be suffering from disability in a certain member and through overexertion die because of the strain upon that member. Should the employer be charged with the payment of compensation and bear the loss? The Michigan court has said: "The presence of a structural weakness or actual pain antedating the injury alleged, in the region where the injury occurred, does not preclude a recovery if the injury itself is distinct and the result of a particular strain causing a sudden protrusion of the intestine."

Hernia a Cause for Compensation

In another Michigan case the facts disclosed that while the claimant was assisting another in moving a gasoline engine weighing some 600 lb. he suddenly had pain in his left groin, noticed a small swelling in the groin that night, consulted a physician, was advised that he had hernia and was operated upon for hernia. A physician, the first consulted on the witness stand by the claimant, testified that in his opinion the hernia was caused by the strain in moving the engine; that when he first examined the claimant he was able to reduce the hernia with his finger; that there were no adhesions, and that his conclusion was that this was a new and not an old hernia. The operating surgeon was of the opinion that the hernia was produced by the exertion described by the claimant. All the experts seemed to agree that the visible evidence of the hernia was the protrusion through the inguinal ring of the peritoneum and its contents and that "the hernia is the peritoneum going through, accompanied by the intestines or some other substance."

The testimony for the defense was to the effect that the peritoneum is incapable of sudden, and is capable of very gradual, extension; that the sudden complete development of hernia in a pathological sense is impossible, but the hernia may be felt—the sudden projection of the hernial contents into the preformed sac—for the first time during a straining effort. Various medical authorities to which the court was referred appeared to sustain the proposition that hernia is of slow formation and can never arise from a single augmentation of intra-abdominal tension, however great it may be. This proposition was not denied by the claimant's experts; they regarded the condition which they found as caused by the strain and exertion of the claimant.

Classifying Injuries

Said the court: "The Michigan law does not award compensation for all personal injuries suffered by an employee, but for accidental injuries only. Was it an accidental injury within the meaning of the law? It has been said of the expression 'accident' and 'accidental' employed in an act having a similar purpose to ours that they were used in their popular and ordinary meaning. Happening by chance; unexpectedly taking place; not according to the usual course of things, or not as expected. 'If a result is such as follows from ordinary means voluntarily employed and in a not unusual or unexpected way it cannot be called a result effected by accidental means; . . . but that if in the act which precedes the injury something unforeseen, unexpected, unusual occurs which produces the injury, then the injury has resulted through accidental means.' (Quoting the United States Supreme Court.)

"'It has been held that death resulting from a ruptured artery was not accidental when the rupture occurred while the insured was reaching from a chair to close a window, did not slip or fall or lose his balance, and nothing unforeseen occurred except the bursting of the artery.' (Quoting the Iowa Supreme Court.)

"An examination of cases arising principally upon accident-insurance policies discloses that in the opinions which seem to be best considered the distinction is observed between the means by which an injury is produced and the result of the producing cause or causes. It is not sufficient that there be an unusual or unanticipated result; the means must be accidental—involuntary and unintended. There must too be some proximate connection between accidental means and the injurious result.

"The statute seems to contemplate that an accidental injury may result by mere mischance; that accidental injuries may be due to carelessness, not wilful; to fatigue, and to miscalculations of the effects of voluntary action."

The court decided that in this case the strain producing the hernia was an accident, but declined to announce the decision as a rule, saying that it decided the case at hand only.

The only justification for quoting this case at length is that it presents in a very clear way the new idea that is persistently creeping into the decisions of courts and commissions; namely, that hernia is a disease and not an accident. The courts are having a hard time to distinguish between their former decisions and this well-recognized medical fact. Just how long it will be before the precedents will be overturned and the decisions handed down with the opposite opinions is a matter of conjecture.

The court, in considering the preceding case, mentioned another Michigan case where the claimant received a hernia while attempting to open a window in the room of the factory where he worked. A brief consideration of this case by the court will show how it was decided.

The window in question had been put down during a storm and had swollen enough to make it stick, and it required considerable effort to put it up again. The claimant testified that after lifting the window he "felt something come down that felt quite painful;" that "when I felt the pain after lifting the window I went to the toilet and found a lump there. The lump was about the size of an egg. It was on my right groin. I never noticed the lump before."

When asked whether he noticed any condition that made him think he had hernia he answered: "It came down Friday night. I got it back Saturday, and Sunday it stayed in place. On Monday when I went to work it came out again." Claimant did not work Saturday or Sunday, but returned to his usual work on Monday and suffered pain all day. On reaching home that night the doctor was called, and after some effort the hernia was reduced. A necessary operation was performed and the claimant was disabled for ten weeks. The court found that the rule had been established in Michigan that hernia was an accident, and gave compensation accordingly.

A New York Case

In a New York case a workman suffered from the result of a cerebral hemorrhage induced by overexertion. Claimant's physician testified that the injury was "rupture of cerebral artery on right side, producing a clot of blood on the brain and causing complete paralysis of the left side."

The Industrial Commission had found "that while claimant was working for his employer at the employer's plant and was assisting another employee in lifting a barrel weighing about 200 lb. he was seized with a stroke of apoplexy by reason of the strain occasioned by the lifting of the heavy barrel. By reason of the apoplexy that portion of the brain in which the apoplexy was seated became degenerated, and while the claimant gradually recovered from the motor paralysis of the left side, which immediately followed the apoplexy, there remained a deterioration of his mental faculties due to the above-mentioned degeneration, by reason of which apoplexy and degeneration the claimant was disabled from working from the date of accident to the date hereof and is still disabled."

In reviewing this finding, it was held by the court that the injuries were accidental and arose out of and in the course of the employment. The opinion was affirmed and compensation granted.

In Massachusetts the claimant was helping to load ashes on a wagon. The ashes were in barrels and the men threw a barrel as high as they could, but the teamster failed to catch it and it slipped down suddenly. In attempting to steady the barrel the claimant "felt a wrench in the back of his neck," and as a result of the strain he lost the sight of his left eye. The evidence as to the happening of the accident was undisputed. The medical testimony was such as to indicate that the strain would be an adequate cause for the injury to the eye. The court awarded compensation.

In an English case a fireman had an apoplectic stroke while raking out the fires, and it was shown that his arteries were in a diseased condition and that any exertion on his part might have induced a stroke, but the court found that the injury resulted from an accident within the meaning of the English act.

A Radical Decision

A workman in California was putting heavy timbers on a pile when he suddenly slipped and fell. He attempted to resume his work, but found that he could not move, and he was disabled for some time. A physician testified that it was impossible to state "the anatomic basis of the sciatic pain and the pain in the back complained of" and that most of the signs of sacroiliac trauma were lacking, but recommended treatment for a sacroiliac slip. Nevertheless the court held that the injury was an accident. This case is perhaps as radical as any handed down to date on the subject of strains, or overexertion. It only goes to show, however, the length to which the courts will go when the evidence shows beyond a doubt some unexpected event—in this instance the slipping or falling down.

In Canada a court made the following decision: "If an accident necessitates an operation and death ensues, even though it is not a natural or probable consequence, the death may, if the chain of causation is unbroken, be said to have in fact resulted from the injury."

In a New York case, a workman received a hernia while pushing a heavy truck about a factory. He went to a physician and was operated upon, but the ether caused pneumonia, which together with the shock of operation caused death. The court allowed compensation.

The claimant in another case was a mason's helper in Minnesota. He was going from one place of work to another, wheeling his tools in a wheelbarrow, the combined weight of which was about 150 lb., when he suddenly collapsed. The trial court found that the cause of the collapse was the sudden giving away, or rupture, of a blood vessel, "due to muscular strain and exertion employed by him in propelling said wheelbarrow." Compensation was allowed.

It is a well-settled rule in this country that compensation will be allowed where a preëxisting disease is aggravated or accelerated by strain, or overexertion, as will be proved by a decision rendered in a New York case where the deceased had chronic heart disease, the valves of the heart being thick and curled up, but where it was found that he came to his death through overexertion, award of compensation being affirmed.

These decisions of the courts of actual cases which are coming up every day in factories and manufacturing

establishments all over the country should be of great interest to employers. They do not involve unexpected or unusual situations, but the commonplace and the ordinary, and while it is quite uniformly understood that strains and overexertion producing incapacity are compensable the varied conditions surrounding each case do not permit of a fixed and arbitrary rule.

The trend of the decisions is toward compensation, with a slight leaning to the belief that hernia produced by strain is an impossibility as a traumatic injury, but more in the nature of a disease and therefore not compensable. This latter opinion, however, is not the general rule as yet.

The results of strains, or overexertions, have much to do with determining whether compensation is due in the particular case, and this can be determined only by a study of the decisions already announced by the courts.

Creating a Class of Super-Foremen

BY J. V. HUNTER

In all discussions on the preliminary planning of shop operations it would appear that to a great extent the writers would develop a race of super-foremen—at least they would be super in a superfluous sense because the member of a planning department accredited to a certain shop department would be the real acting head of that organization; he would virtually direct every move made by anyone under his supervision, and the foreman would become an unnecessary adjunct to the payroll.

IT MIGHT appear to the higher shop executive very simple to hire high-grade foremen who are competent to direct work by preliminary planning rather than to invite friction in the organization by adding an intermediary who would come between the executive superintendent and his departmental foreman. In fact the preliminary-planning organization which some organizers would create as a distinct body or department appears more in the light of a group organization of superintendents of each individual shop department. Each of these would be thoroughly familiar with all of the work, tools and equipment in his department, thoroughly capable of planning the work for his men, and qualified to administer discipline through his sub-foremen or straw bosses, as the shop foremen become when so subservient to a planning department.

Doubtless the idea of creating a planning department is to take intelligent or technical men and train them for this work in this department, but it is questionable whether it would not be far more satisfactory, with less probability for interorganization friction, to take promising candidates for the position of foreman and put them through an intensive training, each in the department for which he is qualified or experienced, to fit them for their work in general preliminary planning methods. The writer has been in some of our large modern shops where the shop foreman has on his own initiative taken this step, and with plenty of work and numbers of men to handle the foreman has trained one or more sub-foremen whose sole duty it was to do the preliminary work of planning the tools and operations for each piece of work.

Greater satisfaction would obtain among the younger men of a shop organization if they knew that due application would qualify them for advancement rather than to always see outsiders being trained for the task. A young man, shop trained, familiar with the parts of the various machines, and who had shown diligence in night-school classes, would probably require even a shorter period of training to qualify him to begin the preliminary planning of departmental work than would an outside man who had only a theoretical or technical education. Besides, the shop man, after being trained to hold a position, would be satisfied to do the work for a longer period.

The duty of training his foreman and department chiefs in these methods should devolve upon the superintendent. However, he is usually too busy to accomplish this properly, and generally he feels that he has done his duty when he calls the offending foreman "on the carpet," points out the failings of his department, censures him, gives him a very few instructions as to what he wants accomplished and lets him go back to the shop probably as unenlightened as before, but spurred by a burning sense of indignation and a desire to correct conditions just enough to avoid getting into trouble again.

Methods of Training

Now if the average foreman was competent to solve all these troubles and do all the planning for his department he would indeed be a superman; but the only way to reach that state is by long and careful training—regular schooling, in fact. Such training should be given to a foreman as schooling, but never to make him feel that he is being censured. He should be trained so that when problems arise, when the necessity for planning new work occurs he, as the man on the job, will be the one to whom to go for information; not to someone in a distant office who determines feeds and speeds with a slide rule and not knowing whether the scale on a lot of castings is exceptionally hard or whether or not the tool steel will stand up for that particular cut. A particular box tool breaks—who is going to put into immediate service another of different general type but giving the same results? Why, the foreman on the job, of course, not the slide-rule man in an office.

For a large shop or department the ideal plan would be to start such a man on preliminary planning as an assistant to the foreman. During certain hours each day the general superintendent, or preferably an assistant trained for this work, or a supervisor of preliminary planning, could hold intensive-training classes for one or two hours two or three times a week to instruct these qualified men and foremen, giving them only a general outline of the work and instructing them in the

details of how to plan and carry it out successfully. In addition each man must receive individual training and instructions in planning and the methods to apply to his own department. For this a short period every day or two—it need be no longer than the foreman usually spends in conferences—could be devoted to the training. The remainder of the man's time would be spent in the shop in order to familiarize himself by practice with the methods outlined.

Again, as assistant to the foreman, he would have the advantage of the older man's training and experience, and the plans made by their mutual consultations could be more readily put into effect. Should the older man be unable to improve and keep his department in trim the younger man could then be advanced without disturbing the organization; but should the older man always retain necessary executive ability to govern his shop he could use the younger man, or subforeman, to do the preliminary planning.

When an assistant foreman is made a foreman he should be required in the same way to train another to take his place in case of illness or other reason. One advantage in such shop-trained men is that they are not so likely to leave at a time when they begin to be of value.

The last alternative, that of going to outside organizations to do preliminary planning work, and briefly outlined by a previous writer, leaves the shop organization always relying for advice from an outsider, and it curtails the initiative spirit of its own men. While such a consulting business might in the beginning be developed by a few firms competent to advise, it would eventually lead to the formation of other consulting organizations, some of which would be no more competent to direct than the average shop foreman. Under such a system the manufacturer would be forced to carry the overhead and business-getting departments of an outside organization from his income which should be used to carry his own overhead; in other words, he would be paying outsiders for service, the cost of which should be devoted to the betterment of his necessary shop management.

Speeding Up the Old Blueprint Machine

By John S. Carpenter

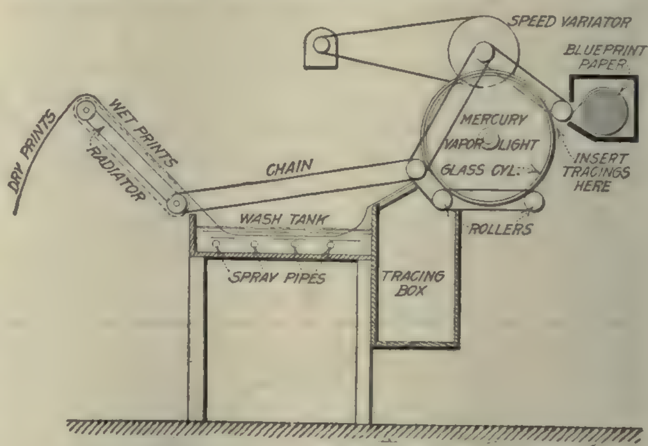
Associate Member American Society of Civil Engineers

In a shop where the writer was employed some time ago we had an electric blueprinting machine of the vertical glass-cylinder type with a contact cloth that had to be rolled back and forth for inserting the tracings. We had trouble with our blueprint boys, who left us at the rate of about seven a year, and a maximum day's work was about 275 prints. We needed nearly double this number at times, and when we appealed to the manager for another machine he wanted to know if we wanted another one of the same kind.

He observed the cutting of the paper, the rolling back and forth of the contact cloth, winding up the escapement machanism, getting the prints into the water, slushing them with a brush and then putting them on a rack to dry. Then he called the writer and said: "Let's make that thing continuous; let the printing, washing and drying be done by a motor so that all the boy needs to do is to put in the tracings, letting the prints come out dry at the other end where an extra boy can trim them."

After much sketching and discussion the continuous-printing machine shown in the illustration was evolved. The writer makes no claim to originality of design, but proposes to show how with little expense and by using material already at hand any blueprint machine of the type mentioned can be transformed into a machine of 100 per cent. efficiency. The general scheme only is shown, as space forbids details.

We procured a small slow-speed motor which we belted to a set of cone pulleys so arranged as to provide minute speed variations in order that the printing speed of the paper might be accommodated. The glass cylinder from the machine was mounted in a cradle formed by four felt-covered rolls of wood, which were driven at a common speed by means of bicycle



AN IMPROVISED BLUEPRINTING MACHINE

chain and sprockets, the sensitized paper being therefore at rest in respect to the cylinder and showed no tendency to slip. The tracings were inserted from below at the front of the machine and the entire width of the cylinder was kept covered.

In the wash tank the paper was sprayed from the under side by means of four pipes which were drilled with a row of small holes throughout their length. The spray coming from below caused considerable motion of the water and made the washing practically perfect, which fact was demonstrated by the non-fading qualities of the print when exposed to strong light.

The drier was made up of thin wood slats riveted at their ends to rubber belts. These belts ran over pulleys large enough to admit a steam radiator of about 100 sq.ft. area between the running parts of the belts, the radiator being set at an angle of 45 deg. with the wash tank so that the drip would run back into the tank. The drier was in fact a belt conveyor, as the wet prints would not stand any pulling. After passing over the drier the tracings were allowed to fall into a large box, and the blueprint was cut up into 6-ft. sections for trimming.

One might think that this machine would need a very intelligent person to run it, but the fact is that two colored boys at $4 per week ran it nicely.

On one occasion there was a lot of tables to print for new shop standards, etc., on 18 x 24-in. sheets. After eight hours' work the prints were counted and there were 996. Thus the capacity of "Big Liz" had been nearly quadrupled.

Industrial-Lighting Curtailment

By C. E. CLEWELL
Assistant Professor of Electrical Engineering University of Pennsylvania

This article discusses the question of coal conservation by means of several plans, and treats of the industrial-lighting field as one channel through which coal savings might be made were it not for the fact that the quantities of light now used for shop purposes are none too great and are often entirely inadequate. Expert opinion is used to show that reductions in the use of light may be considered of advantage in all the fields of lighting except that of the industries, where the opinion is that war conditions and the necessity of speeding output makes an increase rather than a reduction of light advisable at this time. The article may be looked upon as an unbiased statement of the shop-lighting situation in its relation to war conditions.

A GOOD deal of attention has been given during the past months to the question of coal conservation and, furthermore, to the saving of artificial light as one of the means for saving coal. The purpose of this article is to give some idea of the importance of plenty of light for the industries of the nation at this time, and to investigate whether or not it is to the present interests of the country to curtail the use of artificial light in the shop and factory at a time when the pressure upon the industries is unusually great, or whether it may not be a distinct advantage to improve shop-lighting conditions over and above the practice as it existed before the war.

The subject of the article, "Industrial Lighting Curtailment," may therefore be looked upon as being in the nature of a question, and the following notes are designed to give the reader a fair idea of the way in which experts throughout the country look upon the use of artificial light at this time for shop operations. One other point should be made clear at the outset. It refers to the two ways in which the word "curtailment" may be considered. Shop lighting may be conserved (a) by taking care to use lamps only when they are actually needed; that is, by turning off all the lamps promptly which may not actually be required, or (b) by cutting down the quantity of lighting furnished to the workmen for given classes of work.

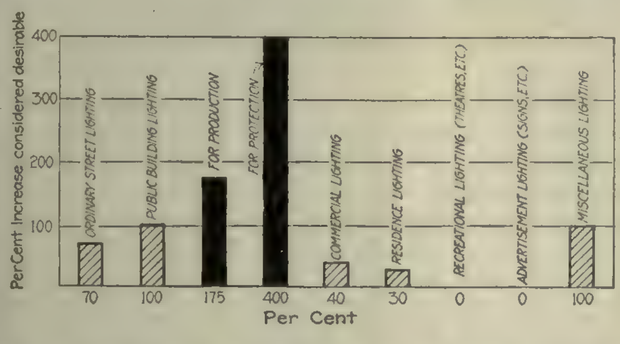


FIG. 1. DESIRABLE INCREASE OVER PRESENT LIGHTING
This chart shows by how much existing lighting should be increased at the present time, according to expert opinion, in comparison with practice just before the war

Economy in the use of shop lighting by not using the lamps longer than necessary, as outlined under (a), is a commendable policy not only now but at all times, and this feature in the management of shop-lighting systems has undoubtedly been referred to frequently in these columns during the past years. For example, clouds may obscure the sun for an hour or so on an otherwise clear day and practically all the lamps throughout the shop be turned on. There is always a risk that the lamps will be left burning after the sun comes out again unless someone is especially appointed to see that they are turned off. Waste of this kind should never be tolerated, and it is particularly to be avoided at a time like the present.

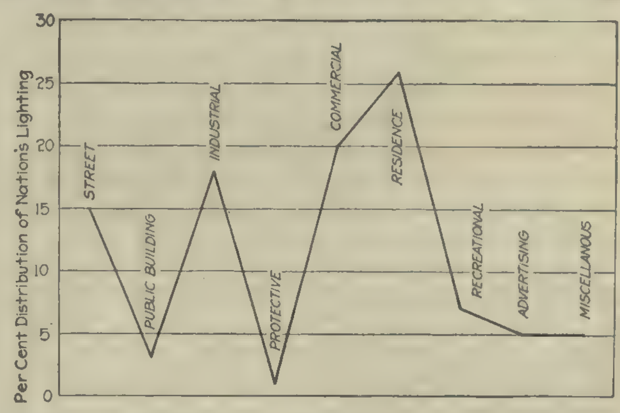


FIG. 2. PRESENT DISTRIBUTION OF LIGHTING
This curve shows the way in which the various fields of electric lighting are distributed in this country

However, when it comes to a question of light economy by means of scheme (b), then careful attention must be given to the matter of how the light is related to the efficiency of the shop, and also to such points as to whether the highest efficiency in the operation of the plant is being realized by the present quantities of light in use for given departments; whether a larger quantity of light might not increase production at a time when labor is scarce and when the necessity for speed in filling orders is of the utmost importance; and, finally, whether a reduction in the quantities of light as now used might not cause a far greater economic loss to the country at this time than could possibly be offset by the relatively small amount of fuel which could be conserved by such a course.

To summarize, therefore, this article is concerned chiefly with the question of quantities or intensities of the light at the work and with the further question whether this is a time for reducing or rather for increasing the light used in and around the shop. Hence in all that may be said the reader is asked to remember that the writer not only favors but urges all those who are in a position to do so to use every endeavor to conserve the use of light in the shop whenever it is not actually needed; likewise to remember that good light plays a most important part in production, and that it should never be curtailed at the expense of the

eyesight of the workingman and at the expense of his ability to do his work effectively, with a consequent risk of accidents in handling machinery and materials and with a tendency toward defective workmanship.

One of the most recent discussions of general interest to all branches of the lighting field is that of Preston S. Millar on the subject "Lighting Curtailment,"[1] in which the opinions of experts are used to show that in nearly all branches of artificial lighting the present ideas of desirable practice point to the wisdom of the use of larger quantities of artificial light than were in in use for this purpose before the war.

The Place Held Today by Industrial Lighting

Fig. 1 has thus been drawn to show graphically by how much lighting should be increased, according to expert opinion, in the various fields in comparison with the practice before the war. This chart shows the fact that for the best interests of efficiency in manufacture, the quantity of electric lighting used in the industries of this country for production should be increased by 175 per cent. over what was used before the war; and, furthermore, that the quantity of light used in and about industrial plants for protective measures should be increased by 400 per cent. over that in use for this purpose before the war.

This chart also shows that according to these same experts the percentage increases which should be put into effect are greater for these two uses in the industries than for the other branches of the lighting field. Two important conclusions may be drawn from these opinions: One is that in the past the quantity of light used for shop purposes on the average throughout the country has probably been very inadequate, and the other is that the present conditions which surround the industries call for more light than was required prior to the war. Our first general conclusion, therefore, is that from the viewpoint of the standards of

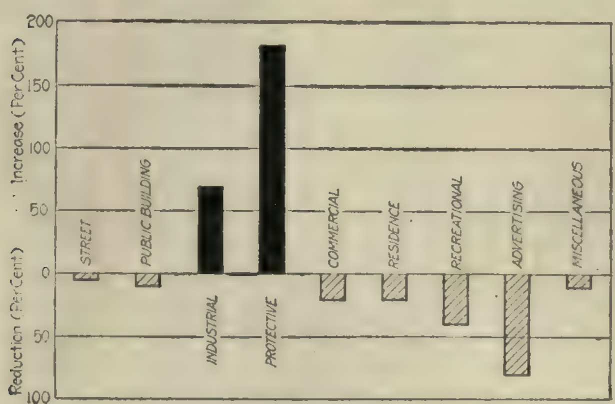


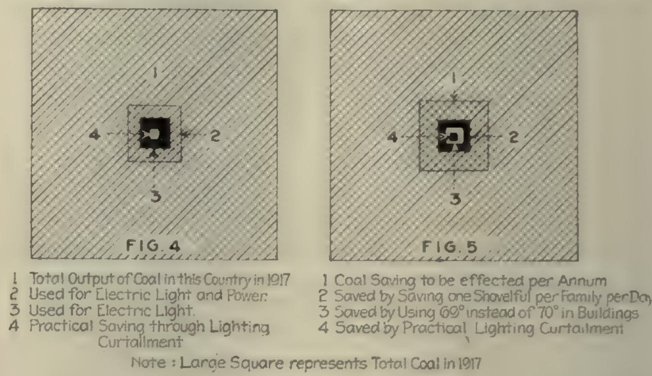
FIG. 3. DESIRED READJUSTMENT OF LIGHTING

This chart shows, according to expert opinion, what readjustments should be made to the standards which existed before the war. These readjustments are suggested in view of the war and due to the shortage in fuel

shop-lighting practice, and without any regard for the unusual conditions imposed by the war, the quantity of light in the industrial plants of the country should be increased by a large percentage.

[1]This paper was presented before a special meeting of the Illuminating Engineering Society in New York City on Feb. 14, 1918 Figs. 1, 2 and 3 have been designed by the writer on a basis of data found in this paper and Figs. 4 and 5 have been rearranged on a basis of diagrams found in the same paper. Frequent references have been made to Mr. Millar's paper with his permission in the preparation of this article.

This leads to another point along the lines of fuel conservation. If expert opinion indicates that to realize the most efficient shop conditions industrial lighting should be increased by these large percentages, then at a time when the utmost efforts are being made to obtain the greatest possible production in our plants, lighting, as one of the important factors in promoting production, should be brought up as nearly as can be



FIGS. 4 AND 5. DIAGRAMMATIC COMPARISON OF TOTAL COAL OUTPUT WITH AMOUNT USED FOR LIGHTING

Fig. 4.—This diagram shows graphically the comparison between the total coal output and the coal used for electric power and light. The smallest square shows the relatively small amount of coal which might be saved by practical lighting curtailment. Fig. 5.—Savings of coal which might be made in this country by various plans

to those standards which are considered essential to these ends. The problem then is not so much one of curtailment of industrial lighting as the extent to which these improvements can economically be made at this time.

Further along in these notes it will be shown that present opinion among experts favors a part improvement of industrial lighting; that is, an increase over conditions as they existed before the war, and that some curtailment may be practical in other branches of the lighting field which in a way may offset the larger quantities which are looked upon as desirable for manufacturing plants. In other words, as far as electric lighting is concerned, the industries may be considered today of greater importance than any other fields where light is used.

Turning now to Fig. 2, the place held by industrial lighting in comparison with other fields of lighting is graphically shown. Here it will be seen that with the two exceptions of commercial and residence lighting, the volume of light used in the industries is greater than in any of the other fields, forming about 18 per cent. of the total light used in the country. The amount of light used for protective purposes in and about industrial plants, while only about one per cent. of the total, is apparently a very important factor in the protective measures which have been found necessary at this time.

It is only fair to say in connection with Fig. 2 that the figures there given, showing the percentage distribution of light used in the various fields, are only roughly approximate because of a lack of accurate statistics on the subject. In a general way, however, Fig. 2 shows the approximate distribution, and it is thus helpful in gaining a bird's-eye view of the lighting field at this time, and more particularly for showing roughly the place held by shop lighting in terms of the total.

Mr. Millar, in connection with his paper on "Lighting Curtailment" referred to in the article, has sought to establish on a basis of expert opinion the branches of electric lighting in which reductions in the use of light might be made as a temporary measure in view of the war and of fuel shortage. A graphical tabulation of the result of this canvass among experts is shown in Fig. 3.

It is striking to note that the opinions of these 14 experts throughout the country favor a reduction in all the branches of lighting as a temporary move to conserve fuel on account of war conditions except in those of industrial lighting used for production and for protective purpose. In the case of the industries the opinions favor an increase in industrial lighting proper of 70 per cent. and an increase in protective lighting of 200 per cent. Referring back to Fig. 1 we find that experts consider that industrial lighting for production should be increased by 175 per cent. over the practice which existed prior to war merely to place the shop-lighting practice on a basis to meet the requirements of efficient production all over the country. Similarly protective lighting in and about the industries should be increased by 400 per cent. over the practice which was followed before the war in order to met the ideas of these experts as to what is a desirable quantity of light for this purpose. Fig. 3 shows, therefore, that present opinions favor only a part increase of industrial lighting at this time because of fuel shortage and war conditions, that is to say, an increase of 70 per cent. instead of 175 per cent. as given in Fig. 1, for industrial production lighting, and, an increase of 200 per cent. instead of 400 per cent. as given in Fig. 1 for protective lighting.

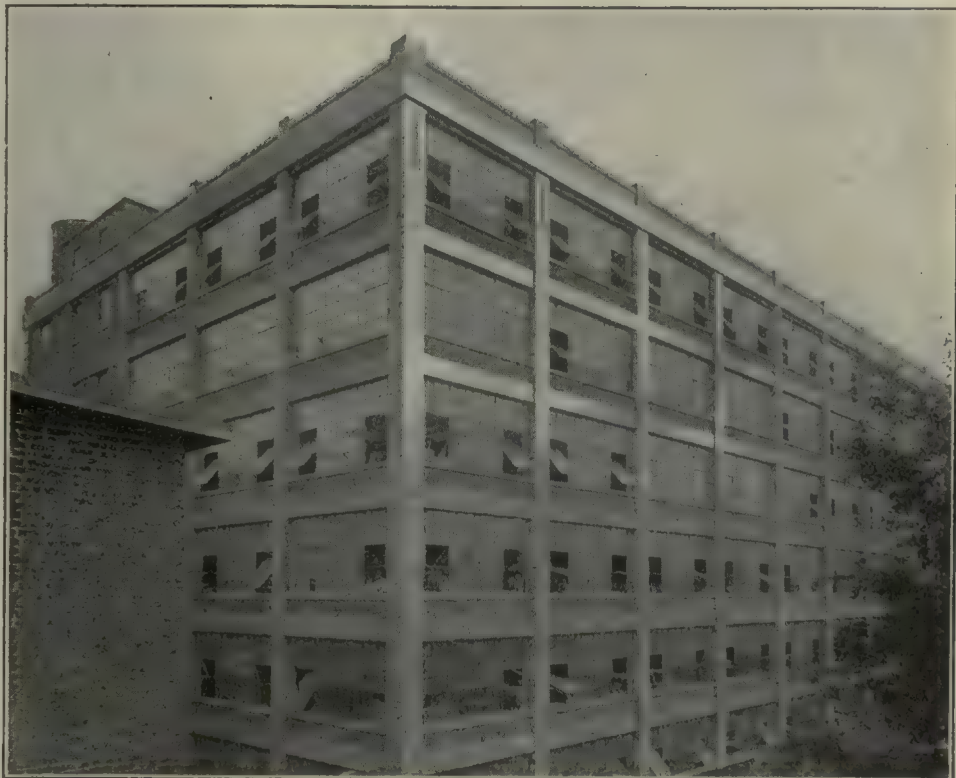


FIG. 6. A MODERN FACTORY DESIGNED TO ADMIT PLENTY OF DAYLIGHT

This data answers the first point which has been suggested by this article; namely, How far can the industries be expected to go at the present time toward the increases of light suggested by Fig. 1, when due account is taken of the fuel shortage and the peculiar situation which confronts the country due to the war? We may conclude that while lighting curtailment is well worth considering in seven of the nine branches of lighting outlined in Fig. 2, the industrial pressure demands that no limitations be placed upon the production rate by a curtailment of those factors which have a vital connection with the quantity and quality of work which can be turned out by the country's manufacturing plants.

Hence it would appear that a conservative increase in the amount of light for shop purposes is today of paramount importance and that whatever curtailment may be made in the use of light should rather be limited to those other branches of the lighting field which are indicated in Fig. 3. The net effect of increasing shop lighting by the percentages given in Fig. 3 and of curtailing the amount of light used in the remaining branches shown in this diagram would result in a saving of about 7 per cent. of the quantity of electric light used throughout the country. Millar gives the approximate coal consumption for electric lighting in 1917 at 12,000,000 tons as compared with a total output for the country in 1917 of 640,000,000 tons. A net saving of 7 per cent. in all branches of electric lighting would thus be equivalent to about 840,000 tons of coal annually. While a saving of this amount of coal is well worth while, the same authority points out that it is rather small when compared with the coal shortage of 50,000,000 tons, this being the total amount which must be saved in one way or another.

To give the reader a better basis for the comparison of these values we may state that according to Millar the following other channels present possibilities for coal conservation: (a) An estimated saving in coal (based on 1914 figures) of 13,000,000 tons per annum if all private generating-plant power were replaced by central-station power, (b) an estimated saving of 10,000,000 tons per annum if the temperature of building interiors was maintained at 67 deg. F. instead of 70 deg. F., (c) an estimated saving of 3,000,000 tons per annum if 69 deg. F. was maintained instead of 70 deg. F. for building interiors, and (d) an estimated saving of 15,000,000 tons per annum if each family throughout the country decreased by one shovelful its daily quantity of coal used.

The relative magnitudes of the quantities of coal

used per annum for electric light and power (not including that used for the operation of electric railways) and for electric light alone in terms of the total coal output for 1917 are shown in Fig. 4. This diagram also shows the amount of coal which might be saved by the net curtailment of lighting indicated by Fig. 3.

In Fig. 5 the relative magnitudes of several possible ways of saving coal are shown graphically in terms of the total coal output in 1917. In this diagram the largest square stands for the total coal output in 1917. A careful study of Figs. 4 and 5 will give a good idea of the approximate status of the coal-conservation situation.

The foregoing notes lead to a closer scrutiny of those factors in the shop-lighting problem which deserve unusual attention at this time. The reader may well ask why it is that expert opinion favors such marked increases in industrial lighting as are indicated by Figs. 1 and 3, whereas it favors the curtailment of lighting in the other fields as shown in Fig. 3.

Some idea may be gained of the way in which shop lighting is being viewed at present by the fact that in the organization of the committee on labor of the Advisory Council of National Defense there is a committee on lighting whose interests are mainly directed to the industries and their present needs. Moreover, no less than five states throughout the country are at this time either preparing or revising shop-lighting codes for enforcing higher standards of the quantities of light used in manufacturing plants and the ways in which the light is applied. These facts indicate an awakening to the importance of better shop lighting in a way and to an extent never before realized in the program of state legislation.

Furthermore, renewed efforts have been made for the definite determination of how good lighting is related to shop production. Thus tests have been made very recently in a machine shop of a large plant in Chicago which proved that production was increased from 8 to 27 per cent. when the quantity of light was increased from 4 to 12 units on the work. These tests included eight different shop operations and showed an average increase in production of 15 per cent. Figures of this kind have long been required in order to show to those shops which have lagged behind in the adoption of improved lighting that a failure to install an adequate system of lighting means a distinct loss in the output rate.

Hence, to quote from one of the author's published lectures on the subject of shop lighting, it is more important today than ever before to consider carefully that good factory lighting possesses the following

FIG. 7. PRODUCTION IN THIS SHOP SHOULD NOT BE CURTAILED AT NIGHT BY INSUFFICIENT ILLUMINATION

advantages, any or all of which are within the reach of every shop which adopts a system of good lighting for an older and inadequate system: (1) Increased production for the same labor cost; (2) greater accuracy in workmanship; (3) reduced accident hazard; (4) avoidance or at least reduction of eyestrain; (5) surroundings made more cheerful; (6) work performed with less fatigue; (7) order, neatness and sanitation promoted; (8) superintendence rendered more effective.

Put in simple language, then, shop lighting is of fundamental importance to production and its cost small when compared with its advantages. In fact it has been found that when its cost is compared with the wages that may be saved by its adoption, the expenditure for the best lighting is remarkably small.

It seems noteworthy to conclude this article with several quotations from practical shop managers and others, which have been used by the Industrial Commission of Wisconsin in its efforts to show how such men look at good lighting. These quotations are abridged from letters published in the commission's latest book on "Industrial Lighting," issued in 1917.

One practical correspondent wrote: "I have always said that when we cannot have daylight for working conditions the best system of artificial lighting is none too good," and "we have found that by the use of better lighting we have increased production, improved quality, which means less waste, and our employees are more contented."

A manager wrote: "We think we have solved our lighting problem, and we think we have one of the best-lighted factories in Wisconsin. Our men have no difficulty in doing as close work during the period that the factory is lighted by electricity as they can in daytime."

Another manager wrote: "We are getting a better grade of work while working with artificial light than was possible before making the change. At the same time we have increased the output of the departments at least 2 per cent. without any increase in the cost of power. We have decreased the chance for accidents to a minimum, and our employees are more than pleased with the present lighting conditions."

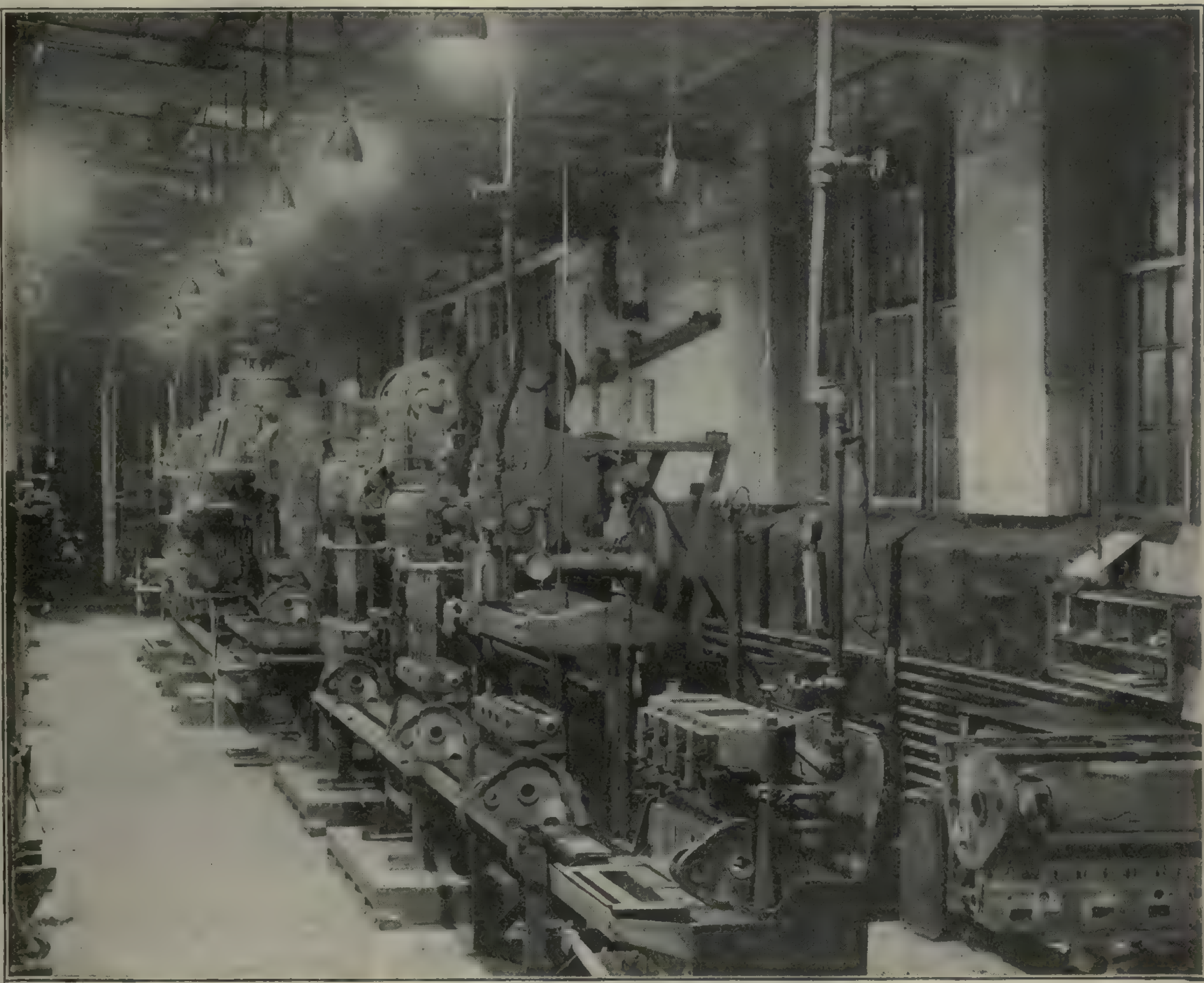


FIG. 8. ARTIFICIAL LIGHTING SHOULD BE ADEQUATE

These and similar opinions which might be given show how progressive shop people are beginning to view good light as an aid to production and as possessing other important advantages to their plants.

In conclusion, attention may be called to the suggestions which will occur to the reader from the series of illustrations included in Figs. 6, 7, 8 and 9. In

these days when every effort is made to design the modern factory to have an abundant supply of natural light within the departments, as indicated by Figs. 6 and 7, it is apparent to all that those who may be obliged to work under night conditions, as in Fig. 8, should not be called upon to suffer eyestrain or be hampered in their work by anything but the best system of artificial lighting, without which no employee can

FIG. 9. PROTECTIVE LIGHTING OF DARK PASSAGE

be expected to work effectively, for work which is not done effectively is always a disadvantage to employee as well as to employer, and under present conditions, more than ever, a disadvantage likewise to the country as a whole.

Pumps for Handling Lubricants

By W. Thomas

I have been interested recently in the question of pumps for handling lubricant. There are apparently three types of pumps to choose from: (1) The plain plunger pump, either single or multiple; (2) the geared pump; (3) the centrifugal pump. These types are old and tried and are all good in their way, but I do not believe that any one type is good for all conditions.

If I wanted the lubricant or coolant at a heavy pressure and could remove the dirt and chips before allowing them to come to the pump I would use a plunger type. If I wanted a large volume at a low pressure, and did not care about straining and cleaning the liquid, I would use a centrifugal type. If I wanted a moderate pressure and could get the liquid fairly clean I would use the geared type.

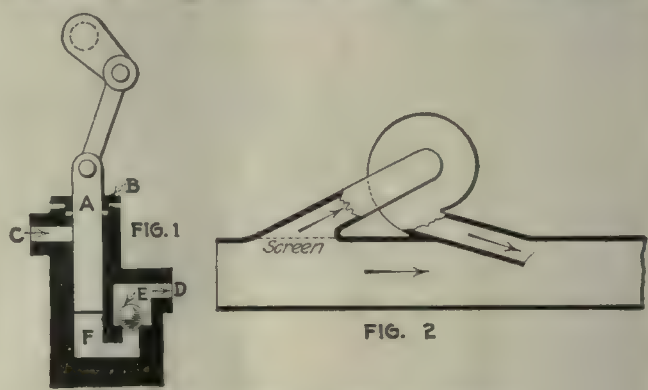
The question of drive and type of pump on a machine should be given careful consideration. It may seem a small matter compared with the price of the machine, but it is like a lot of other small things in that a real apreciation of their value is only obtained when they are not taken advantage of. The machine designer therefore will find it profitable to his reputation to put in a pump that is most efficient for the purpose for which it is to be used.

Dependability is one of the most important features to be considered, and dependability means simplicity. The fewer the parts the less chance of failure, and if a few parts can be omitted, even at the expense of a slight reduction of efficiency, it would seem to be right to omit them.

Years ago I remember seeing a small pump for handling liquids, which was designed long before pumps for machine lubrication had come into general use. It was made to do away with all possible parts, and it impressed itself on my memory because of the omission of one part that I had thought always necessary in a plunger pump, and that was the inlet valve. I do not recollect the exact design, but the sketch, Fig. 1, shows the general principle. *A* is a reciprocating plunger packed at the top by gland *B*; *C* the inlet; *D* the discharge; *E* the ball valve, and *F* the suction chamber. When plunger *A* lifted, if everything was tight, there was a partial vacuum created below the plunger. When the lower end of *A* had passed *C* the liquid rushed in, filling the space *F* below. When the plunger, moving downward, had passed *C*, the remaining liquid was forced out past the ball valve *E*. I suppose it might be said that the plunger itself made the inlet valve; but it does not seem as if it could be considered as one exactly, at least not such a one as would be formed by a cup leather on the bottom of the plunger. There was of course some small leakage, and the power required to raise the plunger against the partial vacuum was lost, but it answered its purpose.

I would like to suggest the consideration of a pump scheme which may or may not be new, but which I do not remember to have seen illustrated or described. The idea is in Fig. 2.

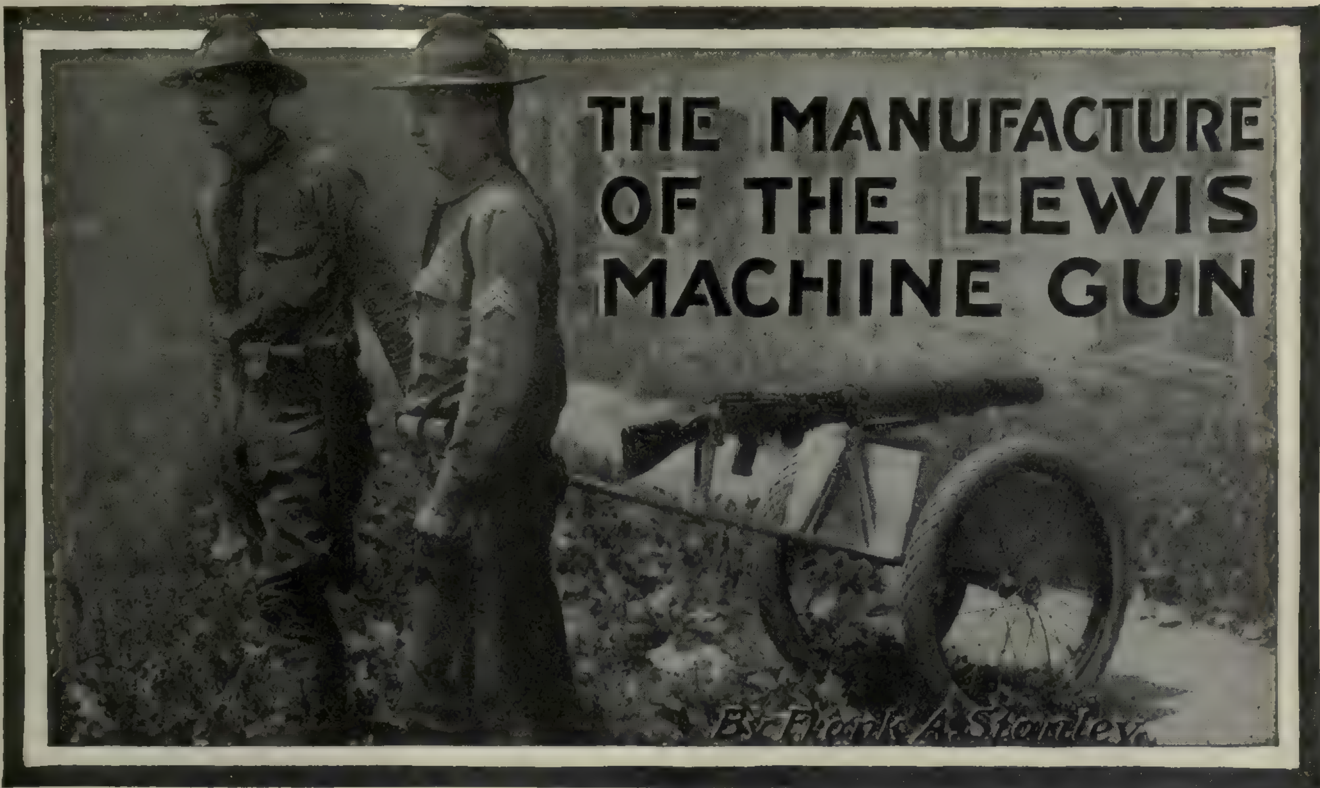
It consists of a small centrifugal type of pump to take a certain percentage, say 20 per cent., of the



FIGS. 1 AND 2. PUMP DETAILS

liquid from the suction and discharge it again into the main pipe in the direction of flow, the injector principle of the discharge being used to force the remaining 80 per cent. up to the desired velocity. It seems to me that even if inefficient it might have its uses; such, for instance, as handling large volumes at low pressure or handling liquids having a considerable quantity of matter in suspension, using for the purpose the clearer liquid near the surface. It is my impression that the injector principle applied to a nonelastic fluid has a very low efficiency, but on the other hand with a properly shaped nozzle it might handle a quite heavy volume more easily than by having the entire amount go through a large, slow-moving pump.

In any event I do not think there is any harm in endeavoring to open up a discussion of new ideas even if they prove to have been tried out and discarded.



THE feed cover of the Lewis gun fits over the top of the receiver and incloses the feed mechanism. It corresponds in general form to the upper portion of the receiver, and its contour is in fact made to the same dimensions as the exterior of the receiver platform, so that the two parts match up for the entire length of the cover which extends over two-thirds of the receiver length. The feed cover is a drop-forging which in its original form appears, as shown, to the left in the upper row of covers, Fig. 67. The work in various stages of progress, from the forging to the finished feed cover, is represented by the other members of the group in the illustration. The finished cover will be seen at the left of the lower row of parts or directly under the rough drop-forging shown in the upper row in the illustration.

VIII. The Feed Cover—I

This member is made from a drop forging and has two small hubs machined at the rear end for locating in various fixtures and jigs. The engravings show typical tools and operations in profiling machines, drilling machines, etc., and illustrate gages for checking the accuracy of cuts.

Some of the various steps in the transformation of the piece from the rough forging to the finished article may be followed and should prove of interest to the reader.

There are over 60 distinct operations in the making of this feed cover as scheduled in the operation-sequence sheet which follows.

The feed cover is first ground on the bottom; then it is placed in a jig, Figs. 68 and 69, where three small bosses, or hubs, on the top face are hollow milled to form locating points for further operations. Two of these hubs are near the rear end of the feed-cover forging and the other is near the front. They are seen clearly on the covers shown in front of the jigs in Fig. 68. It will be understood that they form a three-point bearing for the work in other jigs and fixtures and that as the piece nears completion they are removed, since they constitute no part of the finished feed cover. Two of the hubs will be noticed in the rough on the drop-forged cover at the upper left-hand corner of the group in Fig. 67. The third is produced in the jig by hollow milling down into the raised surface near the front end of the forging. The hubs are hollow milled to a diameter of $\frac{3}{8}$ in., and the adjacent seats faced to $1\frac{3}{8}$ in. in diameter.

Two jigs of the same construction are used under the spindles of the multi-spindle drilling machine, Fig. 68, each set of spindles carrying roughing and finishing hollow mills. One jig is shown opened, the other closed, and in connection with the illustration, Fig. 69, they show the general features distinctly. In the latter the work is shown resting against stops at side and end and secured by screws in the top and at the side. The top plate is secured when closed by three T-head clamp screws requiring only a quarter turn for fastening or releasing. The thumbscrew through the side wall for pressing the work sidewise against the rear stops is secured by a short binder handle which acts as a lock-nut.

The three small hubs hollow milled on the face of the feed cover are held closely to size and to the correct center distances apart, so that the work will locate properly in other fixtures. In Fig. 68 the knurled gage near the middle of the drilling-machine table is a limit gage for the diameter of the hubs. The rectangular block with upright vertical rod in front of the first

FIG. 67. THE FEED-COVER IN VARIOUS STAGES FROM DROP FORGING TO FINISHED WORK

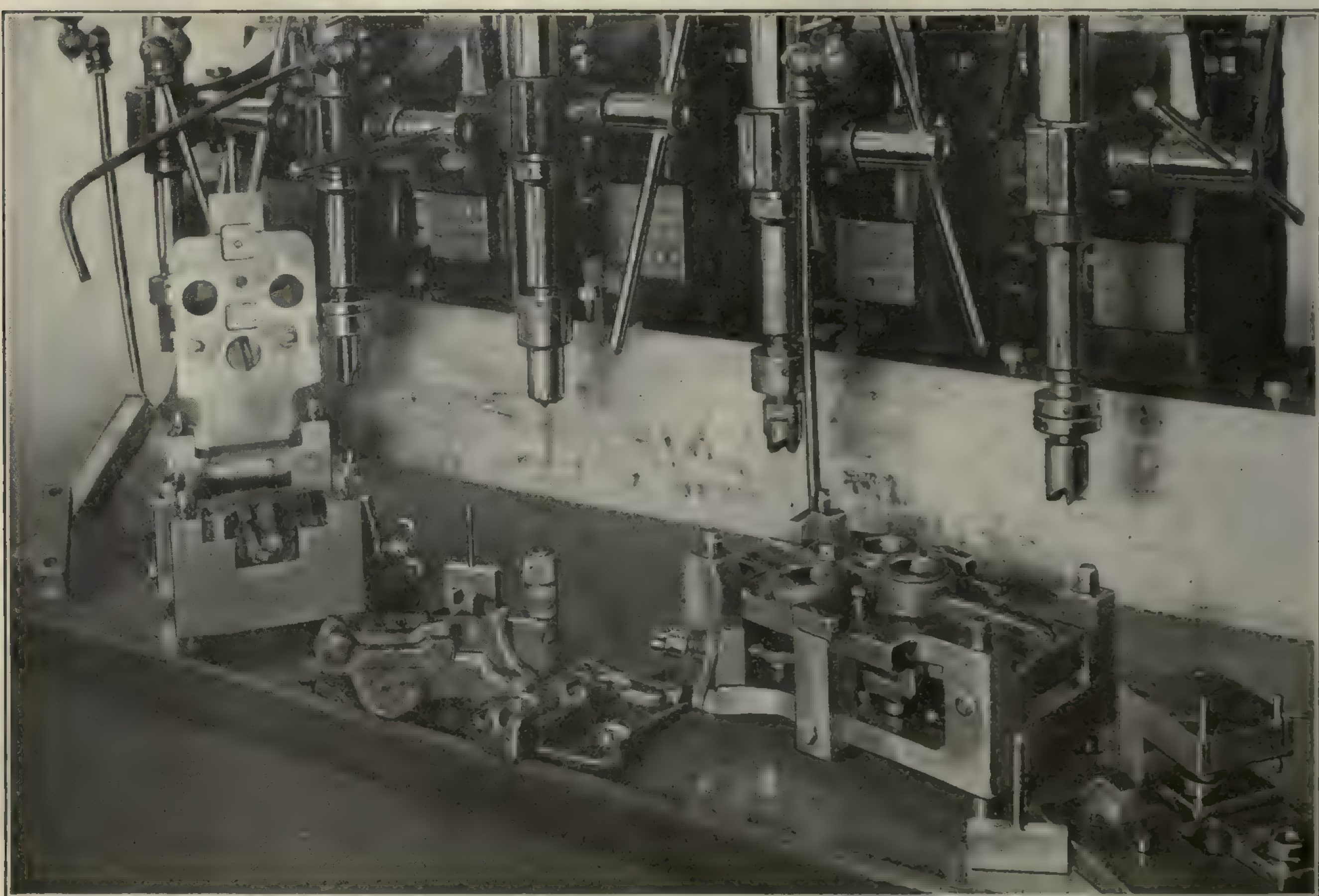


FIG. 68. JIGS FOR HOLLOW MILLING THE LOCATING HUBS ON THE FEED COVER

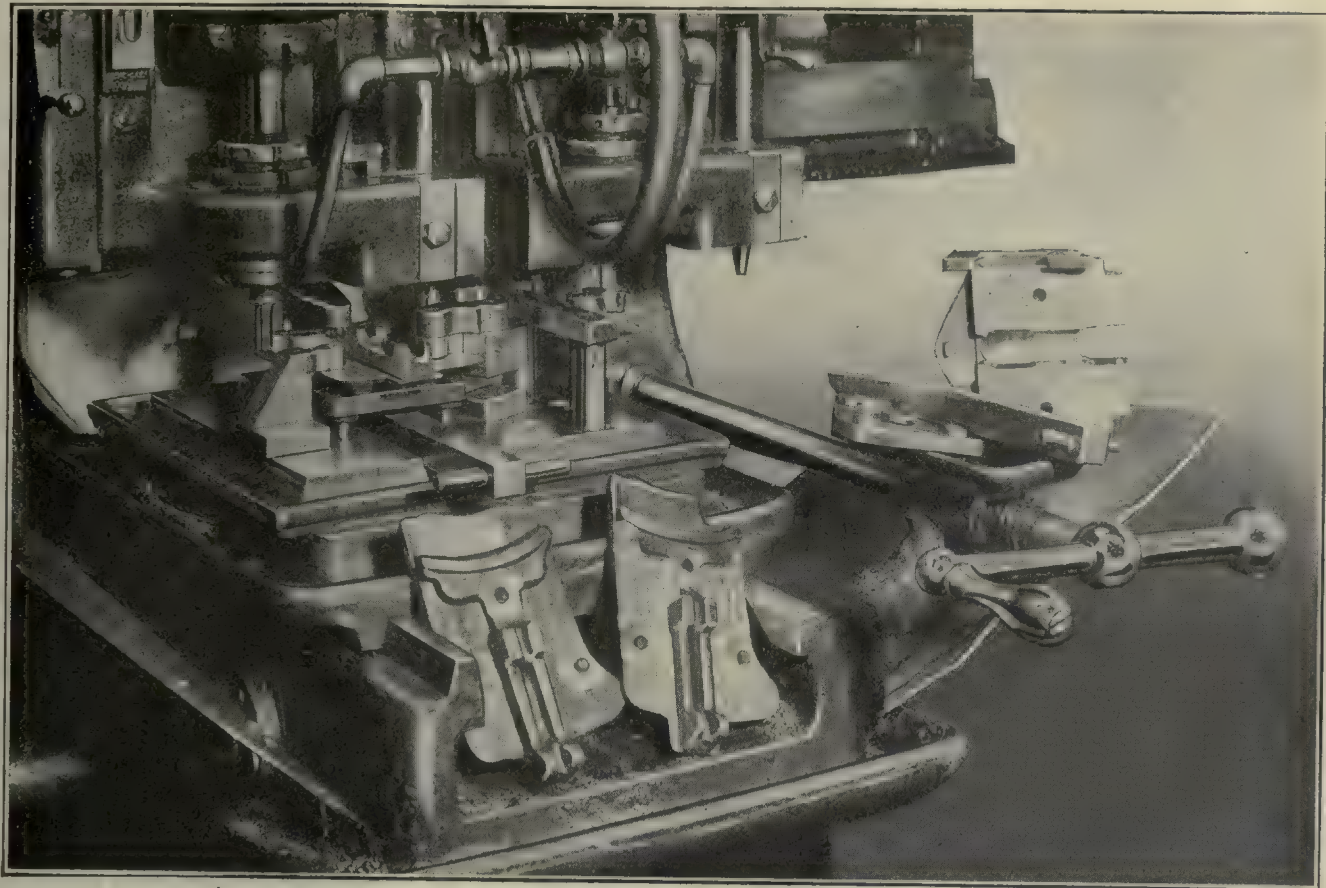


FIG. 71. PROFILING THE TOP AND THE SIGHT-LUG SIDES
Operation 3—The cover at the left is as it appears before the operation while the one at the right has been profiled over the top surface, across the shoulder in front and along the sides of the sight lug

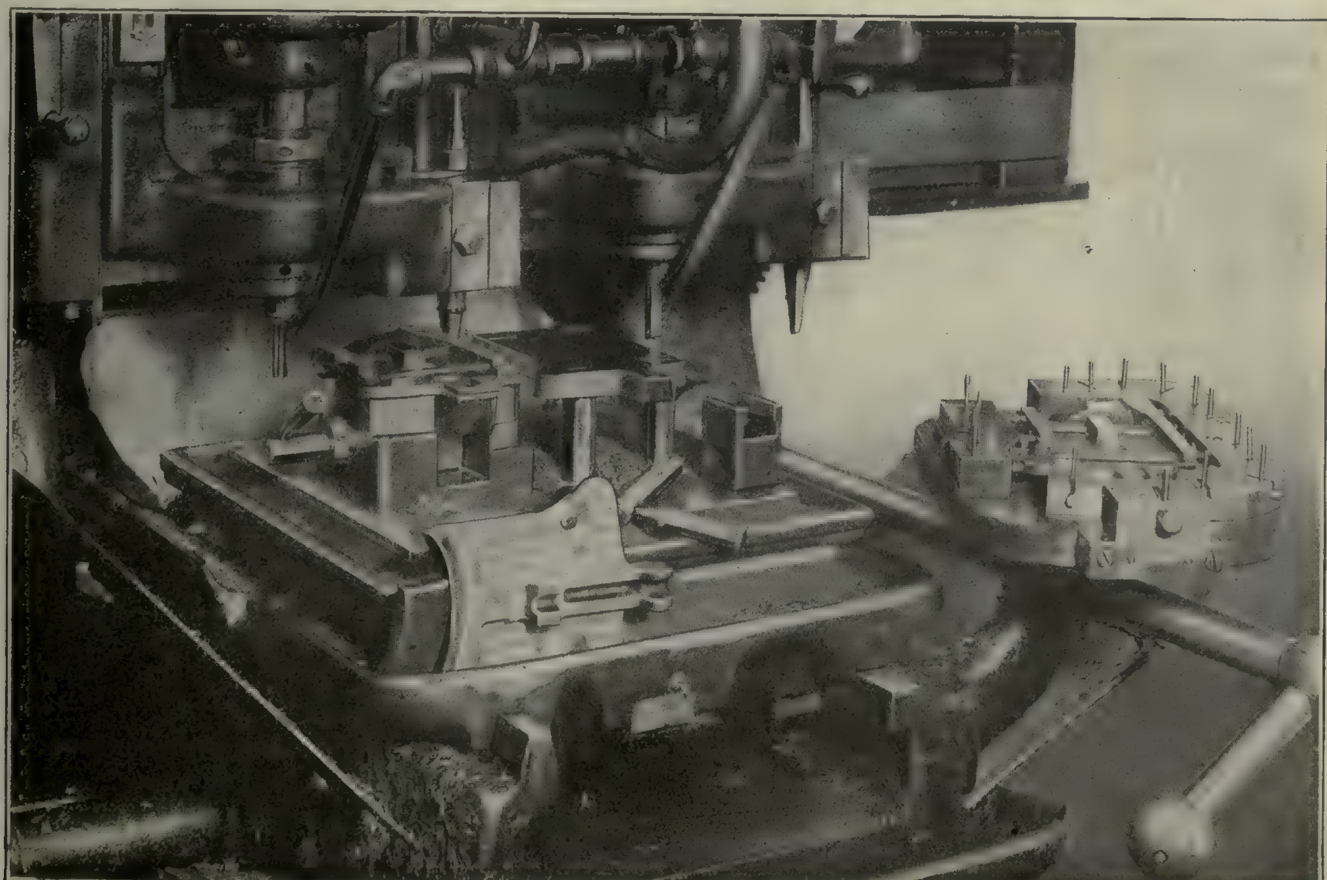


FIG. 73. PROFILING THE OUTSIDE SHAPE OF THE FEED COVER

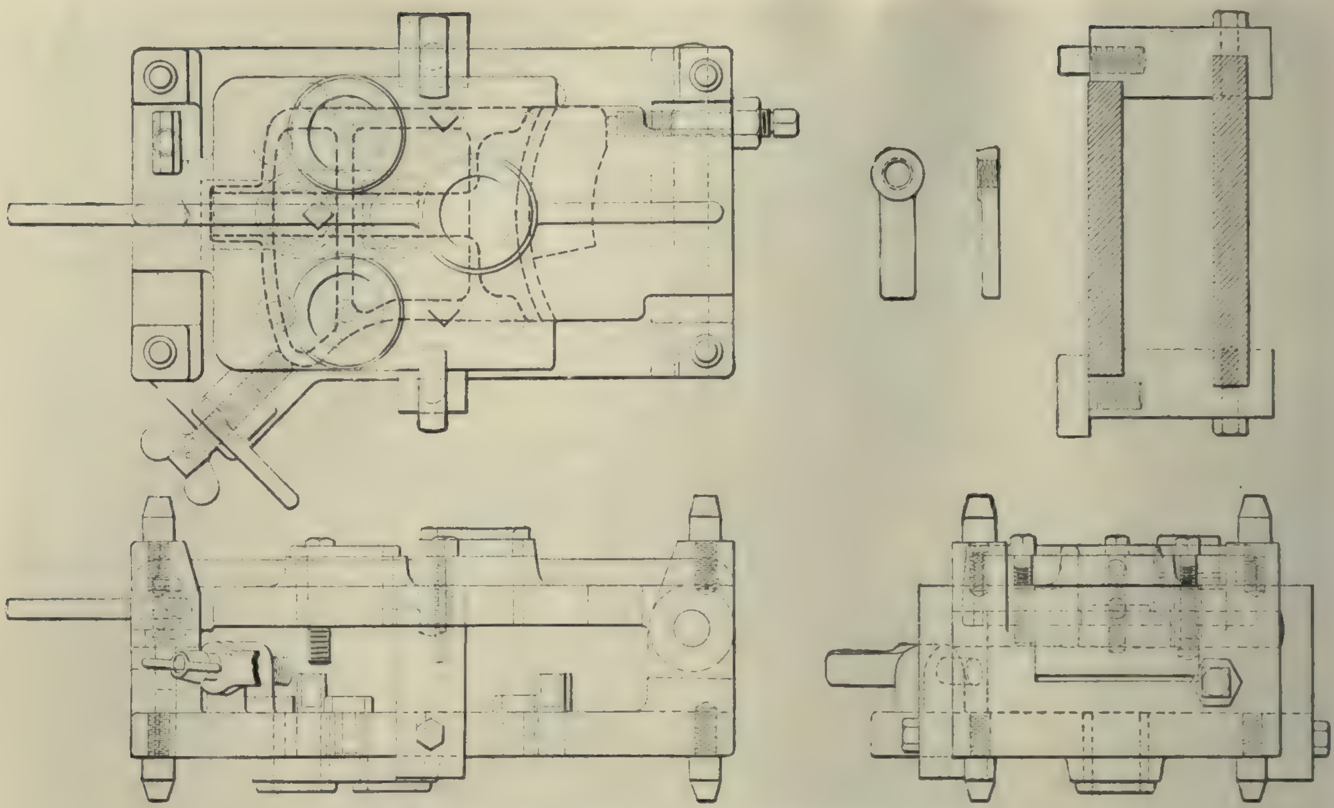


FIG. 69. CONSTRUCTION OF HOLLOW-MILLING JIGS

jig is a flush-pin gage for testing the depth of the seating cut from the top of the guide bushings. The gaging fixture at the right of the table is fitted with flush pins for testing the piece while it rests upon its three bearing points. The gage at the extreme left is a flat bar with two holes the right distance apart for testing the center distance of the two rear hubs.

The templet, Fig. 70, is fitted with two projecting bushings to fit over the rear hubs of the work and is shaped externally to correspond to the feed-cover contour, besides having numerous openings cut out to represent various lugs and surfaces on the face of the cover. This templet is applied to the feed covers as they come from the jig, Fig. 68, to make sure that all surfaces will machine up properly without an undue amount of metal at one spot and a correspondingly limited amount of stock at opposite points or surfaces of the work.

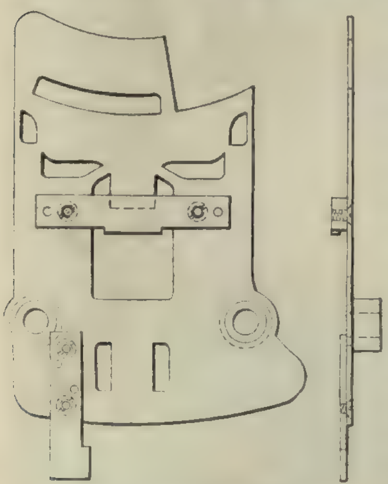


FIG. 70—A TEMPLET FOR THE COVER AND JIGS

This templet may be applied to the work at any time to determine if the forgings in a given lot are being centrally positioned in the jig so as to leave a fairly uniform amount of material at all points, and any adjustments found desirable in this way are readily attended to.

The first profiling operation is illustrated by Fig. 71. This operation, No. 3, is the profiling of the top surface and of the sides of the sight lug of the shoulder at the front end, leaving stock on the forward lug or sight base for clamping. Two feed covers will be seen at the front of the profiling machine; one as it appears before the profiling operation, the other profiled over

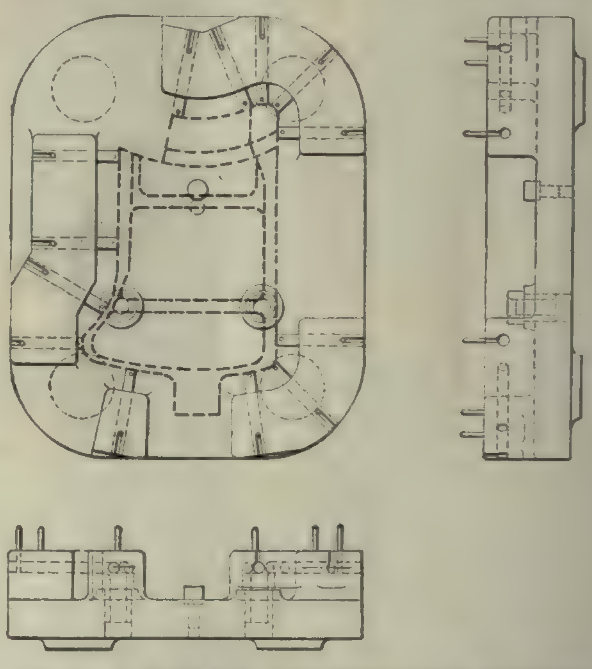


FIG. 75. A GAGE FOR THE FEED-COVER CONTOUR

the top surface across the shoulder in front and along the sides of the sight lug. The method of holding the work in the fixture is quite unusual and will be appreciated on examination of the fixture details in Figs. 71 and 72.

Upon referring to the latter illustration the feed cover will be seen at *A* located against the under side of the overhanging fixture brackets *B* and *C* by means of the two $\frac{3}{8}$-in. hubs formed in the hollow-milling process which enter hardened-steel bushings in the brackets. The other end of the work locates against a steel plug in the under side of a third bracket *D*. The work is pressed upward against the under side of the three brackets by a triangular shaped plate *E* and a long wedge *F*, which when pressed into place bears against the spherical face of a boss *G* at the center of the triangular plate *E*, so that the latter is forced up evenly against the under surface of the feed cover to be machined.

The two $\frac{3}{8}$-in. hubs on the top of the feed cover enter bushings in brackets *A* and *B*, the holes of which are lapped out to 0.376 in., so that there is only 0.001 in. clearance for each hub, thus assuring correct location of the work sidewise in the fixture. The $1\frac{3}{8}$-in. seats faced around these hubs by the hollow mill bear against the under surface of the brackets which are made to a radius of $\frac{1}{2}$ in. at their outer ends where the work takes its bearing, thus leaving ample clearance space for the profiling cutter used in surfacing the top of the work. The three bearing surfaces under the three brackets at front and rear bring the work perfectly level; and the clamping plate *E* having three projecting plugs in its upper face to take bearing against the bottom of the work secures the latter firmly without possibility of distortion when the operating wedge *F* is pressed into position.

The form plate for controlling the guide pin and movement of work under the cutter is clearly shown and needs no description. The gages for the profiling cuts are seen on the small tray on the right of the table in Fig. 71. The flat gage shown on edge tests the thickness and position of the sight lug, this gage fitting over the two $\frac{3}{8}$-in. hubs on the feed cover and therefore gaging the sides of the sight lug in respect to distance from the two hubs. The gage jaws are provided with pins, as indicated, which are brought into contact with the surfaces to be inspected. The long wedge and plate shown at the side of the gage are duplicates of the two parts used in holding the work up against the under side of the fixture brackets as previously described in connection with Fig. 72.

After the operation just described several other profiling and milling cuts are taken on the work. One of the profiling operations consists in milling two grooves along the sides of the front lug at the center of the plate, leaving a T-head on this lug for future clamping purposes. That is, the lug is thus formed to the right shape to receive a clamping block which has a T-shape opening, allowing the block to slide over the T-section for the purpose of drawing the work down tightly in its holding fixture. One of these clamping blocks with the T-slot milled across its head is shown on the right-hand corner of the profiling machine table, Fig. 73, this view illustrating the fixture and method of profiling the outside shape of the feed cover.

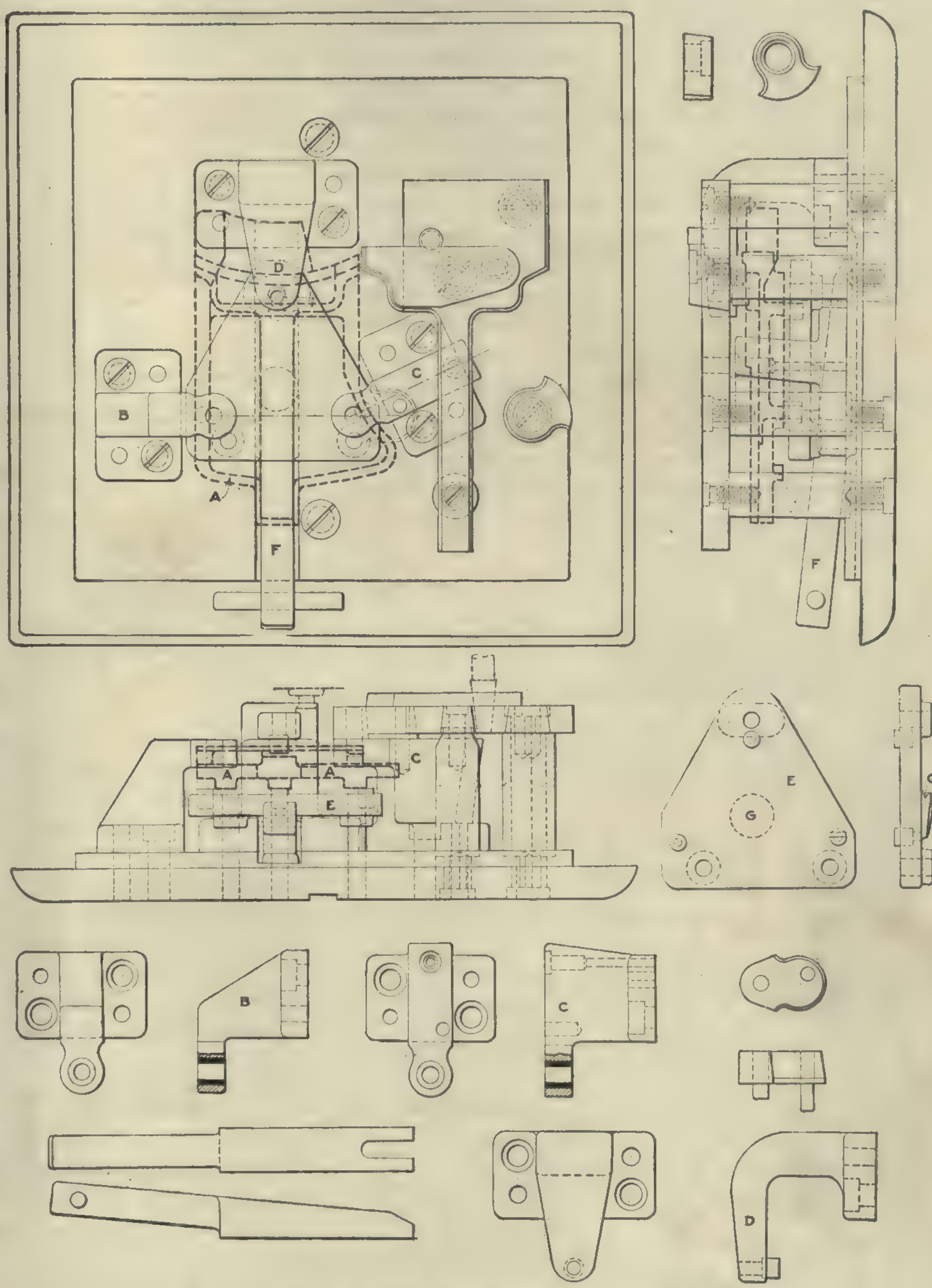


FIG. 72. THE PROFILING FIXTURE

An assembly drawing of the fixture and certain details are illustrated in Fig. 74, where the holding block with the T-opening referred to is represented at *H*. When the feed cover to be profiled around its edge is placed on this fixture the clamping block *H* is in uppermost position, allowing the sight-lug shoulders to slip into the T-opening, and the eccentric stud *I* is then turned over by its cross-handle to draw the work downward against the top face of the fixture with the ⅜-in. hubs on the work entered into the locating bushings *J* in the fixture top. These bushings are the exact size of the locating hubs, and they position the feed cover exactly on the center line of the holding fixture. The outline to which the feed cover is to be profiled is indicated by the contour of the form plate *K*.

SEQUENCE OF OPERATIONS

1 Grind bottom surface.
2 Hollow mill hubs to size and spot bearing at front end.
3 Profile top surface, sides of sight lug and shoulder at front end, leaving stock on forward lug or sight base for clamping.
4 Profile top surface at front end.
4½ Profile top surface of sight base and rear surface of forward end, leaving stock on forward lug or sight base for clamping.
5 Profile clamping shoulders on front lug.
6 Finish rear end to standard length.
6½ Cross-mill hinge lug at rear end.
7 Remove stock to do operation 10.
7½ Remove stock in panel to do operation 10.
8 Profile full outside shape.
9 Profile bottom surface to thickness.
10 Drill and counterbore pawl spring and retaining hole.
11 Profile underside of feed cover and outside shape of retaining lugs (rough).
12 Profile underside of feed cover and outside shape of retaining lugs (finish).
13 Profile top of cross-ribs and finish inside of locking lugs.
14 Profile panels (rough).
15 Profile panels of underside (finish).
16 Finish feed cover locating lug clearance.
17 Profile under surface of cartridge guide lug and shape of front-locking lug.
18 Profile locking lugs on right and left side.
19 Mill cartridge guide-lug cam surface.
20 Mill top surface of cartridge guide lug.
21 Finish end of cartridge guide lug.
22 Rough cartridge spring-guide clearance slot.
23 Profile cartridge spring-guide clearance slot (second operation).
24 Profile cartridge guide-lug cam surface (finish).
24½ Profile radius cut on cartridge-guide cam surface.
25 Mill cartridge guide-spring clearance in end of lug.
26 Profile rib and radius cut in cartridge-guide lug.
26½ Grind for stamping operation.
27 Profile clearance cut at right side of pawl clearance and top of pawl hub.
27½ Profile out stock at rear end of rib at magazine clearance slot for stamping.
28 Rough polish dovetail for stamping.
29 Roll in stamp name.
30
31 Rough out pawl-clearance cut.
32 Hollow mill pawl hubs.
33
34
35 Shave cartridge-lever hub-clearance slot.
36 Profile magazine-clearance slot (finish).
37 Profile rib at rear of magazine-clearance slot.
38 Profile pawl-clearance cut.
39 Spot, drill, ream and counterbore pawl-spring retaining hole.
39½ Rough out for operation 40.
40 Profile spring-clearance cut in sight bed.
41 Profile spring-clearance cut at rear end.
41½ Profile top and clearance between spring locating lug.
42 Profile spring-locking seat at front end.
43 Length mill leaf-resting shoulder at front end.
44 Drill sight-leaf axis-pin hole.
45 Profile elevating screw clearance.
46
47 Fit cartridge guide.
48 Clean pawl base.
49 Fit pawls.
50 File back and break corners.
51 File back sight bed.
52 File to receiver gage.
53 File crossbars and break inside corners.
54 File outside shape.
55 Saw off locating lugs.
55½ Rough polish flat surface.
56 Drill cartridge guide-spring hole.
57 Polish rib on inside.
58 File top.
59 Polish, break outside corners.
60 Match up corners, outside shape.
61 Harden.
62 Sandblast.
63 Brown.

In the articles describing the manufacture of the receiver of the Lewis gun, illustrations were presented showing a multiple flush-pin gage for inspecting the entire outside shape of the receiver at one setting in the gage. A similar type of gage for the same operation on the feed cover will be noticed at the right of the table on the profiling machine, Fig. 73, and the construction of this gaging device is brought out clearly in the illustration, Fig. 10.

The gaging fixture has a cast-iron base in which are inserted two hardened and ground bushings lapped out to 0.375 in. for locating the feed cover in the gage

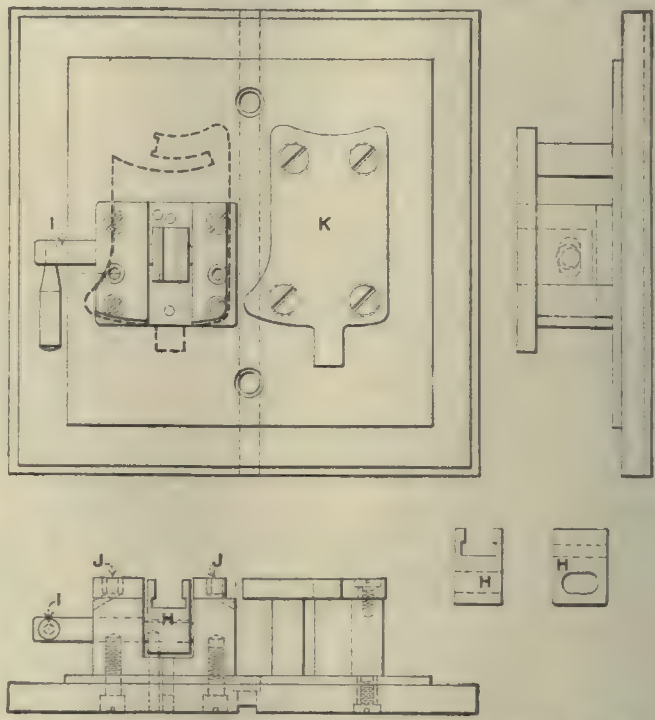


FIG. 74. THE FIXTURE FOR PROFILING THE OUTER SHAPE

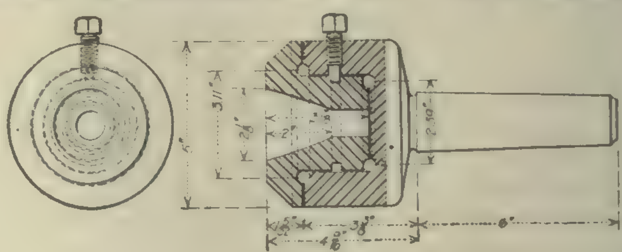
by means of its two small hubs which are a snug fit in the bushings. The front end of the feed cover rests, as in previous operations, upon a hardened plug located near the front on the center line of the fixture. The wide lugs which form the wall of the fixture are bored out to receive thirteen ¼-in.-diameter flush pins which operate at the proper angles to gage the various curves, slopes and straight lines that make up the contour.

Each of the flush pins is drilled crosswise for a small operating pin which slides in a vertical slot milled for a short distance in the top wall of the fixture.

Cup Center for Projectiles

By R. S. Myers

For band turning on any type of shell the cup center design shown in the illustration will be found very handy. The revolving member *A* is fitted to the nose



CUP CENTER

of the shell and hardened. The shank is ground to fit the tailstock of the lathe. With a shell held in the chuck the cup center steadies it while the band is turned.

Standards for the Design of Small Dies

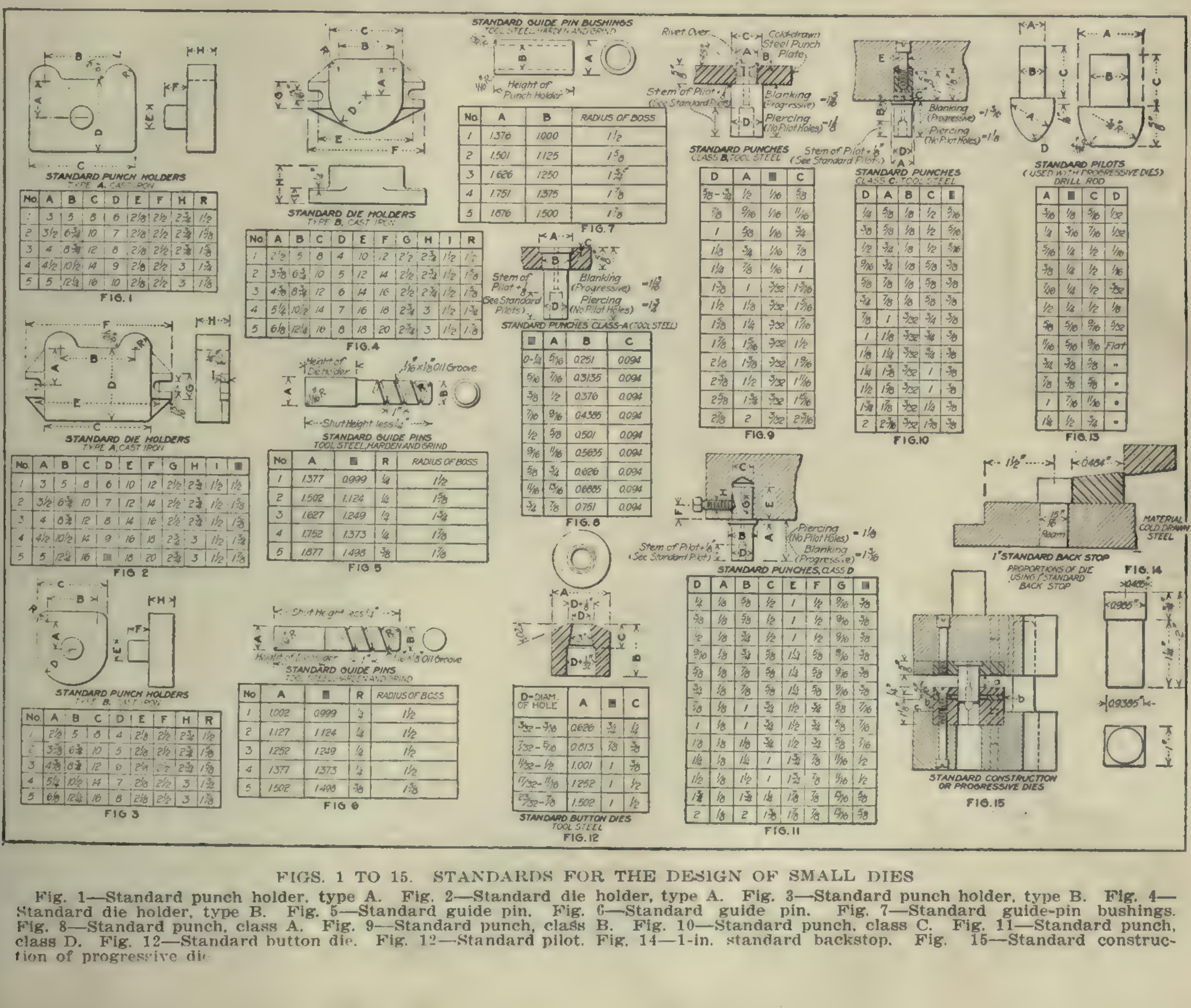
By C. V. LOVELL

The quantity production of small pressed blanks for motor parts, small automobile parts and accessories and many other lines renders the standardization of small punch and die parts a virtual necessity. The standards set forth in the tables accompanying this article are the results of many years' experience in designing these classes of tools. In the designing of dies there are a great many parts that can be standardized, and although it is not always possible to adhere to these standards much expense can be saved and a more uniform equipment of tools produced if the designing department has a set of standards by which to work.

THE tables and sketches in this article show details which I have developed from tools used in different places where I have been employed, and after using them for five years in designing dies for a variety of work, such as automobile parts, small electric motors, mailing-machine parts and hand-grenade parts for Government work, I believe they may be of use to others who design like tools for pressed-metal work The punch holders, shown in Fig. 1, and the die holders, shown in Fig. 2, were developed from the four-post type, as in many cases it was found that the front guide pins were in the way of the operator, and in most cases the dies equipped with two guide pins gave just as good results, besides reducing the cost of construction. The patterns are made so they can be used in pairs and can easily be lined up together for boring. The usual method is to face off both castings, clamp them together in the milling machine and bore both parts to fit a standard-plug gage. Type A, Figs. 1 and 2, is used for general work. while Type B, Figs. 3 and 4, is adapted to round work.

The guide pins shown in Fig. 5 are designed for use with piercing and blanking dies, and are to be used in connection with the bushings shown in Fig. 7. It will be noticed that both the pins and bushings are ground for a press fit in the same size hole and that the small end of the pin is ground to a working fit in the bushing of the corresponding number.

The guide pins shown in Fig. 6 are designed to be used without bushings, and are usually employed in forming dies or in cutting dies where the number of



FIGS. 1 TO 15. STANDARDS FOR THE DESIGN OF SMALL DIES

Fig. 1—Standard punch holder, type A. Fig. 2—Standard die holder, type A. Fig. 3—Standard punch holder, type B. Fig. 4—Standard die holder, type B. Fig. 5—Standard guide pin. Fig. 6—Standard guide pin. Fig. 7—Standard guide-pin bushings. Fig. 8—Standard punch, class A. Fig. 9—Standard punch, class B. Fig. 10—Standard punch, class C. Fig. 11—Standard punch, class D. Fig. 12—Standard button die. Fig. 13—Standard pilot. Fig. 14—1-in. standard backstop. Fig. 15—Standard construction of progressive die

pieces to be produced will not warrant the making of bushings. The punches shown in Fig. 8, Class A, are of the type used for the general run of work, especially where a number of holes are to be punched at one time. When used as blanking punches, as for washers or similar work, they should be made about $\frac{1}{16}$ in. longer, depending on the thickness of the stock, and when used for progressive work they are drilled to take the pilot pins shown in Fig. 13.

The punches shown in Fig. 9, Class B, commend themselves principally because of the low cost of construction where only a temporary set of tools are to be made. While they may be quickly made and assembled in a punch plate by simply drilling and countersinking the plate, they are difficult to remove in case a punch is broken.

A More Expensive Punch

The punches shown in Fig. 10, Class C, are used only where a few are required in a set of tools. Although more expensive to make than those previously described, they possess the advantages of being more quickly replaced without having to disassemble a set of tools and that no punch plate is required.

The punches shown in Fig. 11, Class D, can be used only when they can be placed near enough to the side of the punch holder to be reached by a setscrew, but they possess the advantage of being easily removed or replaced.

A commonly used type of button die is shown in Fig. 12.

The pilots shown in Fig. 13 should have their stems turned or ground for a press fit in the blanking punches.

Fig. 14 shows a backstop for use with large blanking dies, which are built up in sections and make a very rigid support for the cutting edges. They are usually made from square stock, and when a large number of dies are to be made these stops can be turned up in large quantities in the screw machine.

The cross-section, Fig. 15, shows the standard construction for a progressive die. The stripper plate *a* and the guide strips *b* are doweled to the blanking die *c* with short pins so that they may be removed for the purpose of grinding the die, leaving the latter intact with the holder.

Saving in Pattern Cost

Perhaps the greatest economic feature of a fixed standard is the saving in pattern cost. I have seen hundreds of patterns made up for die and punch holders, but as no record of them was kept in a way that was easily accessible new ones were often made which were duplicates of those already in stock. With a table showing the shape and sizes of patterns on hand, new tools can usually be so designed that five or six different pairs of patterns will furnish all the castings required.

Another feature not to be ignored is the uniformity of all tools designed from standard parts. When toolmakers become accustomed to making tools of a given type they will produce them more rapidly than if a new type of design has to be studied out every time new equipment is required.

This may seem like a small point to consider in design but it is an item that counts up considerably and is well worthy of attention.

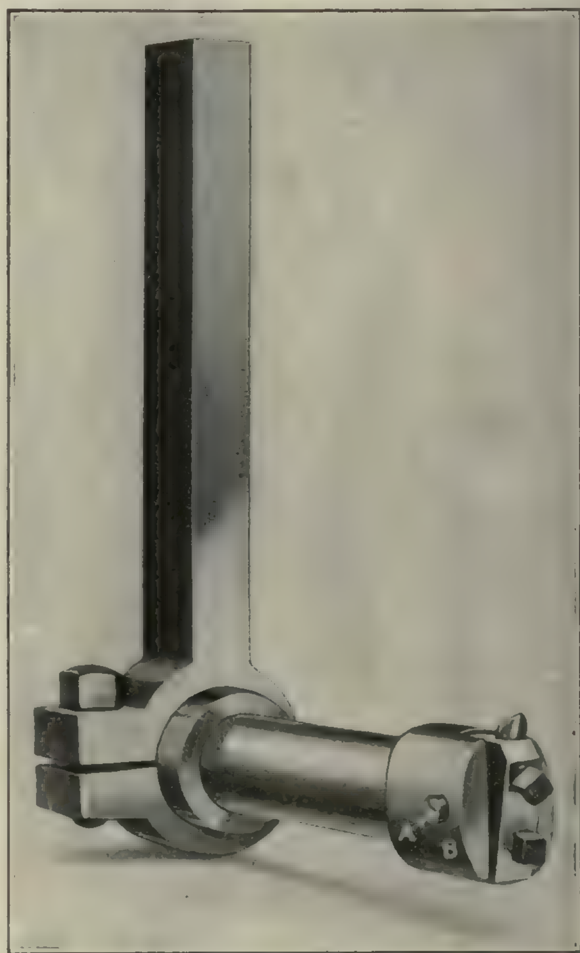
A Tool for Internal Planing

By M. L. Lowrey

The internal-planing tool shown in the illustration has several good features. It is ready for instant use in any planing or shaping machine and is held in the toolpost in the usual way. As the cutting tool lifts in the small clapper box at the end of the bar, the shank can and should be blocked at its upper end, making it very rigid. By turning the bar to the proper position the piece to be machined can be planed on the top, bottom or either side at one setting. The tool being of the toolholder type any shape of tool desired can be inserted.

If desired the bar can be made adjustable for length by threading and screwing it through the shank, as the clamping screw will hold the threaded bar as well or better than the plain bar, and no lock nut or collar is necessary.

The miniature clapper box on the end of the bar is pivoted upon the taper pin *A*, and while firmly sup-



INTERNAL PLANING TOOL

ported against the pressure of the cut is free to lift slightly on the return stroke. To prevent chattering and jumping due to its lightness the upper end, opposite the cutting point, rests upon a spring-actuated plunger set longitudinally in the bar at the point indicated at *B* in the illustration. The photograph does not of course show this plunger and spring, but as its function is to steady the clapper on the return stroke its location and construction are obvious.

Hobs and Hobbing Machines*

FROM BARBER-COLMAN CO., ROCKFORD, ILL.

This review gives a concise detail of the development and capabilities of the hob and the hobbing machine. There was a time when manufacturers believed that these tools could not be used without great difficulty, but this is so no longer, as most of the obstacles in these machines have been overcome, and the work done by them possesses as much refinement as that produced by other tools used for similar work.

THE method of producing gears by hobbing has been understood in its theoretical aspects for many years, but conditions, which are now radically changed, delayed its general adoption until recent years. Unfortunately there has existed in the minds of many an exaggerated idea of the difficulties in using the hobbing process and a failure to appreciate its advantages, which may doubtless be traced more or less directly to the early conditions, and the change in the early conditions has not yet resulted in as complete a revision of the opinions founded on them as the facts warrant.

It is the purpose of this paper to point out briefly what these early retarding conditions were and to show how they have changed, and also to endeavor to be of some assistance in promoting a general understanding of the reasons that cause the present hobbing process to be so admirably suited to the high-duty and high-quality production now the rule in your shops, particularly in regard to a range as to diameter and pitch, which, though limited, nevertheless covers at least three-fourths of the production which is on a quantity basis.

One of the early conditions which retarded progress was the fact that quantity production in the present meaning of the expression did not then exist, and the quantity production is the field to which the hobbing process is especially well adapted. The introduction of the automobile and its manufacture on a large scale necessitated the manufacture of duplicate gears in very large quantities, and thus afforded a chance for the hobbing process to show its capabilities, but it still lacked the refinements necessary to enable it to do high-quality finishing work, and its field was in a considerable measure restricted to the roughing operation; but even with this restriction its use was large enough to furnish both the means and the stimulus to carry on development work, which has resulted in the refinements which today make it an eminently practicable and efficient method for the finest finishing work. These refinements lie principally in the ground hob, which will be more fully discussed later.

Prior to the advent of the hobbing machine, gear-cutting machines were always operated on an intermittent principle. The rotary-disk-cutter method using formed milling cutters had the reciprocating cutter slide with its slow inward-feed motion and the high-speed withdrawing stroke calling for a reverse mechanism working under severe conditions and subject to great wear and tear. In conjunction with this mechanism and controlled by its motion is the indexing mechanism, which also must operate at high speed with considerable jar and shock, which with the attendant wear soon results in inaccurate spacing. The one favorable feature of this disk-cutter method is the continuous cutting action, but even this advantage is open to the objection that the heating effect is concentrated at one side of the blank, the first cut being made in a cold blank, while the last one is with the blank at a considerably higher temperature, necessarily resulting in inaccurate work.

Operating on the generating principle are machines of the planer or shaper type, with a reciprocating cutting tool and intermittent indexing devices. Methods of controlling the reciprocating cutter to generate by rolling the blank are numerous and interesting. An early method was to generate one tooth at a time by rolling the blank past the reciprocating tool, returning the blank to first position and indexing for the next tooth. This method is obviously slow, and inaccuracies inherent in this periodical indexing have long been recognized, as has the local heating effect previously mentioned.

THE GENERATING METHOD

In the generating method represented by the Fellows shaping machine the intermittent indexing is eliminated by a pinion-shaped cutting tool rolling with the blank to give the generating motion and reciprocating to give the cutting motion, an additional short reciprocating motion being required to give clearance to the cutter on its return stroke. The mechanism that controls this rather complicated collection of motions is one of the most interesting to study, but need not be detailed here. In operation the cutter is sunk into the blank to the depth of the cut desired and then the rolling mechanism is started, the gear being cut to full depth at one revolution of the blank, therefore the objection of local heating and unequal expansion of the blank, referred to above as characteristic of other methods, is not avoided in this one.

From a study of the methods above outlined and a consideration of the advantages and disadvantages of each it is apparent that an ideal system would have the following characteristics:

First—A continuous cutting action, as in milling with a disk cutter. Second—Generation of each tooth by a single tooth or tooth profile, as in the single-tooth generating process, so that each tooth will be a duplicate of its mates. Third—Distribution of the cutting action around the blank so that an even heating may take place. Fourth—Continuous indexing by rolling, so that inaccuracies in spacing by intermittent methods may be eliminated.

A moment's consideration shows that the hobbing process has all these characteristics of an ideal system, for: First—The cutting action of the hob is obviously a continuous milling cut. Second—Each tooth in the gear is generated by the same set of teeth in the hob. An inaccurate hob may produce an incorrectly shaped

*Paper read at meeting of American Gear Manufacturers' Association, White Sulphur Springs, W. Va., Apr. 20, 1918.

tooth but even so all of the teeth will be alike. Third—Both work and cutter rapidly rotate, thereby assuring uniform distribution of heating and expansion. Fourth—The indexing is continuous by rolling. Every revolution of the hob spaces out a tooth on the blank as it rotates in proper relation with the latter. The indexing is in no way affected by shock and jar as in the intermittent method.

It being accepted that the hobbing process combines these desirable features the question then arises of designing a machine to give practical effect to them in the best manner. The trend today, in machine design as well as in human endeavor, is toward specialization, and it is well recognized that making a specialist of a machine, while limiting the range of work to which it is applicable, is profitable for quantity production because it increases its efficiency on the work within its range.

Applying this view to hobbing-machine design it seems apparent that by limiting the diameter of the gears to be cut to 12 in. and the diametral pitch to 3 in., a machine can be produced having great rigidity for the kind of work expected of it, and at the same time having a range sufficient to cover most of the quantity production. Rigidity is a prime consideration, and it is important that the mechanisms be plain and simple. The design must also insure long life by providing ample bearing surfaces and adjustment facilities for maintaining continued accuracy.

Being a manufacturing machine, speedy loading and unloading should be a main feature of operation. This will influence the design, and the designer will find himself at the point where he must choose between the vertical and horizontal arrangement of the work spindle.

Advantages of Vertical Arrangement

The vertical arrangement lends itself to machines of large capacity, as a more compact design can be worked out with this arrangement than is possible with the spindle in the horizontal position. But for a range of sizes up to 12 in. here considered the horizontal arrangement has many advantages. In the quickness with which the work can be loaded, in combination with the stiffness that can be built into the work supporting means, the horizontal-spindle machine is superior to its vertical-type competitor. Cleanliness is another feature in favor of the horizontal spindle, as chips fall clear of the work support and do not hinder speedy reloading nor impair the accuracy of the results. Therefore, for the machine in view, the horizontal work spindle is superior. Having disposed of the work spindle and work support the question of the hob support would next be considered.

This should be arranged with a minimum overhang and a simplicity of design that would give the desired results. The hob should be so mounted that it can be set at an angle to enable both spur and helical gears to be cut. Lateral adjustment without disturbing the hob on the arbor should be provided so that a quick and easy means is at hand to set the hob to bring successive places into the cutting range, thereby distributing the wear and allowing greater economy in the use of the hob.

From the first the hobbing process has proved itself to be a rapid method of producing gear teeth, and for this reason its advocates have had little difficulty in demonstrating its ability for roughing where quantity is required. Present-day figures on this kind of production are such as to place it in a class by itself. The reason for this is to be found largely in the nature of the hobbing cut itself, which has the advantages of being a continuous cut; of breaking up the chip; of operating on a rotating blank, thus equalizing the load and distributing heat; of having no portion constantly under cutting action, thus facilitating heat radiation and dissipation, and of distributing the load upon a great many teeth, no tooth removing metal its whole depth, therefore facilitating a rapid and complete circulation of the cutting compound. In addition to these advantages the constant rolling-indexing method of spacing the teeth allows a much higher operating speed than is practicable with intermittent spacing devices, and constant motion of all mechanisms in one direction permits higher speeds than would be possible on long runs with reciprocating mechanisms, at the same time greatly reducing wear.

Accuracy Demanded

But roughing is not all. Gears require to be finished, and finished with a high degree of accuracy. In the earlier days of the hobbing art the demand for accuracy in finishing gears was not nearly so severe as at present, and the use of carbon steel in the manufacture of hobs did not introduce the difficulties that are found where high-speed steel is employed; but even at that the hobbing process was at a disadvantage in the finishing operation because of the difficulty in producing sufficiently accurate hobs.

Later as the demand for accuracy in the gears increased, and as the use of high-speed steel became a necessity in the race of economical production, the relative disadvantages of the hobbing process in finishing became more marked, and today for high-class finishing it would be out of the race entirely if there were no means available for correcting the hobs after hardening. Fortunately such a means exists today, and the result of the use of this means is the modern ground hob, in which not only are the inaccuracies introduced by hardening eliminated but a greater degree of accuracy is attained than is possible, even in the soft, by ordinary machining methods.

Development of Hob Grinding

The development of the hob-grinding process to its present high state of refinement has been no easy matter, as several hob manufacturers know to their cost. The experimental and development work required several years and suffered many disappointments. It involved refinements much more difficult to obtain than those necessary in the hobbing machine, but the final results are so satisfactory that the advocates of hobbing claim and can show results superior in the matter of accuracy, all things considered, to any other method. Furthermore, duplicate hobs of any form can be made with reliability and certainty, and the hob can be set to cut on any part of its surface without changing the result in the finished gear, so that the whole wearing life of the hob can be utilized. However with hobs that are not ground the distortion of hardening often re-

sults in there being one point on the hob which will produce good results, whereas no other place on the hob will do so.

The hob which is formed and not ground is still recognized as the proper tool for roughing, and it may be used for some classes of finishing, but not where a high quality is required, for although it will make all the teeth in the gear alike it cannot be relied upon to give an accurate tooth shape unless every tooth in the hob follows in proper relation, without zigzagging from the theoretical path. There are a number of causes that account for the zigzag, or drunken, path that the hob tooth of an unground hob may take. Reviewing the operation through which the hob passes to its completion we find in each operation a chance for a small error that in the aggregate may show a wide variation from the true generating path.

First—Sharpening is a cause of wide variation in the relation of one tooth to its adjacent mate, but is correctible to a degree that reduces the error from this source to a minimum. The teeth of the hob must necessarily be equidistant from the axis at the cutting edge to get a continuous true relation of one to the other.

Second—Hardening is most dufficult to control, as the materials hobs are made of require high heats and cold quenching, setting up strains that cannot be predetermined.

Third—Hole grinding is also a cause of variation. This, however, is correctible to some extent in sharpening.

Fourth—Relieving the thread is often the cause of error, even though the operation is performed on heavily constructed machines. The material is not always ideal in working qualities, no matter how carefully the steel is manufactured, heated or treated, and variation in hardness, even in the same bar, is a cause of error.

Resort to Grinding

These difficulties have defied the art of the hob maker and forced him to resort to grinding, which at first seemed impossible, but which today is entirely successful and practical. The resulting combination, giving rapid production and highest quality at the same time, makes the hobbing process, as its advocates claim and show, the superior of any method for finishing, as well as for roughing; in fact, the superiority of the process is today greater in finishing than it is in roughing, for not only is the quality superior but the gain in speed over other methods is greater in finishing than in roughing.

Of almost equal importance with design and construction of the hobbing machine comes the work-holding means. Manufacturing work necessarily implies long runs and special equipment suitable to adequately take care of the peculiar conditions in each particular case. Little can be said in a general way as to this equipment, as each case must be solved on its own merits.

Aside from the production of spur and spiral gears the hobbing process has a further field to which the recognition of its superiority has been more prompt. This field is the production of spline shafts, which have come into such common use in automobile construction, and which are now being more and more adopted in other lines. The spline shaft owes its popularity, and from a manufacturing standpoint, its practicability, to two modern processes—pull broaching and hobbing.

Hobbing is particularly well adapted to spline-shaft generating, as in this work the uniform distribution of the heating effect is even more important than in cutting gears, and added to this is the fact that in making spline shafts by milling with intermittent indexing methods the releasing of surface strains from one side of the shaft at a time throws the shaft out of true and makes accurate results extremely difficult to attain. Not so in hobbing, because the stock is gradually removed from all sides at once, working progressively from one end, the effect of the removal of stress-resisting material is balanced, and no distortion takes place.

Besides these important features we have the accurately indexed keys, each a duplicate of the other, with off-center keys eliminated, and added to all this is the high rate of production. There is no limit to the number of keys it is possible to hob with little or no increase in production time for shafts of equal diameters. This has undoubtedly led to the present wide adoption of shafts, particularly for axle drives, with eight, ten or more keys, giving a greater root diameter for a given key-driving strength, the accurately indexed splines distributing the load evenly.

Silent Chain Sprockets

Another field that the ground hob has opened for hobbing is the silent chain sprocket. Sprockets of a large number of teeth have been handled quite successfully by the formed hob, but those with a small number require the greater accuracy of the ground hob. Hobs are used extensively to cut teeth in roller and block chain sprockets. These are usually range hobs, each covering a small range in numbers of teeth possible with each hob.

Special cases of hobbing also include those in which teeth in ratchets, slotting saws, burrs, etc., are generated. Hobs may be made to generate almost any toothed section that has teeth equally spaced on a cylindrical base. It is not necessary that the teeth be symmetrical on an individual axis, but each must be duplicates of any other or in alternate groups.

There might have been included in this paper an indefinite amount of figures taken from actual cases to support the claims made in regard to rapidity of production both in roughing and in finishing operations, but in the interest of brevity and clearness it has been thought best in place of including them here to supply on request special figures having a close relation to the special cases of those interested. Such information is available either now or at any other time.

That Concrete Metal-Planing Machine

By Alonzo G. Collins

That concrete metal-planing machine described on page 603 of the *American Machinist* seems to be one way out, but why not make the gun lathe of concrete in the first place? If the planing machine is accurate enough to make the lathe bed, surely they could have made the concrete-lathe bed just as accurately.

SIDELIGHTS

EDITED BY E. C. PORTER

Nearly 50,000 tons of completed shipping was delivered and 41,105 tons launched in the week ended Apr. 29; the total launchings since the beginning of shipbuilding program are now 1,405,000 tons.

* * *

The Senate has confirmed the appointment as directors in the War Finance Corporation of McLean, Harding and Meyer. The President has sent to the Senate the nomination of Clifford M. Leonard of Illinois in place of Mr. Forbes, who was unable to accept appointment.

* * *

Orders for 30,000 box and coal cars to cost $80,000,000 to $90,000,000 have been placed by the Unitel States Railroad Administration with the American Car and Foundry Co. at fixed prices which represent about 5 per cent. profit. This is a portion of the 100,000 cars which it has been generally announced will be ordered.

* * *

The Department of State has issued a warning to American citizens who contemplate trips abroad that applicants for passports must expect their applications to remain in Washington at least seven days before final action is taken. The department finds it necessary to decline to give earlier consideration to one passport than to another and will not answer letters, telegrams and other communications concerning passports until the passport application has been finally acted upon.

* * *

To meet the war needs of the country, sheep and cattle will be grazed on the national forests in increased numbers this year. Half a million more sheep and nearly a quarter of a million more cattle will be taken care of than last year, according to the officials of the Forest Service. This will bring the total number of stock grazed under permit to about 9,000,000 sheep, 2,360,000 head of cattle, and 51,000 swine. This increase is on top of an increase of 200,000 sheep and 100,000 cattle made last year, when it was recognized that the country's need for beef, mutton, wool and hides called for the fullest possible use of the national forest ranges.

* * *

Federal Reserve banknotes of $1 and $2 denominations designed for the nation's first war-time currency have been approved by the treasurer and the new bills will appear in general circulation about July 4. A symbol of the war is given on the reverse side of the $2 notes in the design of one of the newest battleships, and the face of the $2 notes bears a portrait of Thomas Jefferson. The face of the $1 note carries a portrait of George Washington, and the reverse side has a design of the spread eagle, in warlike attitude, clutching the American flag. The bills are intended to replace silver certificates, about $30,000,000 of which have been withdrawn from circulation, as the silver which secured them was melted into bullion under the new Silver Act.

The kaiser has approved the founding of a trust to be known as the Kaiser Wilhelm Trust for the Promotion of War Science. The aim of the trust is to further the development of scientific and technical aids to warfare by uniting the scientific and the military forces of the country for work together. The scientific work is to be carried on by the following technical committees or commissions: (1) Committee on chemical raw materials for the production of munition-manufacturing materials; (2) committee on chemical war materials (powder, explosives, gas and the like); (3) committee on physics, including ballistics, telephony, telegraphy, determination of targets and distances, measurements, etc.; (4) committee on engineering and communication; (5) committee on aeronautics; (6) committee on obtaining and preparing metals.

* * *

In 1917 the 29,000 farmers on 1,000,000 acres of land reclaimed by the Reclamation Service of the Department of the Interior went over the top with a crop valued at $50,000,000, according to the report of the bureau recently made to Secretary of the Interior Lane. The 1917 crop from reclaimed lands exceeds in total value by $11,000,000 all the crops of Maine, as shown by the census reports of 1909. It is greater by $7,000,000 than the combined crops of New Hampshire and Vermont, and only $4,436,000 less than the total crop values of Massachusetts and Connecticut. The gross average of $50 an acre for crops grown on the Government's irrigated farms is remarkable when compared with similar statistics for all farms in the United States, the average yields of which in 1909 were only $16.30 per acre.

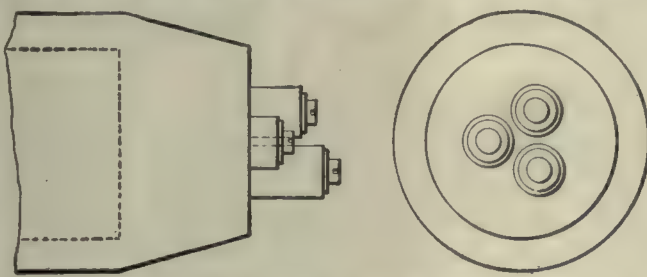
* * *

The greatest industrial war drama in the history of the South is being enacted at Muscle Shoals on the Tennessee River in northwestern Alabama. Developments of tremendous importance to the United States in both times of war and peace are being rushed to completion there at a cost of $70,000,000. The Government has already well under construction two emergency nitrate plants that will extract nitrogen from the air for use in preparation of ammonium nitrate, so essential to the manufacture of gun cotton, smokeless powder and other high explosives used in war, and for making high-grade fertilizer so necessary to the restoration of soil fertility. President Wilson has also authorized the construction of power and navigation dam No. 2 of the Tennessee River at Muscle Shoals, in which the United States army engineers have recommended ultimate installation of hydroelectric machinery for generating 480,000 hp. Nitrate plant No. 1 will be in operation during June. An army of 2200 men is employed on this work alone. The plant will manufacture 30 tons of nitrates a day by the synthetic-ammonia process of air-nitrogen fixation. It will also consume 100 tons of coke a day and from one to two tons of dolomite. The remainder of the raw material will come from the atmosphere.

Locating Holes on Close Centers by Means of Special Buttons

By John G. Rock

The illustration shows a part of a drilling fixture in which three holes were to be located too close together to allow the use of a test indicator. The first time the job came up the holes were located and drilled one at a time, but this method consumed more time than was necessary and allowed greater opportunity for error than if all the buttons were located at one setting.



LOCATING CLOSE CENTERS WITH SPECIAL BUTTONS

The second time the job was to be done, the writer was prepared with special buttons, one longer and one shorter than the regular set. This allowed all three buttons to be set at once, and by swinging up the longer one first the lathe man was enabled to center and bore them in succession.

A Radius Truing Fixture for Use On Grinding Wheels

By Robert C. Morse

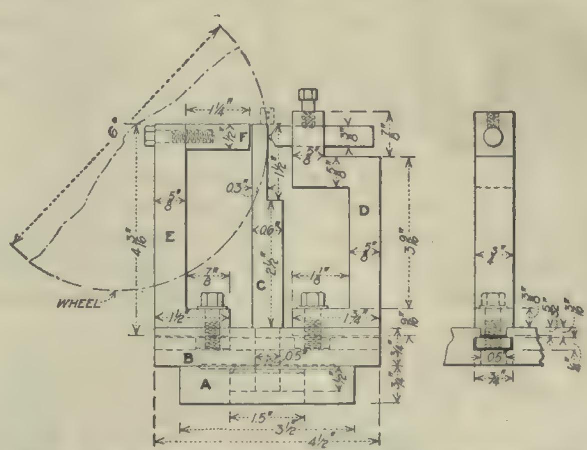
It is essential on various classes of tool and die work that the radii be ground, therefore a radius truing fixture must be made to suit the purpose. There are many types of fixture in use in various parts of the country, some of which are simple and others complicated.

The illustration shows a successful fixture, which is very simple in construction and less costly than some I have seen. It is quite rigid, which is essential to success in making a true radius, and is very easily adjusted for both internal and external radii. The diamond is set by means of size blocks by which method an accurate setting may be attained. All parts of machine are casehardened, thus assuring accuracy of fitting and better wearing surfaces.

Referring to the sketch, the base *A* is surface ground on the top and bottom, and the hole is ground to 1,500 in. diameter. On the plate *B* the 0.500-in. diameter hole, the 1.500-in. diameter projection and the surface that bears on the base *A* should be ground in one setting to insure precision.

The T-slot is ground to 0.500 in. in width, making it easy to center it with the 0.500-in. hole for the setting plug *C*. The shank of this plug *C* is ground to fit the 0.500-in. hole, while the body is ground to 0.600 in. in diameter. For about 1½ in. of its length one-half its diameter, or 0.300 in., is ground away, leaving a flat that exactly cuts the center line, and it is from this flat that all settings are made. A small projection about $\frac{5}{16}$ in. in length and of suitable diameter is turned on the end of the plug to facilitate grinding, and should be eliminated after finishing. The diamond holder *D* is adjustable in the T-slot, and the shank of the diamond is also adjustable in the holder, thus allowing a wide range of adjustment.

The section *E* is for setting the diamond for truing internal radii and is also adjustable in the T-slot. By means of the size blocks the setting point *F* is adjusted to the correct distance from the center, the center plug being turned around if the desired radius is less than 0.300 in. The center plug is then removed and the diamond adjusted to contact with the face *F*, the section *E* then being removed from the fixture.



FIXTURE FOR TURNING RADII ON GRINDING WHEELS

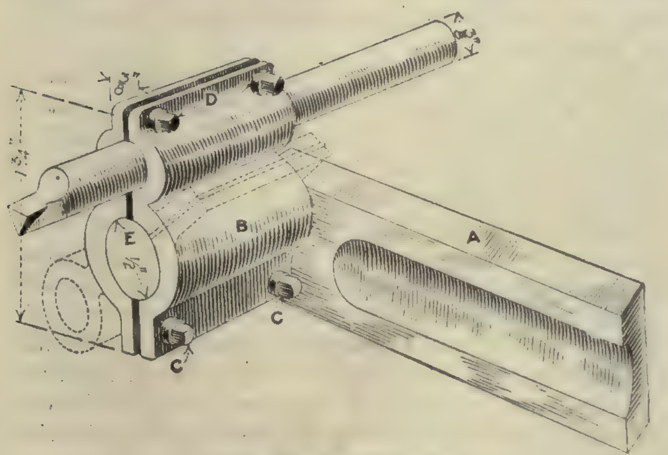
In making small internal radii on grinding wheels a small diamond especially adapted for this purpose is necessary and a radius smaller than 0.125 in. is impracticable. This fixture will accommodate wheels from 3 to 7 in. in diameter, which is the range ordinarily used on a Brown & Sharpe surface-grinding machine.

A Small Boring-Tool Holder

By Hugh F. Pusep

Most toolmakers possess a small boring-tool holder of some kind for the purpose of boring small jigs, bushings and die blanks. Although the larger sizes of boring-tool holders are to be found in almost every toolroom, holders for the smaller tools have not, so far as I know, appeared on the market and it is up to the individual toolmaker to design or copy one.

The boring-tool holder, shown complete in the illustration, in my estimation is one of the best of its kind, its range of adjustment being greater than may be found in the majority of toolholders, the shank *A* and the block *B* being made of machine steel and casehardened. On tightening the two shoulder screws *C* the toolholder block is securely clamped to the cylindrical part *E* of the shank in any desired position.



BORING-TOOL HOLDER

Screws *D* serve to hold the boring tool and allow necessary adjustments to be made easily.

The advantage of this toolholder, besides its range of adjustment, lies in the fact that it presents the boring tool always parallel to the axis of the lathe spindle, thus making it possible, in the case of a very small hole, to use a boring tool just enough smaller than the hole to clear it, which permits the use of the most rigid tool.

As can be seen from the cut, a $\frac{3}{8}$-in. diameter boring tool is the largest size that the holder block will take. Drill rod of any size smaller than $\frac{3}{8}$ in. can be used by making a split bushing out of $\frac{3}{8}$-in. round cold-rolled steel, with a hole bored to suit the diameter of the drill rod of which the tool is to be made.

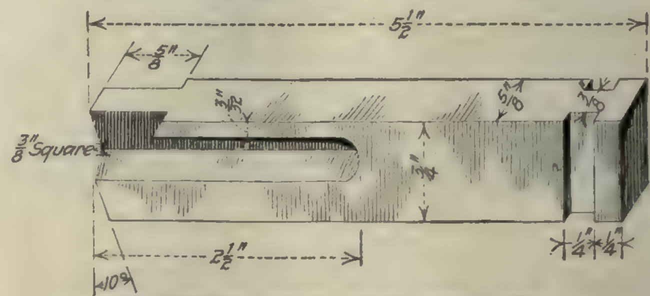
A toolholder made to the dimensions given will have a $1\frac{3}{16}$-in. vertical range of adjustment. In order to get the full benefit of this toolholder it should be clamped directly upon the finished top surface of the compound rest, the rocker block and washer being unnecessary, as all vertical adjustments are made by swinging the toolholder block till the $\frac{3}{8}$-in. hole is brought to the height of the lathe centers and then clamping it with the two $\frac{1}{4}$-in. shoulder screws.

In order to insure that the center line of the stud, which forms part of the tool shank, shall be in a horizontal plane when the tool shank is clamped in position, this stud should be turned in the lathe with the shank of the tool strapped to an angle plate which is in turn bolted to the faceplate of the lathe.

A Toolholder for the Lo-swing Lathe

By H. W. Woolums

Desiring to use stellite and high-speed steel bits in the Lo-swing lathe, and having no means of brazing or welding these materials to low-carbon steel shanks,



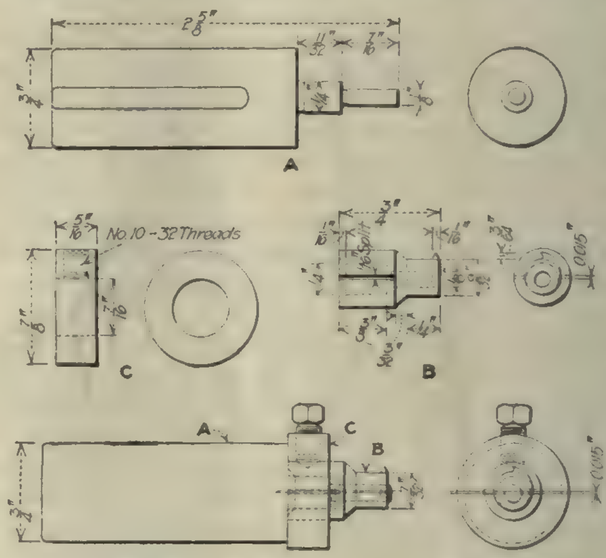
HOLDER FOR HIGH-SPEED TOOL BITS

the writer devised the toolholder shown in the illustration. Though the dimensions of the slot are given as $\frac{3}{8}$ in. square, in practice we make them about 0.005 in. less than this, which permits grinding the bits to a press fit.

A Small Adjustable Boring Tool

By F. M.

A boring tool suitable for use in a small turret lathe is shown in the illustration. It is of quite rigid construction and is easily adjustable to the sizes within its range. It is made in three parts, *A* being the shank, which is fitted to the turret, *B* the cutting tool and *C* a collar by means of which the adjustments are made. As will be observed from the detail sketch the shank is



BORING TOOL FOR SMALL TURRET LATHE

turned down at one end and the cutting tool is made in the form of a sleeve, which is a neat fit on this projection. The sleeve is split lengthwise to allow being clamped firmly in place by means of the setscrew carried in the collar *C*.

That part of the sleeve *B* which is turned down to form the cutting point is made eccentric to the hole upon which it turns, so that adjustment for varying the diameter of the hole to be bored is made by turning the sleeve slightly and clamping it with the setscrew.

EDITORIALS

The Need of Teamwork in Getting Big Guns

THERE seems to be no question as to the necessity for big guns, and plenty of them, on the western front and elsewhere, and though Great Britain and France may be able to supply us for the present there can be no shirking the very evident fact that it is up to us to add greatly to the heavy artillery for the coming campaigns.

The next problem to be investigated, and this is likely to come as soon as the present airplane investigations are concluded, will probably be along this line. And when it is found that not only have we failed to order the big guns but also to a very large extent the machines with which they must be built, questions both pertinent and impertinent are very likely to be asked. Those who appreciate the difficulty of securing large machine tools have been trying for months to secure some fairly definite ideas as to the big-gun program, so that the boring and turning lathes and other necessary machine tools might be ordered or prepared for in advance. We have urged the adoption of a machine-tool program which would take care of this and which would include the ordering of sufficient machine tools to prevent further delays as soon as the big-gun designs and program shall be completed.

* * *

A comprehensive list of the machine tools needed has been prepared by thoroughly competent engineers who have endeavored to have the authority given to order such machine-tool equipment as may be necessary to at least make a beginning on some program of this kind. Up to the present time this is still under consideration, and no move has been made to secure the necessary machine-tool equipment or to let manufacturers know what kinds and sizes of machines will be required.

When we realize that there is practically no available capacity for the building of large machine tools in this country, and that it will be necessary in most cases to greatly enlarge present facilities or to create new machine-building establishments, the necessity for speedy action becomes apparent. In this connection it is interesting to note that a number of the progressive machine-tool builders have already been in conference with a view to combining their facilities, so far as possible, and of creating in various machine-tool centers sufficient capacity to handle the new program as rapidly as is humanly possible. Even this, however, is not particularly encouraging when we consider that it will be almost impossible to secure the machine tools needed for making the big guns in less than from 8 to 12 months after the order is placed. And even the knowledge of this condition has so far failed to secure the requisite action when all that is necessary is an approximate idea of the dimensions of the guns to be built. It is not even necessary that the gun designs be completed, although it would seem as though this should have been accomplished in less than a year after entering the war.

* * *

In marked contrast with this is the condition of the navy program. And though its problems are less difficult because its expansion has been very much less than that of the army, it must be credited with having a definite program laid out and with taking every precaution to see that the necessary machine capacity for carrying it out should be available when wanted.

This planning was so carefully done that at the present time the Navy Department has contracts with practically all of the large builders of machine tools capable of turning and boring big guns, which will utilize their capacity for from two to three years. This makes it necessary for the army to create, or to assist in creating, new machine-tool building facilities before it can hope to secure the machines with which to build the big guns which are so necessary in France today.

The same foresight is also in evidence in the contracts for guns themselves. The navy has contracted for a large percentage of the capacity of the two largest gun-making companies in addition to the work which is now being done at the Washington Navy Yard. This speaks well for the forehandedness of the navy in anticipating its needs. But at a time when the army needs all the facilities which can possibly be secured it is a bit disheartening to find that these guns are being made for naval vessels which will not be completed for at least two years, and in some cases for a much longer time.

* * *

This seems to be a case where team work is badly needed and where a coördinator is necessary in order to distribute not only material but manufacturing facilities according to the most urgent needs. In other words it seems essential to have someone with sufficient authority to apportion priority in munition-manufacturing capacities where it is most needed. If, for example, the gun-making capacity of the two large steel companies, which is now being devoted to the future needs of the navy, as well as the gun-making facilities of the navy yard at Washington could be transferred to the army until such time as new gun-making plants can be established it would go a long way toward solving our problem of securing heavy artillery for our army in France. It is a very similar case to any manufacturing establishment in which one department, either through extraordinary foresight or management or perhaps on account of other circumstances, is able to outstrip all other departments. It makes an excellent showing for this particular department, but it does not help in the total output of the shop. And we are engaged in too vital a struggle not to use every manufacturing facility to the best advantage.

The proper apportioning of our manufacturing

facilities where they will be of the greatest service in the winning of the war requires a broad vision and great power. As our organization is now constituted it is doubtful if anyone but the President of the United States has the authority to do this. It would seem, however, that the time had come for some such drastic action to be taken if we are to play our full part in the great struggle now going on. Unless this is done there seems to be no possible way of securing an adequate supply of big guns in less than eighteen months, and it will probably require a much longer time. Is the time not ripe for some such drastic action to be taken?

The Stop-Watch and Efficiency Controversy

THE periodical discussion as to the use of the stop-watch and efficiency methods is once more engaging the attention of Congress. It is unfortunate that this should take place at present, as it seems likely to disturb the relations between employers and employees just as they appear to have reached a settlement, or at least a truce, in the agreements of the National Labor Board.

The stop watch is simply a tool for measuring certain factors connected with modern production just as we use a comparator to determine definite relations. One gages quantity and the other quality. Both are essential to modern production, and particularly at this time when the volume of useful manufactures is likely to be the determining factors in settling the war. Labor should not object to either the quality or quantity of its work being measured when such measurements are fairly made and not used to its detriment.

* * *

The efficient shop develops ways and means for its employees to earn higher wages and at the same time turn out more product with no increase in physical effort. The stop watch can be of great service to both sides in accomplishing these results, and should not be outlawed any more than the micrometer or the comparator. They should both be used fairly—by compulsion if necessary—and when so used the legitimate aims of both the employer and the employee would be served.

Opposition to the use of the stop watch has developed from its unfair use in some places where the time of the fastest man would be used as a standard for setting piece rates, or where a spurt is timed instead of a steady working gait which can be kept up hour after hour. But employers who will do this can find other means of taking undue advantage of their men. The stop watch is only the means, not the thing, to which objection should be taken.

* * *

The workers of the country will do well to consider the whole case carefully before they allow themselves to be misrepresented in Congress either by members or by their own leaders. They will be making a mistake to allow themselves to be put on record as opposing the instrument rather than the way in which it is used; it places them in the position of opposing increased production at a time when production is more necessary than ever.

Whatever may be the personal feelings in regard to the question we must all remember that the first object of every man, woman and child in this country is to win the war. Our boys on the other side must have more and more guns, airplanes, ammunition and supplies of all kinds. With thousands and millions of our men in the army those who are left must produce more and more per man. If the stop watch can be used to increase our production we have no more right to prohibit its use than we have to refuse to allow a new machine to be made for making shells. We can protest against its being used to injure those who use it, but not against the machine itself.

Our boys over there—our sons and brothers and pals—welcome any new weapon which enables them to do more effective work against the enemy. If a stop watch and motion study would enable them to get into action more quickly they would welcome them too. Anything which will make any of us more effective is a necessary part of our equipment.

* * *

The *American Machinist* has always stood for fair play for both employer and employee. It has condemned unfair practices on both sides. But it also believes that nothing should stand in the way of securing the greatest possible production in all lines of essential industry now. Prejudices of all kinds should be laid aside. The National Labor Adjustment Board should prevent unfair advantages being taken by either side, and above all should oppose any cessation of production for any preventable cause. Labor has its opportunity of proving that it is thoroughly and intensely loyal, and by so doing it will greatly strengthen its claims to a substantial reward when the world returns to a more normal condition.

Let us forget the stop-watch and efficiency controversy for the present and devote ourselves to increasing production by any and every means at our disposal. The lives of our boys in France should be our first consideration. Let us all pull together for the one great object—the winning of the war.

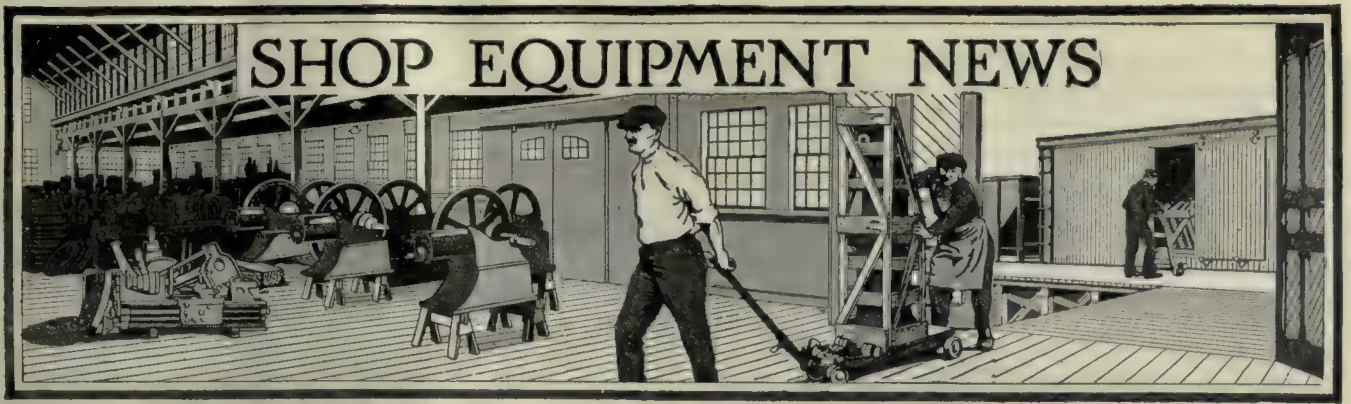
Keep on the Job

TIMES change, but the different ages present the old problems in a new form. Our responsibility to our fellow man is more than ever apparent. Everyone of our boys in France is looking to *you* to back him up, to keep him supplied with guns, ammunition, clothes and food—all that he needs. He is fighting *your* fight —dying perhaps that you and yours may never know the plight of ravaged Belgium.

You must see that he never lacks for anything. *You* must do your full share, not only today but every day.

You are getting high wages, and we are glad. But it must not blind you to the duty of keeping everlastingly on the job. Let the ball game wait till the war is over or until it does not interfere with your work.

You are your brother's keeper—to keep him supplied with all the implements of war. Laying off when not absolutely necessary is like a soldier shirking a battle. Remember *you* have a great responsibility—the responsibility to turn out all the munitions and the machines which makes munitions *you* can. And not only today but *every* day until the war is won.



This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist."

Oliver Wood-Shaping and Surfacing Machines

The illustrations show two types of machines that are the product of the Oliver Machinery Co., Grand Rapids, Mich. Fig. 1 shows the No. 483 high-speed, double shaping machine, which is adapted for rabbeting, grooving, fluting, routing or shaping of all descriptions. The table is ground and fitted with three sets of rings. High-carbon crucible steel is used for the vertical spindles, which are ground to size. Bearings

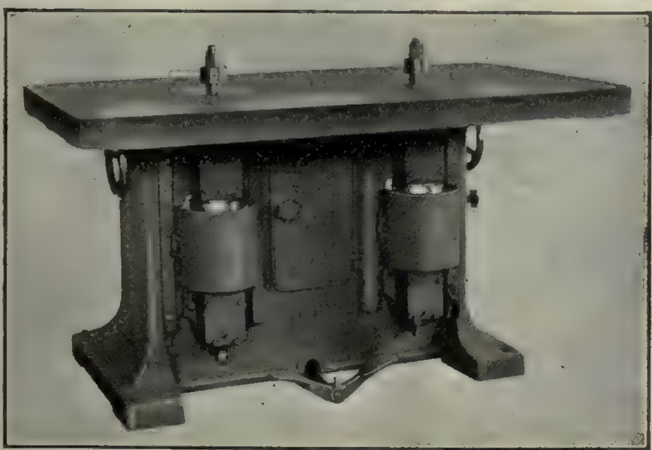


FIG. 1. OLIVER NO. 483 HIGH-SPEED, DOUBLE, WOOD-SHAPING MACHINE

Speed, 7000 r.p m.; vertical adjustment, 6 in.; length of collars, 8½ in.; diameter of spindle at collars, 1⅞ in., at top bearings, 2⅜ in., at bottom bearings, 1½ in.; length of top bearing 7½ in.; length of bottom bearing, 4½ in.; width of driving belt, 4 in.; number of rings, 3; hole in smallest ring, 2 in.; size of table, 60 x 36 in.; distance from front and side edges to spindle, 18 in.; distance from center to center of spindles, 24 in.; height from floor to table, 36 in.; diameter of holes in table, 8 in.; floor space, 60 x 44 in.; horsepower recommended 7½.

are of bronze, conical in shape, and are surrounded by oil chambers which lubricate the spindles the entire length of the bearings. The bottoms of the spindles ride on adjustable copper steps and a large brass drip cup catches the waste oil from the upper bearing. Pulleys are balanced and held in place with taper pins. The yokes are raised and lowered by means of handwheels at the side of the machine, and there is sufficient adjustment to lower them beneath the table. Top bearings are furnished if desired and are adjustable and of bronze. One guard is regularly furnished with each machine, but the table is drilled and tapped for two guards in case they are desired.

Fig. 2 shows the No. 1 single-cylinder, four-roll, double-belted cabinet surfacer which is made for work up to 8 in. thick and widths of 24 and 30 in. A number of improvements have been made on this machine, such as complete housing and guarding of the gears, sectional

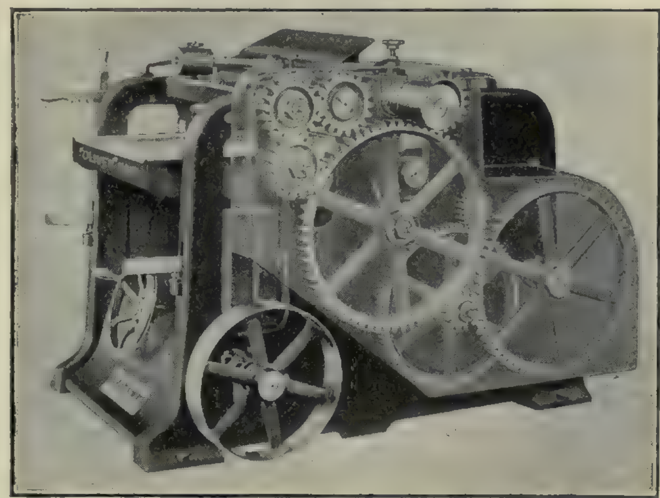


FIG. 2. OLIVER NO. 61 CABINET SURFACING MACHINE

Made in two widths, 24 and 30 in. Specifications for 24 in. machine: length, 58 in.; width, 35½ in.; height, 37½ in.; cutting diameter of cylinder, 4½ in.; bearings, 9¾ x 2 in.; pulleys, 5 x 5 in.; speed, 3800 r.p.m.; diameter of feed rolls, 4 in.; feed-roll bearings, 4½ x 2 in.; feeds per min., 14, 18, 24, and 31 in.; roll gears, 6 in. in diameter, 3 pitch; main driving gears, 22 in. in diameter, 3 pitch; length of bed, 48 in.; adjustment of bed in slide, 8 in.; depth of slide, 12½ in.; depth of table, 14¼ in.; raising screws, 1⅝ in. in diameter, 4 threads per inch; floor space, with countershaft, 8 ft. 4 in. by 5 ft. 2 in., without countershaft 5 ft. 2 in. by 5 ft. 2 in.; horsepower recommended, 7½ to 10.

chip breakers and a new knife-grinding attachment. The sectional chip breaker consists of 1⅛ in. sections pivoted in connection with section weights on two horizontal bars attached to two plates. They yield eccentrically to the cylinder independently of one another.

General Electric Pressure Governor for Gas and Liquid Systems

The General Electric Co., Schenectady, N. Y., has recently placed on the market a new pressure governor for use on gas and liquid systems which must be maintained at about a certain pressure. The governor maintains the pressure between certain predetermined limits on any gas or liquid system, starting or stopping the motor-operated pumps or compressors as necessary. The governor is known as the company's Type CR2922 and

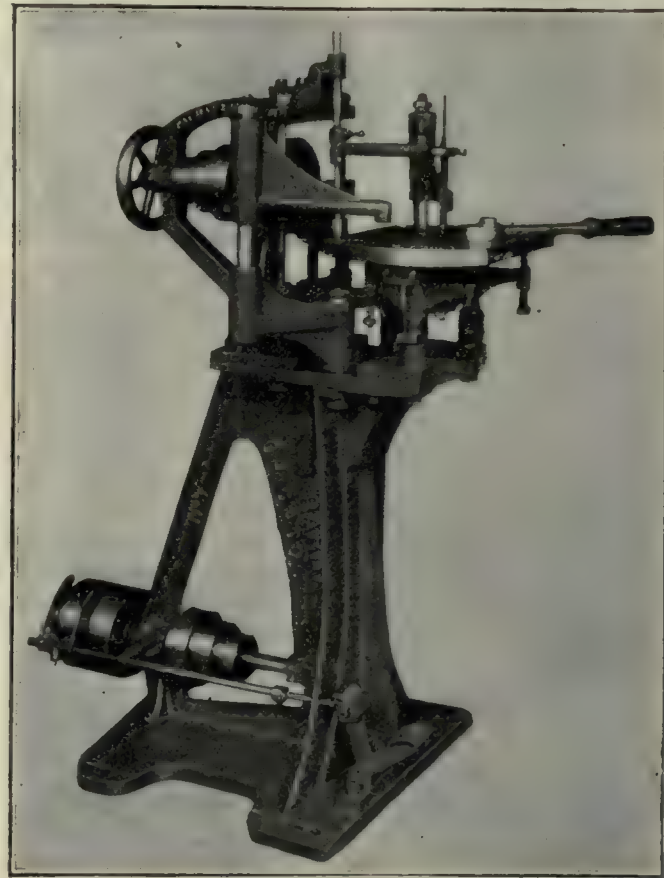
can be used on any standard alternating or direct current circuit. It is rated for pressures of 80, 100, 160, 300 or 500 lb., as desired, and operates within settings of from 3 to 12 lb. between high and low pressures. The device can also be supplied for higher pressures on special orders. The governor consists of a Bourdon tube, an indicating needle, a graduated-pressure scale, adjustable high and low pressure stops to determine the desired pressure range, and a relay which actuates the contact

PRESSURE GOVERNOR FOR GAS AND LIQUID SYSTEMS

in the control circuit of the selfstarter, all this mechanism being inclosed within a dustproof case that can be easily opened for purposes of inspection. The action of the governor is dependent upon the Bourdon tube, which should be connected to an independent discharge pipe from the pressure tank. After the settings for the pressure range have been made, the governor will automatically maintain the pressure between these limits.

Barry Filing Machines

The filing machine illustrated is one of the products of the Barry Manufacturing Co., 5-11 East Kinzie St., Chicago, Ill. It is made in two sizes, No. 2 and No. 3, the illustration being of the latter, or larger, size. The file holder used permits the use of any regular or special size file with either straight or taper shank, and jig or hack saw blades can also be accommodated. The table is adjustable in four ways to give any angle or clearance required on the work, and indicator scales and needles permit accurate adjustment. A roughing attachment is provided with a cam feed for fast roughing of dies and other work. This can be easily removed when not in use. Adjustable fingers are placed at either side of the table to hold the work. The ways are located above and back of the work table so that filings and dust cannot fall on the working parts. The cross-heads slide on guide rods and carry supporting arms which operate above and below the table, the distance between these arms being adjustable to accommodate files or other instruments of varying length. The lower arm may be adjusted to operate close to the table for different lengths of stroke. The countershaft is attached to the base of the machine and has a three-step cone for 1½-in. belt. This gives speeds of 200, 350 and 600 strokes per minute. Motor drive can be furnished if desired, a ½-hp. motor being the size used. Another feature of the machine is that the adjustable cross-head allows the file to be shifted so that the whole surface of the file can be used, allowing the use of files of any length. Included with the machine is a



BARRY NO. 3 FILING MACHINE

Height from table to floor, 36 in.; dimensions of table, 14 x 10½ in.; stroke of file, 0 to 4 in.; tilt of table, 18 deg. front and back, 10 deg. right and left; diameter of drive pulley, 6 in.; face of drive pulley, 2 in.; horsepower required, ½; weight, 350 lb.

die-holding disk for holding small dies, the purpose of this being to allow the holding of small dies rigidly and at the proper angle.

Assistant Fuel Administrator Appointed

Cyrus Garnsey, Jr., was recently appointed assistant fuel administrator and will be in general charge of the administrative work of the Fuel Administration. He will supervise the business office of the administration; legal matters; the fixing of operators', jobbers' and retail prices; conservation education, and the work of the state administrators. Mr. Garnsey was born Apr. 10, 1861, and in 1880 went to Kansas City, Mo., as private secretary to the general manager of the Kansas Rolling Mill Co. A few years later he became comptroller of the Kansas City, Fort Scott & Memphis Railway Co., which runs from Kansas City to Birmingham, Ala. In 1899 he purchased an interest in and became the executive head of the Galloway Coal Co. of Memphis, operating mines in Alabama. At the same time he also became general manager and one of the proprietors of the Patterson Transfer Co. of Memphis. Mr. Garnsey has sold his entire interest in the coal business and retired from active management of the Patterson Transfer Company.

How Machine-Tool Builders Can Help Make Big Guns*

BY LIEUT.-COL. H. W. REED

THE invitation extended to the Ordnance Department by your president to discuss with the members of your association the problems that arise between the machine-tool builders and the Ordnance Department is the natural sequence of the harmonious relations existing between the department and the machine-tool builders and their representatives serving in the machine-tool section of the War Industries Board.

When problems of such magnitude as are arising today come up for action it is impossible to handle them through the recognized channels of peace times, and so the Ordnance Department has in the past frequently called upon machine-tool manufacturers for assistance not only in expediting the delivery of machine tools so urgently required, but also in determining the requirements of the machines necessary to build certain types of ordnance.

Frequently it has been necessary to send out hurry-up calls to machine-tool manufacturers for the loan of certain of their engineers to assist the Ordnance officers in analyzing some new type of ordnance so as to determine the kind and number of tools required.

ATTITUDE OF COÖPERATION

Recognizing the attitude of coöperation that the members of your association have always shown to this department each of the calls made were sent without regard to the inconvenience that it may have caused you in giving up the services of important engineers of your organization for this work, as it was felt by the department that the best results could be accomplished if a tentative schedule of machine-tool requirements for some of the most important types of ordnance was made up rather than by eliminating the preparatory engineering work and ordering machine tools indiscriminately, trusting that enough of them would be fitted for the work to take care of the various contracts.

By this preliminary time-study work it is safe to say that probably several million dollars' worth of unnecessary machine tools was saved, thus relieving to a certain extent the tense machine-tool situation that existed last fall.

Although comparatively few of you were called upon for this work the prompt response made by those appealed to reflects the spirit of your organization, and the department takes this opportunity to extend its appreciation for the assistance given it by you during these trying days when the production sections were being organized.

Before giving you the machine-tool requirements of the Ordnance Department for its large gun program there are a few general conditions that I have been instructed to bring to your attention.

The question has been asked: How best can the machine-tool builders serve the Government? This may be answered broadly by stating that you can best serve by turning out as many machine tools in the quickest time possible. There are, however, so many phases of the problems to be considered that I will enumerate in their order of importance the specific ways in which you can best serve the Ordnance Department. In frankly stating what the department expects of you, these statements should not be considered as criticisms of your present work, as the Ordnance Department recognizes the wonderful work which has been performed by the companies in your organization. The request for a greater effort from you is based on the knowledge of your past work, and I may add that if all branches of industrial manufacturing had come through as cleanly as the Machine Tool Association we would be further on our way today.

The Ordnance Department asks of you a greatly increased production of large machine tools. Your reply will be that you have reached your limit. If such is the case then you must remove that limit, because the success of the program for large guns depends upon your output of heavy machines for the remainder of the year. In other words the success or failure of the 1919 drive, as far as the use of large-caliber guns is concerned, rests squarely upon your shoulders, and you are expected to carry that load. The machines available are insufficient, and based upon reliable information it is understood that unless the present rate of output for large machine tools is considerably increased the program for large guns will be jeopardized.

Therefore, gentlemen, the first requirement expected of you is an increased output of large tools of a type that will produce large ordnance, and steps must be taken by you to insure an increase over your present output. The procedure to be followed to secure this increased output is part of the burden of the war which you are asked to carry. The members of your association are in the best position to work out a successful plan to produce the required machines, and you are asked to coöperate with the Machine Tool Section of the War Industries Board to determine how the results can best be obtained.

From the splendid record made by the members of your association during the past year there is no fear that you will not produce the required equipment in the time specified, provided you devote your energies to this work. The department is asking you for this additional effort because it believes that you are capable of successfully carrying out the required program.

CLOSER CONTACT WITH WAR INDUSTRIES BOARD

Closer contact should be maintained between the Machine Tool Association and the Machine Tool Section of the War Industries Board, so that the members of the association can at all times be fully informed as to not only the requirements of the Ordnance Department but also as to the other branches of the national Government.

The time has arrived when it may be necessary for certain machine-tool builders who have in the past strictly adhered to certain types and sizes of machine

*An address before the Atlantic City convention of the National Machine Tool Builders' Association held May 16, 1917.

tools and who have enjoyed a national reputation as the manufacturers of these tools to change their commercial commodity. The time has arrived when it is not a question of maintaining your past standards, but of manufacturing types of machinery that will do the most good.

A manufacturer who is equipped for making certain machine tools for which there is no urgent demand by the Government should imediately take steps to devote his energies to some type of machine for which there is a demand, or if his equipment is such that he cannot change to some other type of machine tool, then it is his duty to inquire into the needs of the Ordnance Department to determine the material for which he is equipped and for which there is an urgent demand.

By keeping in close touch with the Machine Tool Section of the War Industries Board you can at all times be posted as to the Government machine-tool requirements, and the Machine Tool Section of the War Industries Board should be able to advise you as to the advisability of changing from machine tools to straight-ordnance manufacturing, provided your equipment is such that it would be impossible for you to produce machine tools which the Government really requires. It is felt that with the Machine Tool Section of the War Industries Board, acting as the intermediary between the Ordnance Department and the machine-tool builders, an alliance can be formed between these two bodies that will be extremely beneficial to both. It should be remembered, however, that in approaching the Machine Tool Section of the War Industries Board you should be in the frame of mind to accept their decision as to what you can best build to suit the Government's needs, and not what you would like to build to suit your own convenience.

Advice Needed as to Best Machines

It is suggested that far too little time is devoted by the machine-tool manufacturers in assisting their customers in arriving at the machine-tool equipment that would best suit their requirements. During peace times every progressive machine-tool manufacturer would check up the requirements of his customers so as to be assured that each tool sold to the customer was the one best fitted for his needs. This service has probably been discontinued to a certain extent for two main reasons: (1) Due to the enormous demand for machine tools during the war period it was not necesary for machine-tool builders to solicit business, and therefore it is very easy for them to unconsciously discontinue their engineering services, which heretofore had been given to the operating departments of their customers' plants; (2) Due to the general unfamiliarity of the country at large on the machine-tool requirements for ordnance work the machine-tool builders have been loath to offer any suggestions as to what tools would be best fitted for the manufacturing of ordnance material.

The result has been that all too frequently equipment has been sold to manufacturers holding contracts for ordnance material which was not suited in any way for their needs. Because of the vast amount of new material to be manufactured and the difficulty in securing the proper personnel for the Ordnance Department it has been practically impossible to check in detail the machines required for all classes of ordnance material, and due to these difficulties, together with the lack of advice from machine-tool builders, quite a large amount of machine tools has been delivered which is absolutely unsatisfactory for the work that is expected to be performed.

You machine-tool builders should realize that it was necessary to let contracts for ordnance material to manufacturers who have had little or no experience in the past on up-to-date machine-shop practice, and therefore, in purchasing tools from you, you should increase the service heretofore rendered your prospective customers by advising them as to what they should and should not buy.

To illustrate this point: Upon checking the machine-tool list submitted by a contractor in the Ordnance Department recently it was discovered that he proposed to buy 180 12-in. lathes. Had these lathes been purchased it would have been impossible to use any of them on his contract. While admitting that this is an extreme case it might frankly be stated that every Government contractor would have been benefited had the machine-tool builders coöperated to their fullest extent in advising the types and sizes of machines to be purchased.

Another important service in which the machine-tool builders can assist the Ordnance Department is in driving the machine-tool gypsies out of business. It should be remembered that the Ordnance Department must defend the prices paid for the machine tools purchased by the Government for their contractors. This may be difficult in a few cases, as the prices on certain machine tools, especially second-hand ones, have been run up to an amount out of all reason, due to one or more wash sales. Transactions of this kind reflect discredit upon the tool industry as a whole, even though those of us who are well informed realize that actions of this kind would not be tolerated by your association, and it is requested that the manufacturers and legitimate sales agents use their influence toward the elimination of the pernicious activities followed by this class of men.

Requirements

Quoting from a letter from Mr. Merryweather, chairman of the Machine Tool Section of the War Industries Board, the present requirements of the Ordnance Department for machine tools may in general be stated as follows:

Briefly stated the American machine-tool industry is apparently well able to cope with all the demands that may be made on it for small and medium sized tools up to approximately 24-in. lathes; 24-in. planers; 36-in. vertical boring mills; radial drills up to 4-ft. swing; all small drill presses, turret lathes, automatic screw machines, surface grinding machines, etc. There is, however, much evidence of a dangerous shortage of planing machines, lathes, slotting machines, vertical and horizontal boring mills, radial drills and milling machines of sizes larger than those specified above. The reasons for this statement are sufficiently obvious.

The following machine tools will be needed for the big gun program and there is also likely to be a demand for a 50-per-cent. reserve supply:

Combination Boring and Turning Lathes.—Sixteen 85 in. by 50 ft., six 75 in. by 50 ft., three 52 in. by 50 ft., fifteen 72 in. by 50 ft., two 52 in. by 80 ft., five 72 in. by 20 ft.

Boring Lathes.—Twenty-eight 54 in. by 12 ft. to 22 ft., five 40 in. by 50 ft. double end, eighteen 50 in. by 25 ft. double end, eight 40 in. by 25 ft., one 32 in. by 25 ft. double end, two 72 in. by 30 ft.

Turning Lathes.—Two 36 in. by 6 ft., seventeen 60 in. by 6 ft. to 26 ft., twenty-nine 54 in. by 6 ft. to 24 ft., eight 70

in. by 50 ft., twenty-two 72 in. by 30 ft., ten 85 in. by 50 ft., four 60 in. by 50 ft., five 48 in. by 30 ft.

Planing Machines.—Twelve 48 in. by 12 ft., ten 72 in. by 16 ft., five 60 in. by 14 ft., six 48 in. by 14 ft., twenty-five 36 in. by 12 ft., five 96 in. by 24 ft., fourteen 120 in. by 30 ft., eight 64 in. by 24 ft., three 42 in. by 16 ft., one 120 in. by 24 ft., four 72 in. open side.

Slotting Machines.—Six 36 in., one 30 in., five 24 in., six 12 in., three 48 in., eight 14 in., eleven 26 in., three 10 in., three 18 in.

Radial Drills.—Eight 6 ft., thirteen 5 ft.

Milling Machines.—Four 6-in. spindle (horizontal), seven No. 6 vertical, six No. 5 vertical, two No. 3 universal, two No. 5 universal (horizontal), three No. 4 plain, three No. 4 universal, six No. 3 plain.

Vertical Milling Machines.—Two No. 6, eight No. 5, two No. 3, two No. 4.

Horizontal Boring Mills.—Twenty-nine 4-in, six 5-in., five 6-in., three 3-in.

Vertical Boring Mills.—One 14-ft., eight 20-ft., one 12-ft., five 10-ft., eight 48-in., seven 72-in., three 66-in., eight 90-in., eleven 60-in., three 50-in., one 96-in., three special.

Floor Boring Mills.—Three 7 in. by 7 ft., two 7 in. by 5 ft.

Rifling Machines.—Three 50 ft., two 30 ft.

Miscellaneous.—Eighteen 48-in. jump lathes, three 60-in. gear-cutting machines, two 24-in. gear-hobbing machines, three 24-in. by 8-ft. grinding machines, three 72-in. gear-cutting machines, two draw-shaping machines, one No. 4 gear-cutting machine, three No. 5 gear-cutting machines, one 16-in. by 50-in. grinding machine, one 10-in. by 72-in. grinding machine, one 18-in. rotary saw, three 26-in. shaping machines.

Recapitulation of Tools for Which a Scarcity Exists.—Boring lathes, turning lathes, combination boring and turning lathes, radial drills, milling machines (general, vertical and horizontal), vertical boring machines, horizontal boring machines, slotting machines, planing machines, rifling machines and floor-boring machines. Total estimated cost, $10,306,000.

In conclusion I wish to emphasize again the important part of the nation's work that your association is called upon to perform during the present crisis that the country is facing.

It has been stated that the mechanical power of an army in the field may be measured by the industrial army at home making the necessary munitions of war. I wish to go a step further and state that the efficiency of the manufacturing industrial army may be gaged not only by the number of machine tools turned out by the machine-tool manufacturers but also by turning out the types that will perform the best service for manufacturing the ordnance material required.

If the machine-tool builders will perform their part by turning out the required tools the Ordnance Department will take up the work at that point and the nation can be assured that the required guns and equipment will be delivered to meet the field armies' requirements.

Frederick Remsen Hutton

Probably no person has been more intimately connected with the American Society of Mechanical Engineers than Prof. F. R. Hutton. For 24 years he filled the office of secretary, during which time the society grew from a membership of 364 to 3366, an increase of 3000, and when in 1906 he was elected president of the organization its commanding position among the national professional societies had long been assured.

PROFESSOR Hutton was born in New York, May 28, 1853, and died May 14, 1918. After preparation in a private school he entered Columbia College, receiving the degree of A.B. in 1873. After graduation he entered the School of Mines, and was given its degree in 1876. A year later he was appointed instructor in mechanical engineering as an associate of the late Prof. W. P. Trowbridge. This was the first recognition which Columbia gave to the important relations of mechanical engineering to other engineering courses. He entered the faculty as adjunct professor in 1881 and became professor in 1890. Upon the death of Professor Trowbridge in 1892 the chair of engineering which he occupied was divided, and professorships in civil engineering and electrical engineering were added to the already existing professorships of mining and mechanical engineering. Professor Hutton was made the head of the mechanical department. He continued to direct this department until his resignation, July 1, 1907. At this time he resigned and was elected professor emeritus. For six years during his professorship he was dean of the Faculty of Applied Science.

During Professor Hutton's association with the university he developed the mechanical laboratories until the equipment at present is the most complete of any technical school. It includes a Baldwin compound locomotive mounted upon its testing equipment, a triple-expansion Allis-Reynolds engine and also a three-stage air compressor and the hydraulic equipment of the Henry R. Worthington laboratory.

Columbia conferred upon Professor Hutton in 1882 the degree of Ph.D., and upon the occasion of its 150th anniversary in 1904 the degree of Sc.D.

Professor Hutton became secretary of the American Society of Mechanical Engineers in 1883 when its offices were located at 17 Cortlandt St. He continued to direct its activities during the years following when it was located successively at 280 Broadway (the Stewart Building), 84 Madison Ave., and 12 West 31st St. In 1890 the house at 12 West 31st St. was purchased for $60,000, and sold in 1906 for $120,000, a profit of nearly $60,000 having been realized. Professor Hutton took an active part in this important and successful transaction and became one of the trustees of the Mechanical Engineers Library Association which was organized to hold the property. One of the most remarkable events in the history of the society was the trip made to Europe in 1889. Professor Hutton was connected with the arrangements for this trip, which had had a wide influence in giving international recognition to the society and establishing the bond of professional fellowship between this and the countries visited.

He was the member appointed by this society of the Conference and Building Committee of the United Engineering Society. This committee was organized to plan the new Engineering Societies' Building at 29 West 39th St. and during its erection he considered the problems and attended to the execution of the details which made the building one of the most complete of modern structures. Professor Hutton was also one of the board of trustees, which is the holding corporation for the United Engineering Society.

Professor Hutton was made president of the American Society of Mechanical Engineers as the culmination of the 24 years of service to the society as its secretary, which he had wished to round out into a quarter of a century. But the year 1907 was the year in which the society moved into its new location in the Engineering Societies Building at 29 West 39th St., and it seemed proper that having led the society from the modest beginnings, where he paid the rent of its office out of his own pocket, up through the successive stages of development and progress of floor occupancy and ownership of a whole house its retiring secretary should be made president that year. He therefore had the honor of presiding at the first gathering of engineers in their splendid auditorium, of representing the society at the

THE LATE FREDERICK REMSEN HUTTON

formal ceremonial days of dedication, and at the first annual meeting in their new home. On retiring from office he took for his presidential address "The Mechanical Engineer and the Functions of the Engineering Society," and developed the thesis that the original historic definition of an engineer by Tredgold should be expanded to cover new functions for the profession that were not before the mind of the originator.

At the close of Professor Hutton's administration as president of the A. S. M. E. he was appointed by the council to the office of honorary secretary.

Besides his work for the society and at Columbia University Professor Hutton had been a contributor to scientific literature. His most important books, which have received considerable acceptance in the educational field in the United States and in England, are "The Mechanical Engineering of Power Plants," "Heat and Heat Engines" and "The Gas Engine." The first of these is used as a textbook in some of the technical institutions of Japan. He was the author of two of the most important monographs of the Census of 1880, one covering machine tools and the other pumps and pumping engines.

He has contributed to the Transactions of the Society over his own name as well as with unsigned contributions and memorial monographs and discussions. Some of his works are: "Mineral Wool as a Non-Conductor Around Steam Pipes," "First Stationary Steam Engines in America," "A Classification and Catalogue System for an Engineering Library" and "The Mechanical Engineer and the Function of the Engineering Society." He has done considerable editorial work as associate editor of Johnson's Encyclopedia, as one of the editors of scientific and engineering titles of the Century Dictionary, as departmental editor in the *Engineering Magazine* as one of the editors of the New International Encyclopedia, and has been a contributor to technical journals and a lecturer to scientific and popular audiences in New York and elsewhere.

In addition to his other activities Professor Hutton served as consulting mechanical engineer for the Department of Water, Gas and Electricity of the City of New York in 1911. He was also consulting engineer for the Automobile Club of America and chairman of its Technical Committee since 1912, in which capacity he exercised general supervision of the important testing work conducted by the club in its laboratory.

Loyalty in the Shop

There has been too much talk of apathy, if not of disloyalty, in some of our shops. Our own observations do not bear this out. On the contrary there have been many evidences of extreme loyalty, even in some of the plants which have figured in the senatorial investigations.

Two specific instances will serve to show the spirit which is pervading the land. One of these is the Modern Foundry Co. of Oakley (Cincinnati), Ohio. Here the departments vie with each other in the quantity and quality of work turned out, as well as in subscriptions to the various appeals, and flags are seen everywhere.

The Italians in one department went to the shop one Sunday and whitewashed the end wall of the building so that the large United States flag would have a clean instead of a dirty background. Every department has its own flag raising and the enthusiasm runs high among all colors and nationalities.

Nor is the enthusiasm confined to flag raising, for at last accounts 98.8 per cent., or 331 out of 336 employees, not including the officers of the company, subscribed to the Third Liberty Loan, and raised the sum of $17,950—a splendid showing for a foundry or shop and indicating the best of relations between the men and the management.

Another pleasing example of loyalty is that of the toolmakers in the Ford Motor Co. These toolmakers volunteered to work Sundays on the tools for the Liberty motor in order to hasten production.

Where the right spirit prevails in the relations between the men and the management there is little chance of disloyalty in the shop.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., May 18, 1918—There is too much loose talk of graft and German propaganda in connection with the unfortunate delay in our airplane program. For while expenditures of several hundred million dollars with very little in sight as a result can be shown, and while it is easy to point out that the lack of planes ties up fairly well with the big drive, insinuations on either side do not prove anything, and there is usually another side to the story. We must not lose sight of the one great objective—the winning of the war—and recriminations or insinuations of any kind should not be allowed to hinder the work in hand.

It has been our privilege to see many of the inner workings of the airplane program, and from various angles. While we have seen and criticised some evidences of unmechanical design and of poor judgment in making constant changes, and have chafed at the delay which we believe it will be difficult to justify, we have seen no proof of the graft which is being so freely discussed; but neither charges nor countercharges should hinder a full and fair investigation.

Much money has been spent unwisely in the attempt to secure a perfection which does not and never will exist. Changes in design and construction have been ordered which would not be tolerated by business men of broad vision who, realizing the crying need for airplanes in the shortest possible time, would have insisted on building the best machines possible today and better ones next month or next year.

Shops have been given orders for one thing and had the order changed after fully equipping for it. This meant buying new machinery at inflated prices, and can probably account for more millions than we realize. For the new equipment means not only the machine tools but the fixtures, tools and gages. And those who are familiar with the cost of these at the present time will readily see how great sums of money can be wasted in this way. The cost of tools and gages was never so great, due perhaps as much to our lack of skilled mechanics as to the extraordinarily high prices charged. It is one of the ways in which as a nation we are paying for our failures to make a business of training mechanics.

Probably Millions in Unfinished Motors

Then too we must remember that there are several million dollars tied up in material and in partly finished components. Cylinders, connecting-rods, valves and other parts for hundreds of motors in various stages of completion are being held in many cases while decisions as to further changes are being considered. The waste of money in planes (or it might be more considerate to call it unwise expenditure) is even more apparent than with motors even though the amount involved may probably be less. The creditable desire to secure a perfect plane seems to blind the eyes of many to the necessity of getting the best we can get in large quantities—and getting them now. The new mail-carrying machine, for example, will carry 600 to 800 lb. of bombs just as well as the same weight of mail. They are fairly fast, though not as speedy as the "Spad" which we abandoned before completing any. But a thousand of these planes could certainly make life interesting for some of the German cities and prevent the troops of the German army from going to sleep on the job. And a thousand of these machines can in all probability be built by one factory in not over two months.

The Cost of Constant Changes

In looking for leaks in the aircraft-appropriation barrel we must remember that nearly all the shops are on a cost-plus basis and that overhead expense goes on whether airplanes are being built or not. Every change which has been made, and there were literally hundreds of them, required new drawings, new tools and gages, and cost more money than we realized. But while the cost to the country has been great and the delays have been even more serious it is manifestly unfair to those who may have done their best to prefer charges of graft against them unless we have much better evidence than has yet been shown. The *American Machinist* is not defending the delays in any case, but it demands fair play for all concerned.

But changes have not been confined to aircraft. Orders for field guns have been changed so often as to make one dizzy in some instances. In one case the manufacturer has been ordered several times to change from one size to another. Orders coming from different divisions are a bit confusing, as they come at intervals, sometimes several days apart. And when it happens, as it did in one case at least, that the order from the last division to change to a certain size was received after division No. 1 had ordered the size changed back again it is a bit confusing.

There is a tendency among manufacturers in different lines to demand and to insist upon positive orders covering a specified number of guns or whatever it may be. They do not wish to be arbitrary, but it seems to be the only way of pinning the order to something definite. And knowing the necessity of getting started,

if we are ever to get guns or anything else, they are insisting and getting in some cases at least definite orders to go ahead without further changes.

The need for machine-tool equipment for railway shops is being pointed out by railroad men themselves, and those railway shop officials who have been trying in vain to secure new machinery for the past few years are hoping that the new régime will equip the shops as they should be. Much of the need unfortunately is for heavy planing and boring machines, which are rather difficult to get and likely to be ever more difficult if the machine-tool program of the machine-gun division ever makes its appearance.

Small machines, such as engine and turret lathes, can be had very promptly, and a good-sized order to be distributed among the railway shops needing the tools would be beneficial in every way. It would help the railways to repair their locomotives and cars and also materially assist the machine-tool builders to maintain their organizations so as to have them ready when wanted.

A machine-tool dictator, as suggested a few weeks ago, would help wonderfully in maintaining a proper balance in this all-important industry. By consultation with a committee of machine-tool builders and with representatives of the different divisions using machine tools in large quantities the right man in such a place could be of great service to the country.

Combining his own knowledge of the needs of the country as a whole with the advice and suggestions of the various divisions, he could do much to prevent shortages in any particular line and to stabilize the whole machine-tool industry. He could create a suitable reserve where necessary and so establish a reservoir which would absorb production in certain lines and allow the filling of rush orders without undue delay. He could be of the same assistance to the industry and to the country as the similar institution which has been so successful in Great Britain. The control of mushroom-growth machine builders and of the prices of second-hand machinery would have a very satisfactory effect on the industry after the war.

One of my railroad friends points out the fact that while the adoption of standard locomotives will eventually increase locomotive production, it will not have this effect this year owing to the time which has been lost in the consideration of the project before making the decision and in the delay arising from the fact that all the details of the new locomotives have not yet been settled.

This is one of the unfortunate features of bureaucratic administration, for it seems as though no one in charge of affairs under this condition is ever able to see the advisability of taking some fairly good standard which is already in existence and duplicating that until at least it is possible to devise something enough better to warrant a change being made. If the locomotive builders could have made duplicates of the locomotives now in use by some of the leading railways, and if the orders had been placed two months ago in the early days of the consideration of this project, a very much larger number of locomotives could have been made.

On the other hand we must not blind ourselves to the fact that even some of the best-known railways have built locomotives for their own use which were unnecessarily complicated and consequently expensive, and in ordinary times at least it might well have paid to give this careful consideration. In times like the present it ought to be evident to almost anyone that the first consideration is to get production, even if there are many things to be changed after we get back to peace.

One other unfortunate occurrence is the distribution of the orders so that both the great locomotive works will be obliged to build all twelve of the standard types. Orders have been split into units of two, three, ten, fifteen, twenty, thirty, etc., which is, of course, a very small order in these days for one type of locomotive. It means the equipping of numerous plants with patterns, fixtures, jigs and special tools, which should not have been made necessary, although exactly the same thing was done in the distribution of the orders for some of the gun carriages.

All these things tend to delay production and add to the cost, both of which are extremely unfortunate, particularly at this time. It must also be evident that it does not give a fair opportunity of comparing the cost of railway equipment and maintenance under the two systems of management, although those who are violently in favor of the old methods will probably contend that all of this is an inevitable part of the new.

Personals

John G. Schindehette, Ann Arbor, Mich., is now traffic manager of the Motor Products Co., Detroit, Mich.

W. J. Hanna has been appointed sales manager of the Trumbull Steel Co. for the Detroit territory, with offices at 523 Ford Building, Detroit.

Fred E. Le Blond has resigned as sales manager of the R. K. Le Blond Machine Tool Co., Cincinnati, Ohio, and will devote his time to fancy farming.

E. L. Steinle, Eastern representative of the Steinle Turret Machine Co., is now associated with the Machine Tool Engineering Co., Inc., of 149 Broadway, New York.

Frank Rhodes of the Independent Pneumatic Tool Co., Aurora, Ill., formerly employed in the engineering department, has been promoted to be factory metallurgist.

W. F. Wagner, after 52 years' service, has severed his connection with Wm. Jessop & Sons, and is now sales manager of the Seaport Steel Co., 217 Broadway, New York.

Wendell P. Norton, works manager of the Hendey Machine Co., Torrington, Conn., and who was connected with that company for 28 years as its superintendent, has resigned.

Henry L. Innes, until recently assistant general manager of the General Motors Co., New York, has become vice president and general manager of the Doble-Detroit Steam Motors Co., Detroit, Mich.

John S. Agey, for 18 years connected with one of the plants of the Carnegie Steel Co. at Youngstown, Ohio, has resigned to become superintendent of one of the mills of the Donner Steel Co., Buffalo, N. Y.

George S. Tontrup, general manager of the American Car and Foundry Co. of St. Louis, Mo., was seriously injured in an automobile accident recently while returning to the city from the Sunset Hill Country Club.

M. T. Lothrop has become assistant factory manager of the Timken Roller Bearing Co., Canton, Ohio. He has been metallurgist and has had charge of the steel and tube department of the company for the past seven years.

J. M. Riordan has joined the selling organization of the Cleveland Milling Machine Co., Cleveland, Ohio. He was recently sales engineer of the Grant Lees Gear Co., Cleveland, and prior to that was Central States representative of the Fellows Gear Shaper Company.

Lahman F. Bowers, Milwaukee, Wis., who resigned May 1 as secretary of the Allis-Chalmers Manufacturing Co., Milwaukee, was associated with the company and its predecessors for 22 years, and devoted nearly 40 years of his life to the service of large-machinery manufacturers.

Howard Coonley, president of the Walworth Manufacturing Co., Boston, Mass., and vice president of the Boston Chamber of Commerce, has been appointed vice president of the Emergency Fleet Corporation and will have charge of the general administration of the corporation, including contracts, purchasing, financing and accounting.

Peter J. Hopkins, who has been for the past four years Eastern sales manager in New York for the Cleveland Punch and Shear Works, Cleveland, Ohio, has joined the Fore River plant of the Bethlehem Shipbuilding Corporation, Quincy, Mass., in an executive capacity. Mr. Hopkins is succeeded in the Eastern territory by **C. W. Hancock** and **R. S. Howell**, who come from the company's main office.

E. E. Maher has been appointed by the Terry Steam Turbine Co. manager for the Chicago district, with offices at 1328-29 McCormick Building, 322 South Michigan Ave. **John D. Stout** has been appointed manager of the New York office of the company in charge of that district with the exception of navy and marine installations. Mr. Stout has been assisting **Mr. Herbert**, formerly in complete charge of that district, who will now devote his entire time to navy and marine requirements.

Business Items

The Machine Tool Engineering Co., 149 Broadway, New York, has been incorporated.

The West & Dodge Co., maker of gages and gage instruments, 167 Oliver St., Boston, Mass., has bought a two-story 50 x 150-ft. factory at Brighton, Mass., and will build a 60-ft. addition to it in the near future.

The Bound Brook Oil-Less Bearing Co., Bound Brook, N. J., has located its Western office in room 1723, Ford Building, Detroit, Mich. This office is in charge of Harry J. Lindsley, Western sales manager, and was formerly located at 308 Moffat Building.

The Brown Instrument Co. of Philadelphia, Penn., will open a new office at St. Louis, Mo., on June 1, at 2086 Railway Exchange Building. This office will be in charge of Paul H. Berggreen, who will look after the sale of the pyrometers and other instruments in the vicinity of St. Louis.

Obituary

Eben Boye, employed for some time in the machinery department of Manning, Maxwell & Moore, New York City, died on May 13. He was associated with Manning, Maxwell & Moore in Cleveland, Chicago and Cincinnati.

Lieut. Earl Trumbull Williams, vice president of J. H. Williams & Co., Brooklyn, N. Y., manufacturers of drop-forgings, and first lieutenant of the 301st United States Field Artillery, died on May 7. Lieutenant Williams was visiting friends in Northampton, Mass., and was struck by a falling limb from a tree. He graduated from Yale University in the class of 1910 and entered the business of J. H. Williams & Co., founded by his father in 1883. When the company's plant at Buffalo, N. Y., began operations in 1914 Lieutenant Williams assumed charge of it as vice president and was in active control until the summer of 1917 when he entered the Officer's Training Camp at Fort Niagara. He was commissioned first lieutenant in November, 1917, and assigned to duty at Camp Devens, Ayer, Mass. Lieutenant Williams was at one time a member of Squadron A, New York, and a member of the Saturn and Country clubs of Buffalo.

Trade Catalogs

Bulletin "G." Electrolytic Oxy-Hydrogen Laboratories, Inc., 15 William St., New York. Bulletin, 8½ x 11 in. Illustrates and describes the Levin oxygen and hydrogen generator.

American Chain Co., Inc., Bridgeport, Conn. Catalog A. Pp. 96; 7¾ x 11⅝ in.; also price list, pp. 14, 6 x 9½ in. The catalog illustrates and describes various kinds of chains for a number of purposes.

Mine and Quarry. Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill. This is a quarterly bulletin of news for superintendents, managers, engineers and contractors. Pp. 36; 6 x 9 inches.

The Barnes Precision Cutter Grinder. Wm. O. Barnes, Leominster, Mass. Booklet, pp. 16; 5 x 7½ in. This booklet is illustrated and gives a short account of the mode of action and the economies attending the use of this machine.

Bickford Boring and Turning Mills. H. Bickford & Co., Lakeport, N. H. Pamphlet, pp. 12; 11 x 8½ in. A general description, size and dimensions and illustrations of the 4, 5, 6, 7 and 8 ft. boring and turning mill is given in this pamphlet.

Hardware Specialties. The West Haven Manufacturing Co., West Haven, Conn. Catalog No. 15; fifty-two pages; 6 x 9 in. It illustrates, describes and gives the prices of hacksaw blades, frames, machines and various other hardware specialties.

Strom Bearings Data Sheets. U. S. Ball Bearings Manufacturing Co., Chicago, Ill. Loose leaf, pp. 68; 4½ x 7½ in. These data sheets are compiled so as to furnish in a convenient form essential information regarding the dimensions of all types of Strom bearings.

Stratton Air Separators. The Griscom-Russell Co., 90 West St., New York. Bulletin 1109-C. Pp. 4; 6 x 9 in. A line drawing showing how the separators can be changed in design to meet the demands of special piping and a table of approximate dimensions are given in this bulletin.

Drilling Machines. The Henry & Wright Manufacturing Co., Hartford, Conn. Catalog, pp. 54; 8½ x 11 in. It gives a chart of speeds and feeds for drilling; illustrations and descriptions of classes B, C, H, I. K. L. O and a table of weights, net, crated and cased; table dimensions, floor dimensions, heights, motor required, code word, etc.

Grinnell Automatic Sprinkler. General Fire Extinguisher Co., Providence, R. I., Bulletin (Bankers' Number). Pp. 16; 7⅝ x10⅝ in.; published quarterly. It contains several timely articles of interest, together with a number of halftone illustrations of disastrous fires. Two pages are devoted to a record of fires reported between Dec. 1, 1917, and Mar. 1, 1918.

New Publications

Efficiency Methods—By M. McKillop and A. D. McKillop. Two hundred fifteen 5 x 7-in. pages; six illustrations. Published by D. Van Nostrand Co., 25 Park Pl., New York City. Price $1.50.

This book contains little that is new to any reader of modern-management articles so frequently seen in the various magazines. It is largely devoted to discussions of what the different leaders in efficiency, functional management, scientific management and motion-study lines have said or advocated. There are chapters on management, the various kinds of standardization, remuneration, welfare work, scientific management and the unions, scientific management and education and the installation of efficiency methods.

Essentials of Drafting—By Carl L. Svensen. One hundred and eighty-four 5¾ x 9-in. pages; 450 illustrations. Published by D. Van Nostrand Co., 25 Park Pl., New York. Price $1.50.

This book was written with the idea of its being used as a classroom textbook. It is a neat, well-arranged book printed on a good grade of paper. There is little in it that is new or original, but its numerous illustrations and method of handling the subjects make it a very good book for the object intended. There are 20 chapters in all, dealing with drawing instruments and materials, lettering, constructions, projections, materials and stresses, screw threads, bolts and screws, riveting, working drawings, sections, dimensions, machine construction, sketching, estimation of weights, piping, intersections, developments, picture drawing, shade line drawing and drawing questions, problems and studies.

Trade Specifications and Occupational Index of Professions and Trades in the Army.

This is a new publication just issued by the War Department and known as War Department Document No. 774. The volume has been prepared by John J. Swan of the Trade Test Division of the Committee on Classification of Personnel in the Army. Its purpose is to standardize vocational terminology in the army and to define the duties of specialists and skilled tradesmen required by its various technical organizations. This is to assist in the prompt and efficient placement of specialists and skilled men who may be drafted or enlisted into the national army, so as to utilize each man's knowledge and ability where it will be immediately effective. It includes all the fundamental occupations and trades which have been shown necessary in army life. There are 565 classifications, each of which is defined both as to the duties to be performed and the qualifications desired in a well-trained, high-grade man, or journeyman (who is sometimes an expert or a foreman) who can do the work required. The classification also gives the nearest equivalent or substitute occupations which can be drawn from in case it is necessary to secure an additional supply of a particular kind of labor. While the specifications describe the ideal skilled man from the army standpoint it is not expected that all the stated qualifications will be found in any one man. Immediate and large need of the army for specialists must be met by utilizing the less skilled workers just as has become necessary in our manufacturing establishments. These classifications for the different trades are all keyed to the names and symbols employed by the Adjutant General's office, and occupational groups and code indexes are also given. Only those who have undertaken some such task as this can appreciate the amount of work involved in compiling such a mass of material. Some of these specifications occupy half a page, and the total number requires 239 pages 6 x 9 in., which involves a tremendous amount of work, and for which Mr. Swan should be highly complimented. The system has been taken up by the United States Department of Labor and is being extended to cover, first, munition industries, and later will include all trades and industries.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers. Spring meeting at Worcester, Mass., June 4, 5, 6 and 7, with headquarters at the Hotel Bancroft.

The American Society for Testing Materials will hold its twenty-first annual meeting at Atlantic City, N. J., June 25-28, with headquarters at the Hotel Traymore. The permanent headquarters of the secretary-treasurer are under the name of the society, Philadelphia, Penn.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The next convention and exhibit of the Georgia Retail Hardware Association will be held at Savannah, Ga., June 4, 5 and 6, 1918, with the Savannah Hotel as headquarters. Exhibits and convention sessions will be held in the new municipal auditorium on Barnard St. Walter Harlan, 44 Boulevard Circle, Atlanta, Ga., is secretary of the association.

The National Gas Engine Association will hold its eleventh annual meeting at the Hotel Sherman, Chicago, Ill., June 3 and 4. The headquarters of the association are at Lakemont, N. Y.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers, 29 West 39th St., New York. Summer meeting to be held at Dayton, Ohio, June 17-18. Complete war program, at least half of it being devoted to the actual demonstration of war apparatus. All meetings will be held at Triangle Park, a dinner being served Monday evening and luncheons each noon. Reservations may be secured at hotels Miami, Holden, Algonquin, Phillips and Bechel, or by writing the Dayton S. A. E. Committee, 137 North Ludlow St., Dayton, Ohio.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No 2 Southern Foundry, Birmingham	$33.00	$33.00	$40.00
No. 2X, New York	34.25	.....	44.00
No. 2 Northern Foundry, Chicago	33.00	37.00	45.00
*Bessemer, Pittsburgh	36.15	37.25	45.00
*Basic, Pittsburgh	32.00	33.95	42.00
No. 2X, Philadelphia	34.25	33.75	44.00
*No. 2, Valley	33.00	33.95	43.00
No. 2 Southern Cincinnati	35.90	35.90	42.90
Basic, Eastern Pennsylvania	32.75	33.75	42.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4.195	$4.195	$5.00	$4.20	$5.00	$4.20	$4.50
Soft steel bars	4.095	4.095	4.75	4.20	4.50	4.10	5.00
Soft steel bar shapes	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Plates, ¼ to 1 in. thick	4.445	4.445	7.00	4.20	7.00	4.45	6.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.00
Warehouse, New York	4.70	4.60
Warehouse, Cleveland	4.10	4.50
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	5.00	6.445	6.445	9.25	6.385	8.25	6.45	7.50
*No. 26 black	4.90	6.345	6.345	9.15	6.285	8.15	6.35	7.40
*Nos. 22 and 24 black	4.85	6.295	6.295	9.10	6.235	8.10	6.30	7.35
Nos. 18 and 20 black	4.80	6.245	6.245	9.05	6.185	8.05	6.25	7.30
No. 16 blue annealed	4.45	5.645	5.645	8.70	5.585	7.95	5.65	7.70
No. 14 blue annealed	4.35	5.545	5.545	8.60	5.485	7.85	5.55	7.60
No 10 blue annealed	4.25	5.445	5.445	8.50	5.385	7.75	5.45	7.50
*No. 28 galvanized	6.25	7.695	7.695	11.00	7.635	10.00	7.70	9.50
*No. 26 galvanized	5.95	7.395	7.395	10.70	7.335	9.70	7.40	9.20
No. 24 galvanized	5.80	7.245	7.245	10.55	7.185	9.55	7.40	9.05

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 10%	List plus 25%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Current	One Year Ago
New York	$15.00	$13.00
Cleveland	15.00	12.00
Chicago	17.00	11.50

In coils an advance of 50c. usually is charged.
Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

3/8, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
1/8	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
3/8 by 19 in. long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

1/8	33.00
5/32	30.00
3/16	38 00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel	7.50	8.00	7.50
Spring steel (crucible analysis	11.00	11.25	11.00
Coppered bessemer rods	9.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel	9.00	8.25	8.50
Floor plates	6.19½	6.00	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
1/8, ¼ and 3/8	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, ¼ and 3/8	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	41.9%	26.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	37.9%	23.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	29.50
Tin, in 5-ton lots	100.00	85.00	65.00
Lead	6.90	7.25	11.50
Spelter	7.37½	7.50	9.50

*Government price.

ST. LOUIS

	Current	One Month Ago	One Year Ago
Lead	6.70	7.10	10.50
Spelter	7.12½	7.25	10.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	32.50-33.00	32.00	42.00	34.00	42.00	32.50	43.00
Copper wire (carload lots)	31.00	32.00	39.50	34.00	41.00	32.00	40.00
Brass sheets	31.75	30.75	45.00	30.00	43.00	30.00	43.50
Brass pipe base	36.50	36.50	47.50	41.00	50.00	40.00	47.50
Solder ½ and ½ (case lots)	69.75	62.00	40.38	57.00	39.50	60 00	39.00

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	28.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks Current	In Casks One Year Ago	Broken Lots Current	Broken Lots One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	17.00	23.00	17.50	23.25
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	13.50	29.00
Chicago	13.50	28.00
Cleveland	15.00	29.50

Manufacturing in Japan

By Hy Sibley

Japanese labor lacks the seasoned character of the Occidental workers and appears to have no initiative. The mind of the Japanese workman does not yet grasp methods of efficiency and he must be employed a long time on a certain class of work before he shows any speed. Bonuses are generally paid twice a year as the workman whose pay envelope is fatter than usual will take a holiday to spend the excess.

YANKEE ingenuity transplanted to Japanese soil flourishes. In a former article the writer stated that the Japanese possess little creative genius, but they are imitative and, to a certain extent, adaptable, and under the direct guidance of a capable Yankee mind they have accomplished very satisfactory results. This has been demonstrated in the rapid expansion and prosperity of the Nipponophone Co., Ltd., near Tokyo, where 500 Japanese workmen are manufacturing high-grade products in true American fashion under the sole direction of one of our compatriots, J. A. Rabbitt, and Mr. Rabbitt, by the way, hails from that section of the old U. S. A. where mechanical and industrial geniuses are born—New England. Briefly, this organization began manufacturing phonographs in a little stone shop 30 by 60 ft. and grew to its present proportions in three years. It was organized and financed largely by American residents of Japan, who had sufficient faith in introducing American methods into a plant to be operated entirely by Japanese workmen to invest substantial sums. But the credit for the success of the venture is due to General Manager Rabbitt, for he encountered many unusual obstacles in the way of effecting complete organization.

FIG. 2. THE MACHINE SHOP

In the first place he had the very crude and very raw Japanese labor material to work with. It is extremely difficult to get the Asiatic mind to follow American methods, for the rule in Japan is usually the reverse of that in America. A few observations on this subject may be interesting.

The Japanese workman does not adapt himself readily to new operations, and accordingly does not get full speed until he has been on one class of work for some time. He is most adept at operations that are duplicated and continued over a long period, and as a result he does not take to new jobs, especially toolroom work. Herein lay one of the greatest obstacles, as in the manufacture of phonographs, records, electric switches and stamped-metal products much intricate tool design is required, particularly of dies and punches.

In the installation of a cost system the taking of time-study records presented uncommon phases. For instance, in making these records Japanese workmen invariably speed up for all they are worth, whereas in America the workingmen, sensibly or perversely, do just the opposite. Then, after the time study has been taken and the instruction sheets compiled, Mr. Rabbitt found difficulty in getting the men to follow instructions step by step even after they were shown it was to their pecuniary advantage to do so.

The bonus system too must have certain restrictions, for when the Japanese make excess pay on piece work, they simply take advantage of it as an excuse for a holiday to spend the increased increment. Hence it is customary among most firms in Japan to reserve the extra pay as a bonus until the "Bon" (summer festival) and new year seasons when the workers need the money to buy presents.

The apprentice system is a failure, for the boys prefer to move about frequently. Girls are not much of an asset, and only a few are employed by the Nipponophone Co. for light assembly work. They are industrial nomads, like the boys, and are not satisfactory under a system of employment that does not bind them to stay. They work only periodically, and do not remain long enough to be trained for any particular job. The spinning companies of Japan overcome this by keeping the girls in the works' boarding compound.

The greatest assistance Mr. Rabbitt gets in his work is from the native engineers educated in the imperial universities. Those in his employ have been with him about six years, but new ones are not available at this time. It has been found that in general the men who have had military training are much more efficient as they have a keener sense of responsibility and discipline and realize their obligations.

Japanese draftsmen are an interesting class. The individual does very neat work and is fairly accurate, but he has never mastered the geometry of English lettering. The Japanese and Chinese characters, however, he can make with surprising speed and neatness. Aside from the complete organization of Nipponophone production on an American basis Mr. Rabbitt takes his greatest pride in the toolroom work. Under his immediate direction Chief Designer K. Mori and the latter's assistants, S. Mazuki and H. Ito, have constructed some excellent tools, principally dies and punches. A number of these are illustrated. Particularly commendable are the punch and die for making both the top and bottom frame members of the phonograph mechanism (Figs. 6 and 7). These members are duplicates, except that in the top members two square flanges, or lugs, are punched and turned down in two operations. Another punch and die of note is that for making the skeleton table for the disk record in one operation (Fig 8).

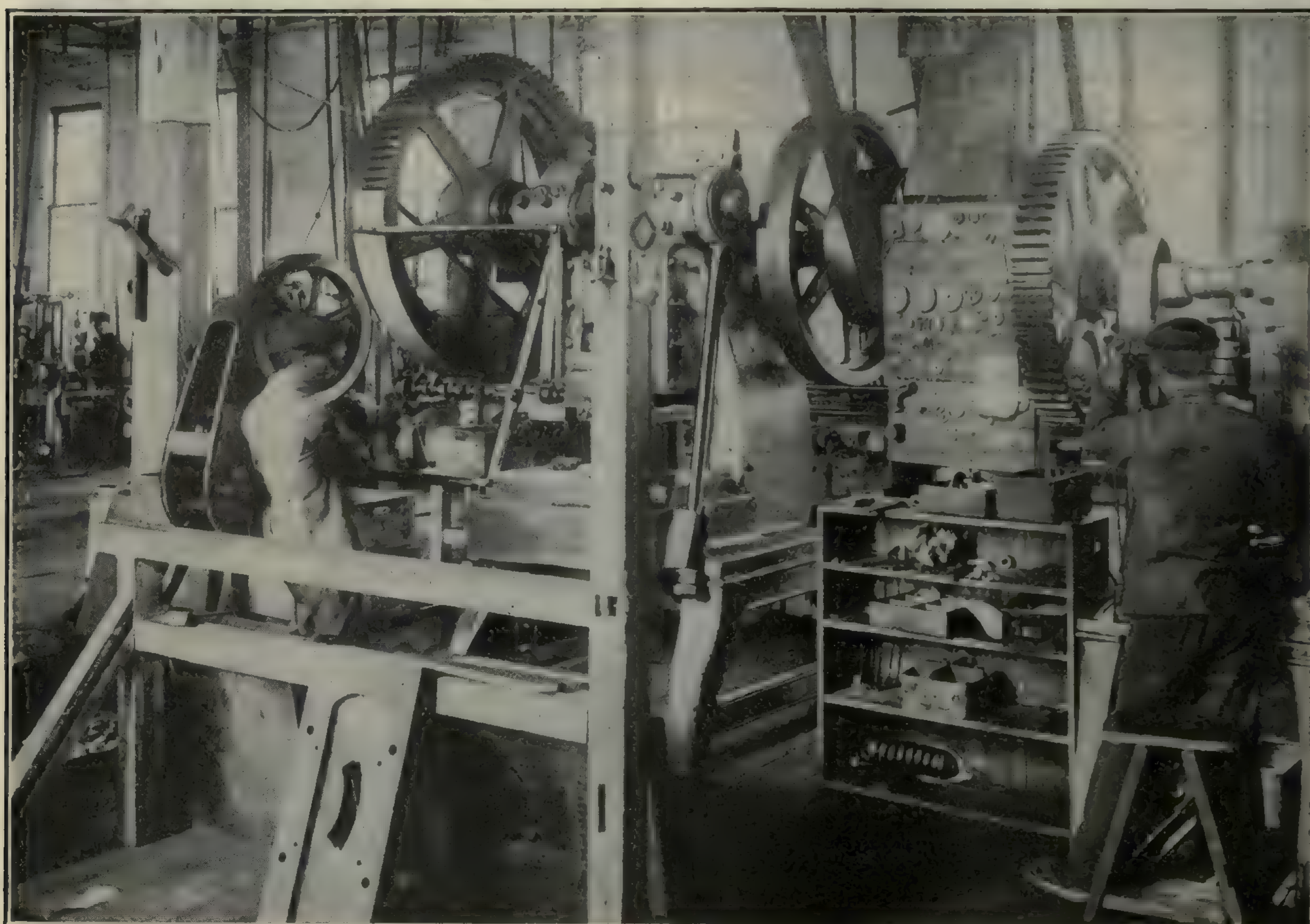


FIG. 3. PUNCHING MACHINES.

In addition to these are a number of more intricate punches and dies for punching and forming small brass parts incorporated in electric switches (Figs. 9, 10, 11, 12 and 13). The tool for forming the brass cap of a patent inhaler made by this company is also an exceptional piece of work (Figs. 14, 15 and 16).

For each division of activities in the Nipponophone Co. Mr. Rabbitt has installed a well-planned system of procedure, and organization charts in both English and Japanese are displayed prominently in the offices. In manufacturing, the high cost of equipment and material is balanced in a measure by the comparatively low labor cost. Shaping-machine hands are paid about 10c. an hour; lathe operators 12c., and milling-machine op-

FIG. 4. FINISHING RECORDS.

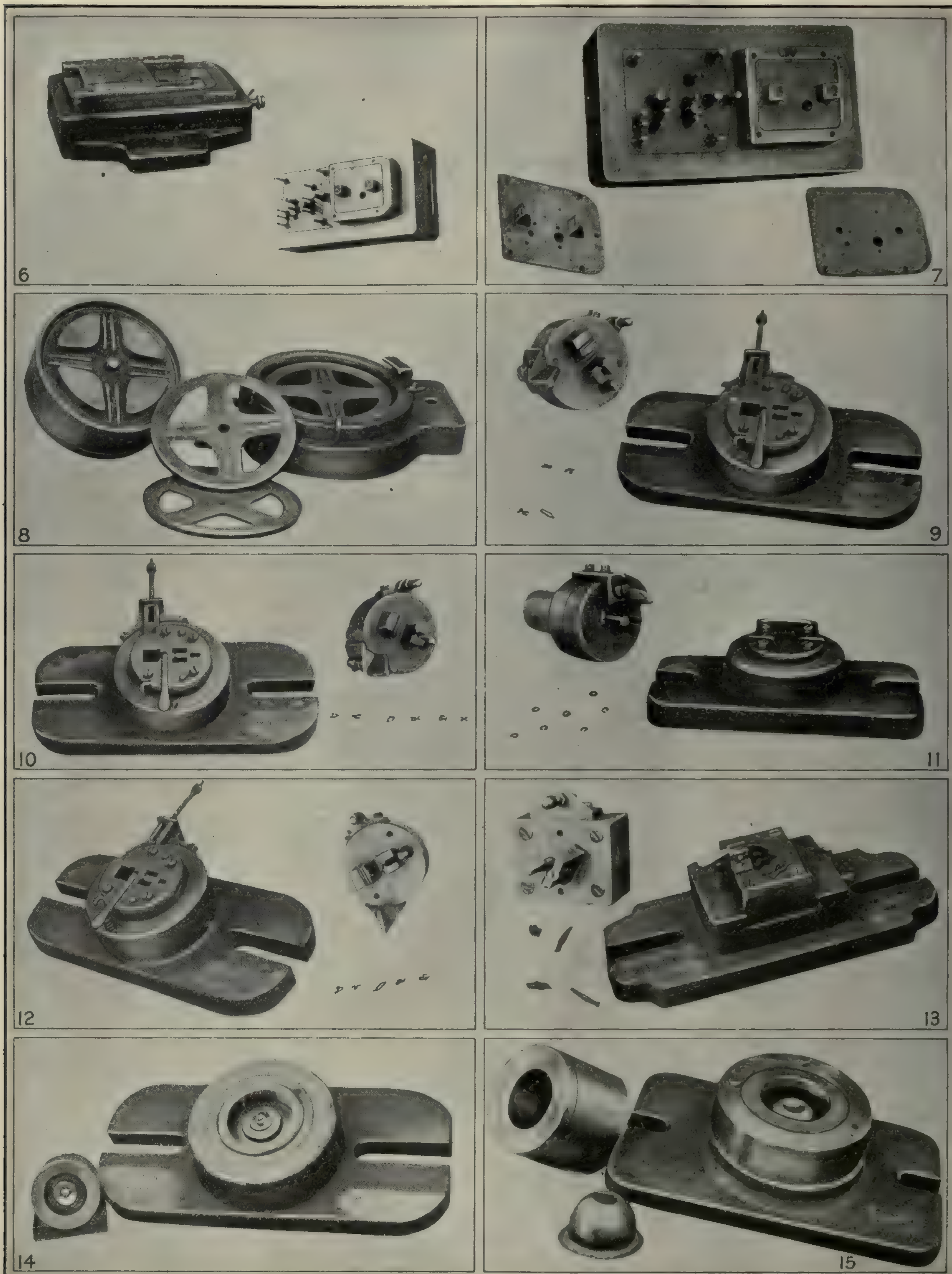
erators 14c. A 10-hour day is in force, with holidays every Sunday and on the 21 national holidays. One may be prodigal in employing draftsmen, for university graduates are paid 25 to 30 yen a month ($12.50 to $15).

In the matter of equipment of this Japanese-American plant it is natural that American-made machines should predominate. In fact there are very few others excepting a number of small Japanese turret lathes for the short-legged Japanese workmen. Among the American machines such names as Brown & Sharpe, Pratt & Whitney, Gould & Eberhardt, Smith & Mills, Bradford, E. W. Bliss, Sibley, etc., are prominent. A few special machines have been made at the plant.

Japanese-built machines have not been found very satisfactory. They are not built accurately, and Mr. Rabbitt states that he has yet to find a native machine with bearings constructed throughout to equal the standard American practice. It is true that some makers give a great deal of attention to headstock bearings, but they neglect countershafts or other parts of equipment, which they do not consider important.

To install American machines, even before the war, was a costly initial investment, because of the import duty and transportation, and even then the manufacturer had to anticipate his needs a year or two ahead of time because of lengthy deliveries. All material too, with the exception of brass and copper, is imported, and by the time it is delivered to the consumer the cost is

FIG. 5. PACKING AND SHIPPING RECORDS



FIGS. 6 TO 15. DIES FOR VARIOUS PARTS

considerable. Castings have been made at the foundry village of Kawaguchimachi, north of Tokyo, where the entire population is engaged in the work, and which has been described in a former article in the *American Machinist*. A new foundry and a modern forge shop are now under construction at Nipponophone.

The principal product of this company has been phonographs and records, and it holds the original

patent for the hornless model in Japan. Recently it has added many other products to its line which can be economically manufactured by its present equipment. The capacity of the plant is 1,500,000 records and about 18,000 phonographs annually, the latter ranging in price from 15 yen to 150 yen ($7.50 to $75), with the popular

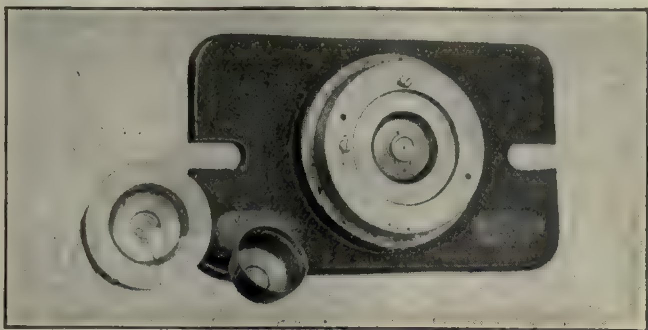


FIG. 16. TRIMMING DIE

model at 25 yen. As many as 80,000 steel needles have been made in a day.

It is not, however, the output that is so impressive, but the fact that 500 Japanese are working in effective coöperation along American lines and following a system that has been diametrically opposed to the methods and precedent that had been instilled into them for centuries. The plant is the most prominent organization of its kind in Japan, and Yankee force is behind it.

Young Engineers Now and After the War

This is an engineering age, and the war has helped to emphasize the fact in many ways. It also shows very clearly that the work to be done after the war will require a large amount of engineering skill of a high order. Bearing this in mind it is somewhat discouraging to note that the attendance at engineering colleges has fallen off about 35 per cent. since this country entered the war. Graduating classes this year will probably not be more than one-half their usual size, due to voluntary enlistments and to the fact that the army and the navy are calling for advanced students.

The average age of engineering graduates is nearly 23 years, so that aside from being keen to get into the war many of the sophomores, juniors and seniors are subject to the draft.

The Engineer Enlisted Reserve Corps and the Naval Reserve Force were formed to assist in keeping at college such students as showed engineering ability to any considerable degree, but even with these organizations large numbers are going into active service. It is of course easy to understand their desire to see active service, but the aim of every citizen should be to serve in the place where his or her service will be of the greatest value to the country. And there can be absolutely no doubt as to the necessity for conserving engineering ability for the present and for the future.

The following letter from President Wilson to Dean Cooley of the University of Michigan will show how our chief executive feels in regard to this important matter:

My dear Dean Cooley:

I understand that there is to be a meeting of the department of superintendents of the American Educational Association in Atlantic City on the twenty-fifth of next month. I would like very much to be present in person at that meeting, but since I cannot be may I not ask you to express to the gentlemen assembled there my very great concern that none of the educational processes of the country should be interrupted any more than is absolutely unavoidable during the war?

My attention has lately been called in particular to the falling off in the number of engineering students, and this has given me a good deal of concern, because it is not only immediately necessary that as many students as possible should prepare themselves for engineering duties in the army and navy, but it is also of the first consequence to the country that there should be an adequate supply of engineers for the period of reconstruction which must follow the war.

Not only has technical training become of enormous importance in military operations, but the role of the engineer has become more and more important in every process of our industrial life, and I hope that influences may go out from the meeting in Atlantic City which will call the attention of parents throughout the country to the importance of making any sacrifice that it is possible to make to keep their sons in the schools even during these trying times.

Cordially and sincerely yours,

WOODROW WILSON.

Standardizing Engineering Work Among the Allies

The placing of all the allied troops under General Foch is only one of the many advantages of complete coöperation, and it is pleasing to note that the idea is being carried on in engineering standards to be used by the various countries. At a recent convention held in London, at which there were representatives from practically all of the allied countries, it was decided to recommend that permanent authoritative committees be instituted in Great Britain, Canada, France, Italy and the United States of America in order to maintain continuity of action and to carry forward in the most efficient manner possible the work of coördination. The engineering standards committee will for the time being act as the distributing center of this government international organization. It was suggested that the committee should be constituted of men selected from France, Italy, Great Britain and the United States. The persons named were as follows:

France—Le Colonel Dorand, Inspecteur-Général des Etudes et Expériences techniques; Captain Pierron, Lieutenant Boisleve. Captain Eteve.

Italy—Le Commandant Benza, Chef des Services de la Provisionnement de l'Aviation Italienne, Deputé G. Grassi, and Lieut. A. Bonomi.

United States of America—F. G. Diffin, chairman of the Aircraft Standards Board of the American Aircraft Board; Dr. W. F. Durand, Lieut.-Commander D. Briscoe, Coker F. Clarkson, E. H. Ehrman, Charles M. Manly, James Hartness, Dr. A. L. Colby, F. G. Ericson, Captain A. Tilt, Dr. F. R. Baxter, Lieut. L. Selden.

Great Britain—Sir Henry Fowler, K.B.E., Commander H. Anstey, A. F. Berriman, O.B.E., P. C. Cooper, Col. M. O'Gorman, C.B., Dr. H. S. Hele-Shaw, Brig.-Gen. Sir Capel Holden, K.C.B., R.A., Commander C. F. Jenkin, M.B.E., R.N.V.R., Capt. C. W. C. Kaye, R.E., C. C. Paterson, O.B.E., A. A. Remington, Capt. A. A. Ross, Lieut.-Commander E. S. Saunders, R.N.V.R., Capt. T. Worwick.

ORDNANCE DEPARTMENT

United States Ordnance Department Wants Technical and Skilled Men

The shortage of labor has made itself felt in the Army Ordnance Department as well as among private enterprises. To those who can pass the test the positions here enumerated offer a field for men anxious to assist the Government. However, to prevent dislocating production in private concerns doing Government work none will be accepted who cannot show that he has been released by his former employer.

A CALL for technical men and operatives to fill war positions in industrial establishments is being made by the United States Army Ordnance through the Civil Service. Salaries ranging from $1600 to $6000 a year will be paid to those who can qualify.

Chemists and chemical engineers, men experienced in the manufacture of gas, mechanical engineers on high-pressure apparatus, engineers to take charge of power houses and foremen of machine shops are needed. Persons of military age accepting appointment will not avoid the obligations of the Selective Service Law.

The Army Ordnance in issuing its call insists that no applications will be accepted from Government employees or employees of firms or corporations engaged in contracts for the Government or its allies without the written assent to such application by the head of such establishments.

Manufacturing Chemists

Superintendents of plants engaged in chemical-manufacturing processes, especially those connected with nitrogen fixation and the manufacturing of acids and explosives, will be paid salaries from $2400 to $6000 a year. Assistant superintendents of nitrate and chemical plants will be paid $1600 to $2400 a year.

Applicants for superintendencies must have a standard high-school education or its equivalent, and at least five years' operating experience involving chemical processes in a manufacturing plant, or they must be college or university graduates with at least three years' such experience. They must have been in responsible charge for at least two years of operations involving important chemical processes and must have earned a salary of at least $2000 a year.

Assistant superintendents must have had at least three years' operating experience if they are high-school graduates or one year's experience if college or university graduates. In either case they must have earned at least $1200 a year. Both superintendents and assistant superintendents will be assigned to duty at the Ordnance Department in Washington or elsewhere as their services may be required.

Chemical Engineers

Chemical engineers will be paid from $2400 to $6000 a year and are wanted for duty at the Ordnance Office in Washington and at various plants throughout the United States. They will have complete supervision over one or more chemical-manufacturing processes relating to the war. They must be thoroughly experienced and of proved executive ability. A college or university degree in chemistry or chemical engineering and at least three years' experience in a chemical or mechanical industry or a high-school education or its equivalent and at least six years' such experience in a supervisory capacity are required.

Chemical engineers, with salaries ranging from $1600 to $2400 a year, and assistant chemical engineers, with salaries ranging from $1200 to $1600 a year, also are needed by the Ordnance Office. The positions paying $1600 to $2400 are open to men who have graduated in a course of chemical engineering from a college or university and who have had at least one year's operating experience in some chemical or mechanical industry, or who with a high-school education or its equivalent have at least four years' such experience. The positions paying from $1200 to $1600 a year are open to college or university graduates in chemical engineering who have had at least six months' operating experience, or having a high-school education have had at least three years' such experience.

Gas-Manufacturing Experts

Operatives in gas manufacture—men to operate and control the processes of production of water gas and producer gas—are urgently needed by the Ordnance Office. These positions pay $1600 to $2400 a year, and applicants must have at least five years' experience if high-school graduates or ten years' experience if they have had a common-school education.

Salaries from $1600 to $2400 will be paid by the Army Ordnance to junior mechanical engineers on high-pressure apparatus. Experience in the operation and control of high-pressure hydraulic and gas machinery is necessary. At least one year's such experience will be required of graduates in mechanical-engineering courses from recognized colleges. Four years' experience is required of high-school graduates.

Power-House Engineers

Power-house engineers will be paid $1800 to $2400 a year while working for the Ordnance Department. Supervision of operation of water-tube boilers, condensers, pumps, steam turbines and alternating and direct current generators and motors are among their duties. Machine-shop foremen at salaries from $1800 to $2400 are also wanted by the Army Ordnance. Ten years' experience as machinists—three years in a responsible supervisory capacity—is required.

Assistant operatives in the manufacture of water gas and producer gas, mechanics experienced on high-power apparatus, and operatives of acid and chemical apparatus are wanted by the Army Ordnance. Many positions are open.

The Ordnance Department states that the needs of the service are so imperative that applications will be received indefinitely. Further information regarding these positions can be obtained from the Civilian Personnel Section, United States Army Ordnance, 1330 F St., Washington, D. C.

Dealing with the Ordnance Department

By a Well-Known Manufacturer

In a recent issue on page 545, there is a very interesting article on "How to Deal with the Ordnance Department," by Lieutenant Curtis. It was interesting to me to the extent that, according to Lieutenant Curtis, all the sort of troubles that the small manufacturer has experienced have been eliminated since about Dec. 18, when the writer encountered all the troubles—and a few more—that Lieutenant Curtis mentions in his article. It may be that from the time of the reorganization of the Ordnance Department in the month of January until Lieutenant Curtis' article was written all these troubles were eliminated, but judging from the tales that other small manufacurers have told me of their experiences in the month of March the same old troubles were there at that time.

Lieutenant Curtis stated that there should be no difficulty in securing information providing the contractor is sufficiently familiar with the conditions. I think that the proviso should be left off, and under no circumstances should the contractor have difficulty in securing information, because there has been no way for him to become familiar with the conditions—that is, if he is a small contractor. Why should the manufacturer have to go to Washington and spend time and money going around to try to find information that nobody seems to be able to give him?

Why should not the Ordnance Department have a bureau of information in every large industrial center? They have started bureaus in some cities which seem to be for the purpose of speeding up contracts already let; but if all these bureaus are of the same sort as the one here they're not going to do a whole lot of good even on the speed-up problem.

The bureau in one city has been put in charge of a retired banker, who has no practical experience with manufacturing, and the supposed speeding up is being done by a lot of uniformed reserve officers who are of the same sort complained and written about, because they are selected under the same difficult conditions. Those who have watched the speed-up office in this city are still wondering whether it is going to get anywhere. Instead of the banker, who is doing all he can, it would appear that some man more thoroughly familiar with general manufacturing would be more desirable in charge of this class of work.

No doubt it is as Lieutenant Curtis says—that the purchasing officers are all experts. I know that they question the contractor as to the capacity and qualifications of his plant, but it seems that after all this questioning the matter is pigeonholed.

Lieutenant Curtis says that if anyone is turned down it is because his plant is not suitable for the work for which he is endeavoring to secure a contract. But what about the man who goes there and tells the bureau that he has such and such a plant and asks for information as to what he can make? I have been asked by the officers what I wanted to make, and I could only reply that I do not know what they want made for which my plant is suitable, and they cannot tell me.

If, as Lieutenant Curtis says, the contractor is turned down because there are enough factories better equipped to do the work on a certain article, is it not also very largely due to the fact that contracts have been let out to some people who are assisted in procuring new equipment, instead of using the equipment already available in some other plant? If the productive capacity of the country is so great that it is not necessary to call into service all manufactories for the purpose of supplying ourselves and our allies, how is it that so many special works are being constructed, mostly, we notice, by assisting factories already large instead of using the directive and organizing ability of smaller factories and their idle capacity?

Manufacturers' Agents

Lieutenant Curtis says that it is misleading to think that unless a man is constantly on the job in Washington and knows the ropes he has little opportunity to secure a contract unless he engages a Washington broker familiar with the conditions and pays him 5 per cent. He says this statement is groundless. I can say that it is not groundless in the case of one firm I know, and in proof of this I can quote Lieutenant Curtis himself. He says the purchasing officer insists on dealing directly with the manufacturer or his representative. Of course, the brokers do not call themselves brokers. They are called manufacturers' agents, and the woods are full of them in Washington, as everybody knows, and if the officer insists on dealing direct, that means that the manufacturer or his agent must be on the ground a great part of the time. Of course we know that the concerns who have any considerable quantities of contracts have their men on the ground, and their men are running back and forth all the time. Naturally these men get acquainted with the conditions and learn the ropes, while the fellow in the country has not that opportunity.

Lieutenant Curtis further says that boards of trade and chambers of commerce of several cities have undertaken to help small local manufacturers. Our chamber of commerce has tried to do so, with no perceptible results to its officials.

We are not alone in our experience. Others, who have had more recent experiences than we, confirm our experience in every way.

We are sending you this for your information. Army officers are only human, and we would ask you to keep our name confidential, as well as our location, because human nature being the same whether covered by a uniform or not, criticism is not always welcome—in fact, it seldom is welcome—and there are a thousand ways of making it unpleasant for the one who makes the criticism. We would like to see these conditions remedied, and without criticism they never will be remedied. The facts are that the big concerns are getting bigger on war work, and the little concerns are being drained dry without it. The big ones are stealing their help. They have raised the Government out of its boots, bidding one contract against another on the cost-plus basis. They have not undertaken to train labor to any considerable extent, and their methods of recruiting have simply run up the costs for everyone, so that the market for purely peace goods of every sort is shrinking much more than it ought, due to the inflation of cost that has come about. A little later on all of us little fellows can shut up our shops and go to work for the big ones, who are the ones that are being helped by the present system.

If you will read the proceedings of the American Society of Mechanical Engineers at their meeting last June you will find mention that the Canadians found ways and means to get the little fellows to work, and that the little fellows began to produce the materials quicker than the big ones. This is only natural.

"Many a mickle makes a muckle," but it seems to be a lot of trouble for some people to devise ways and means of gathering up a quantity through using small organizations that are ready and willing to produce it. Of course, that does not mean to say that the small shops can produce large cannon; but they can produce small things, and their only hope of doing it now is to hunt up some contractor and take a subcontract from him below cost and allow Mr. Large Contractor to reap the benefit. There are a lot of us that have even done that, but we wonder why it is necessary.

Stability of Shop Personnel Essential to Maximum Production

Special Correspondence

That the war would ultimately create a scarcity of labor was a foregone conclusion, and despite efforts to prevent the diversion of labor from the machine industry—which is as essential as any other—this scarcity is being increasingly felt.

It is regrettable that in the operation of the draft a large percentage of mechanics were placed in the higher classifications; consequently they are now in the army, whereas their presence in the shops would have been more profitable so far as the advantageous distribution of the man power of the nation is concerned.

During the first two years of the war Great Britain learned an important lesson in this respect, for it became necessary when the lack of skilled help became so acute as to seriously threaten an adequate production of munitions for her to recall a large number of mechanics who had got into the army.

Unless steps are taken to keep at work in the shops of this country all those who are suited by training and experience to the duties required in the production of munitions—without thinking of the distant future—a condition may arise in this country similar to that which resulted in the urgent appeal of the British army for "Munitions, more munitions and still more munitions." It is scarcely conceivable that full quotas of men for field service cannot be drafted from the nonessential industries, and while exemption on industrial grounds may possibly be interpreted by some as a departure from a strictly impartial enforcement of the compulsory-draft law it is a condition, not a theory, that must be met.

Another Serious Aspect

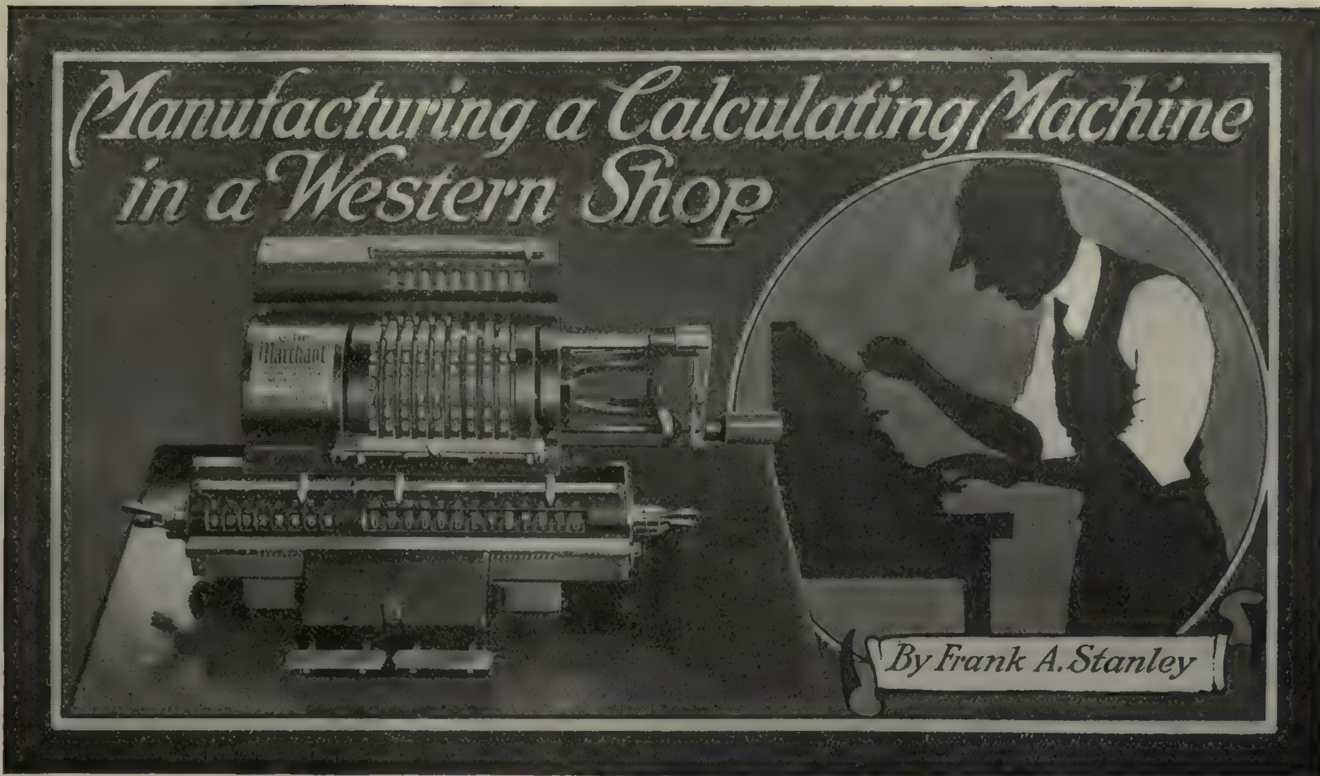
Of late another serious aspect of the skilled-labor problem has become apparent and as a result a condition exists which demands immediate and energetic action by the proper Government officials. There is too much shifting of skilled labor from one district to another and among shops in the same district. Only those familiar with the problem of production in the shop can appreciate the handicapping effect of a personnel that is continually changing, and such handicap is intensified in direct ratio to the degree of skill required in a particular product.

Probably in no branch of the machine-shop field has the scarcity of skilled labor been more keenly felt than in that of toolmaking—the branch on which the enormous supply of necessary gages is dependent—and it is here that the retarding influence of shifting employees is still more intensifying the production problem. The reason for the abnormal changing about is not far to seek. The natural tendency of the toolmaker—just as of other classes of employees—to sell his services to the highest bidder accounts for most of the shifting, and a full recognition of that tendency offers the most immediate and logical solution of the problem.

In the first place all Government work should be placed on an equal basis, and plants so engaged should not be permitted to hire each other's help. The rule should be, "If you are on Government work stay where you are" instead of enticing men from one shop to another by offers of higher wages.

An attempt on the part of the Government to prevent shops from hiring each other's men might result in the standardization of the rates for the various classes of workers—an eventuality that would be akin to the government-controlled shops in England which has apparently done much to remove many obstacles that previously interfered with maximum production.

Many objections might be urged against such a standardizing process, but the grim business of war demands the subordination of every consideration to that of production. There is no gainsaying that a constantly changing shop personnel impedes production, and to remove such impediment is an immediate task to which the proper Government officials can be most profitably assigned.



IV. Press-Tool Work

As in all work of this nature, there is a considerable amount of press work, and this installment deals with interesting examples of blanking, shaving and piercing tools of the pillar type, as well as various operations upon other parts of the machines.

AMONG the operations at the plant of the Marchant Calculating Machine Co. of Oakland, Calif., are included the blanking, piercing and shaving of specially shaped gears and cam plates, blanking and forming of covers and press-tool work on various smaller members of the machine. This work necessitates the construction and repair of varied types of press tools, and a considerable portion of the work of the tool room is of this nature. Some of the methods of the tool department in laying out and constructing these special tools are very interesting.

The object of this theme is to give the details of a few tools of this character along with some closely allied processes on parts intimately related to punch-press products.

Tool-Vault and Press Department

In order to convey an idea of the extensive line of press tools required in this factory, the illustration, Fig. 36, is submitted. This view shows two sides of the storage vault, and includes a sufficient number of tools to give a fair idea of the general punch-press outfit. A considerable range of punches and dies will be noticed; and in many instances they are of the pillar type, assuring constant alignment of punch and die.

The press department, where all the sheet-metal parts for the shop are produced, is shown in Fig. 37. In the foreground will be noticed a portion of the stock rack. On the left is a heavy metal stand with a series of shelves for holding large dies and bolsters, and above this is located a jib crane for handling these heavy members between press and rack.

One of the parts turned out in large quantities by the press room is the gearwheel for the fiber dial, Fig. 38, of which there are a number in each calculating machine. They are made in several sizes and forms, according to the fiber wheel to which they are to be attached, of sheet steel and have special forms of teeth. The fiber wheels, it will be observed, carry on the opposite face a thin cam plate which is produced in a manner very similar to that employed for the gearwheels.

The Dials, Gears and Cams

Details of the dial parts are given on the line drawing, Fig. 39. The fiber wheels A are 0.968 in. outside diameter, and the thickness or width of the edge upon which the numbered characters are stamped is 0.150 in. The hole through the center is $\frac{13}{32}$ in. in diameter. The gear B is pressed from soft sheet steel 0.075 in. thick. It is 0.751 in. in outside diameter with a 0.236-in. hole.

The third member of the group is the wheel cam C, which is pressed from hard stock 0.062 in. thick. The gearwheel B and the wheel cam C are secured to opposite sides of the fiber dial A by means of three small rivets, and form the bearing by which the dial is mounted upon its bar in the machine carriage.

The gear is made from 0.075 in. soft steel $\frac{1}{8}$ in. wide. It has 10 teeth of special shape, the tooth being sharp at the point and with very small radius at the root. The depth of the tooth is 0.139 in. The contour of this gear amounts to a considerable length of cut for a blank of but $\frac{3}{4}$ in. in diameter, when the nature and thickness of material are considered, and in order

FIG. 36. THE TOOL VAULT

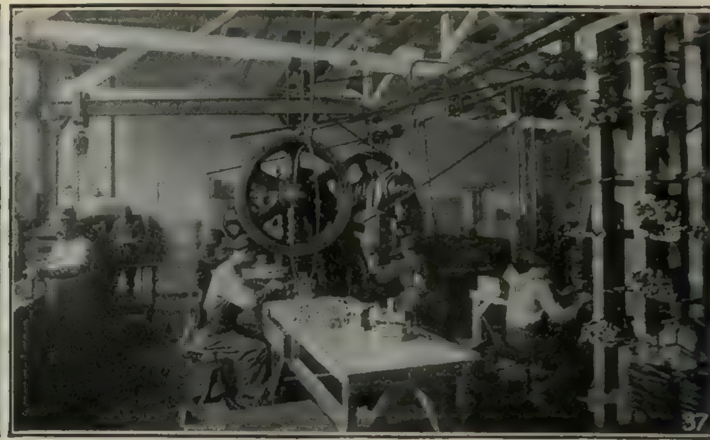


FIG. 37. THE PRESS DEPARTMENT

to insure accuracy and smoothness of cut the three sets of tools shown in Fig. 40 are provided.

The first of these is the blanking tool shown at the right. This view shows the stock guide under the stripper and also the stock-stop, or finger, gage for stopping the strip of material in the right position at each stroke of the press. This stop is located on top of the stripper, working through a hole in the latter, and is operated by the pin mounted upon the front of the punch holder. After being blanked, the gear passes to the first shaving die, where it is properly located by the nesting plate shown attached to the surface of the die.

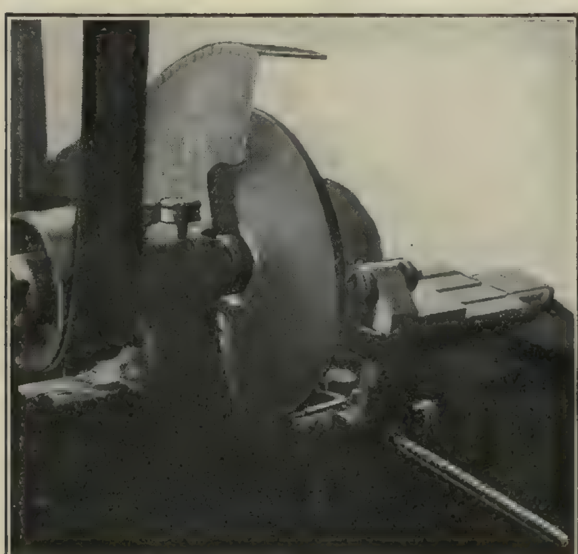


FIG. 42. FINISHING FACE OF GEARS

As the gears come from the blanking die they are 0.010 in. larger in diameter than the finished size, leaving 0.005 in. to be removed by the shaving dies from the entire contour. The first die removes 0.003 in. of this extra material, and the second one removes the remainder, 0.002 in., bringing the gear to the finished diameter of 0.751 in. The hole in the gear is punched in a later operation, these tools being shown in the press in Fig. 41, which makes clear the method of holding the tools in place.

The gear is located centrally over the die by an accurately positioned nesting plate, and the punch is fitted with a movable stripper actuated by four stiff springs which strips the work off from the punch as soon as the latter leaves the die.

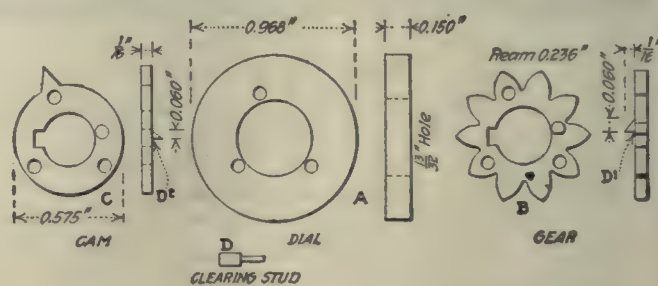


FIG. 39. DETAILS OF DIALS, GEARS AND CAMS

The dies themselves are $\frac{15}{16}$ in. thick and the punches $1\frac{1}{2}$ in. long. The dies are made from the solid, being first worked out carefully to a layout and then finished accurately by a system of master broaches in the use of which much judgment is required, for with work of this character a too severe application of the broaches may lead to unnecessary distortion in the hardening process.

All punches and dies are made from an oil-hardening steel that shows no perceptible change in hardening. In this process the tools are first preheated to 1200 deg. F. in the gas furnace and then allowed to rest for a few minutes, or until the outer surface becomes black, when they are reheated to 1430 deg. F. and quenched in linseed oil. The punches are made from

FIG. 38. THE DIALS

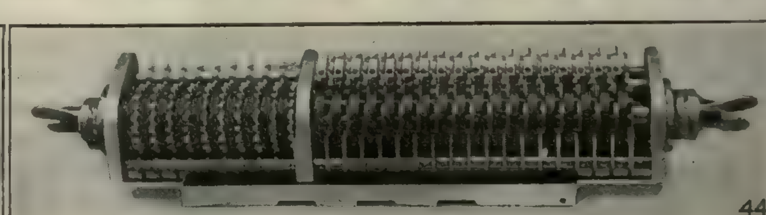


FIG. 44. CARRIAGE WITH DIALS AND BARS IN POSITION

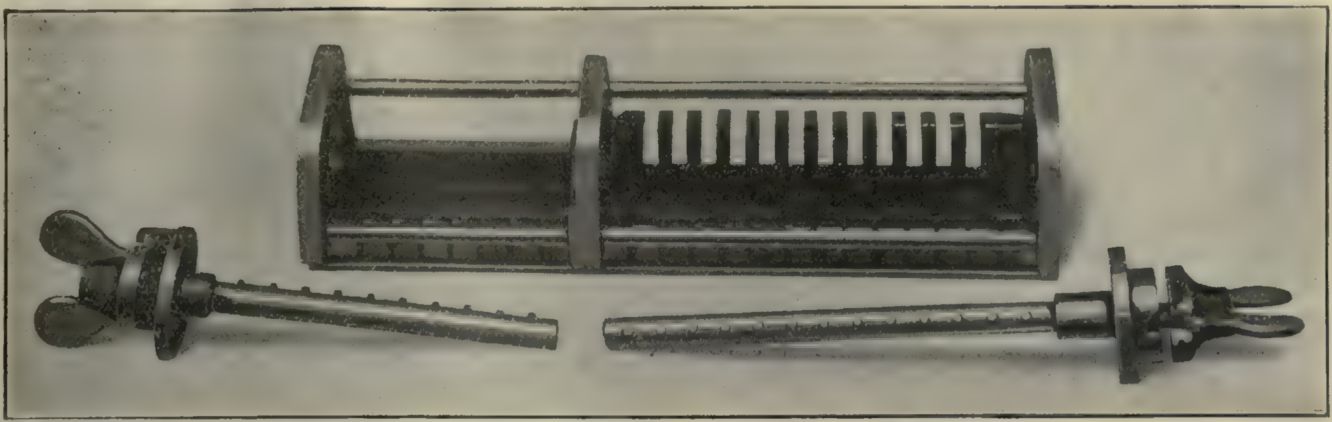


FIG. 43. CARRIAGE AND CLEARING BARS ASSEMBLED

one solid piece, the punch blank being large enough to form a base of sufficient diameter to receive the screws and dowels for mounting it upon the face of the holder, and the punch being turned down from this base and worked out to the desired form. This method of construction gives a very rigid punch and provides for positive attachment to the holder without danger of deflection in service.

The dies are given one-half degree clearance on a side. The base to which they are attached is 1⅜ in. thick and the guide pins or posts at the rear are 1 in. in diameter by 4⅞ in. long. The punch holders are 1⅜ in. thick, and the bosses at the rear, which are bored out to fit the guide pillars, have a length of 2¾ in.; thus the length of bearing surface is nearly three times the diameter of the pillars. These tools when assembled for operation have a height of 5 3/16 in. from base to top. The general method of handling the wheel cam *C*, Fig. 39, is similar to the process of making the gearwheels as described above.

Following these operations both gears and cams are placed in jigs and drilled at three points with a No. 54 drill for rivets having an 82-deg.-angle head, the holes in both cam and gear being countersunk to this angle. The gears and certain of the cam blanks are also drilled to receive the body of a small stud *D*, which is tapered from 0.055 to 0.059 in. to drive into the drilled hole. The head of this stud comes on the inside of the gears and cams and the member is known as the clearing stud, as it is used in conjunction with the clearing bars upon which the gears and cams are carried to clear the dials or bring them back to zero position.

When the clearing studs are driven into their holes in the gears and cams they are milled off to a length of head of 1/16 in., as indicated at D^1 and D^2, Fig. 39, and are flattened on the side of the head to a thickness of 0.060 in., the head being beveled to an angle of 45 deg. The stud then assumes the appearance of a small clutch tooth, which in effect it really is, as when in operation it is engaged by similar teeth formed on the ends of pins driven crosswise into the clearing bars.

In riveting the gears and cams onto the fiber disks, the face with the projecting clearing stud is placed next to the fiber dial so that the head of the stud extends into the 13/32-in. hole in the latter. The three rivets fitting the holes in all three members align them correctly, and after the riveting the assembled unit is

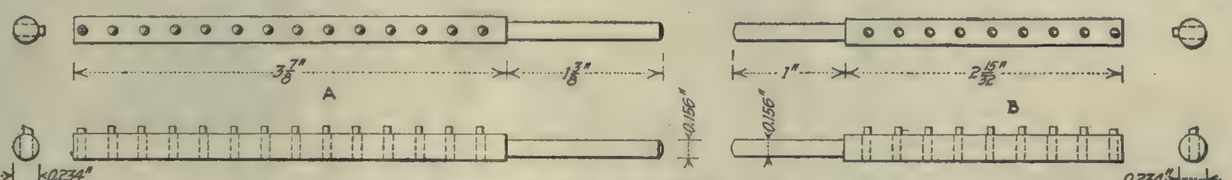


FIG. 45. DETAILS OF CLEARING BARS AND PINS

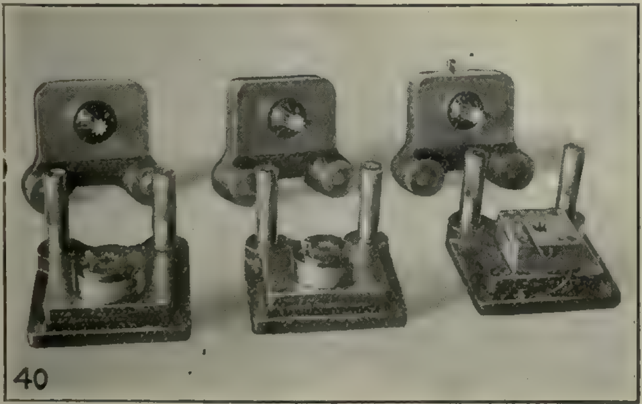


FIG. 40. BLANKING AND SHAVING TOOLS

FIG. 41. GEAR-PIERCING TOOLS IN POSITION

placed in a fixture and ground across the gear face on a disk grinding machine, Fig. 42, to surface off the rivet ends. Allowance for this operation is made by leaving a certain amount of material on the side of the gear blank so that the entire face will be smooth and flush after passing across the grinding disk. Thus, the gears are blanked from stock 0.075 in. thick, and in the finishing operation they are reduced five thousandths, or to 0.070 in. The work is held in a collet which centers it properly, and is drawn against a seat by a knurled knob and draw-in bolt at the rear end of the fixture. The fixture body is tongued to fit squarely on the table of the grinding machine and hold the work with its face parallel to the grinding disk. A pass or two of the work over the disk face is sufficient to finish the gear surface as required. The hole through the gear and cam is finished to size by a reaming process which removes a small amount of metal and finishes the diameter to 0.236 inch.

The two clearing bars, which in the assembled calculating machine pass through the dials, are shown withdrawn from the carriage in Fig. 43, while in Fig. 44 (which represents a larger carriage) they are in position. It will be seen that each bar is fitted with a series of cross-pins which, when the bar is moved longitudinally a slight disance, cngage with the clearing studs in the inner faces of the gearwheels and wheel cams so that the dials may be cleared by turning the wing knobs at the ends of the bars. When moved in the opposite direction endwise the bar clears its pins from the gears and cam wheels. The longitudinal movement of the bars is derived from a cam-shaped shoulder on the end collars, which causes endwise movement when the bars are rotated by the fingers.

The placing of the cross-pins in the clearing bars and the finishing of the bar units are interesting operations in themselves. Details of the two bars are given in the illustration, Fig. 45, and they correspond with the two shown at the front of the small machine carriage in Fig. 43.

In the long clearing bar A, Fig. 45, there are 13 clearing pins, and in the other bar B there are eight pins, all of the same character. The outer pin in each bar is shorter, with two parallel flats on the end. The holes are put through the bars with a No. 49 drill and sized with a No. 48 reamer, the work being held in a jig which answers for both lengths of bars. The pins are 0.078 in. diameter and 0.315 in. long. The

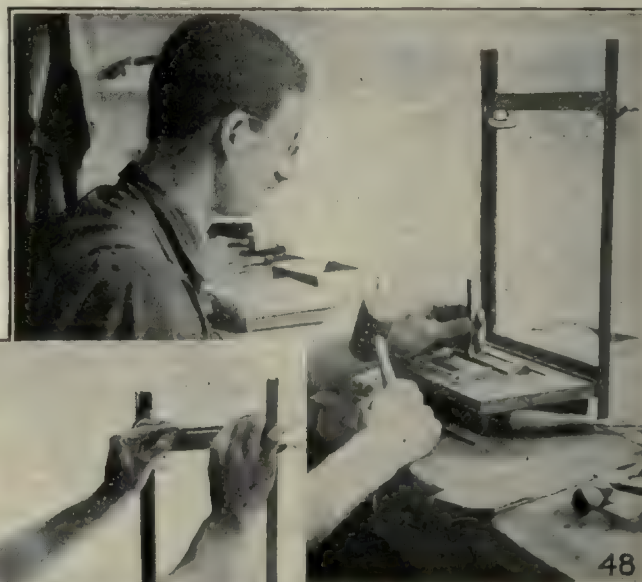


FIG. 48. STRAIGHTENING THE BARS

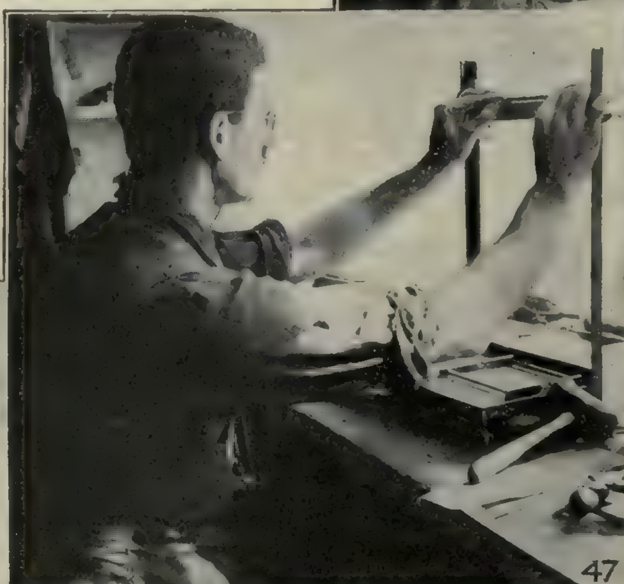


FIG. 47. TESTING BARS FOR STRAIGHTNESS

FIG. 46. SETTING PINS IN CLEARING BARS

bars themselves have a body diameter of 0.234 in. or two thousandths less than the diameters of the holes through the gears and cams on the dials. The operation of putting the pins into the clearing bars is illustrated in Fig. 46, where a number of drilled bars will be noticed beside the operator, and at the back of the bench plate a lot of pins ready for driving into place. The work rests in a parallel groove planed in a small bar of steel which lies on the bench plate immediately in front of the workman. Picking up a pin he enters it in a hole in the clearing bar, and with a light blow of his hammer drives it home. The hole reamed to No. 48 drill gage size is 0.076 in. in diameter, while the pin is made from 0.078 in. wire, leaving a difference of 0.002 in. for driving. The holes will probably run a trifle larger than the indicated size, but between one and two thousandths may be calculated upon for the driving fit, which is a fairly snug drive for so small a diameter.

As the holes are all drilled on one center line and the pins all driven in from one side, there is a tendency for the clearing bar to warp along this center line, with the top side bowed up a little, as that is the side that naturally becomes stretched through the driving of the pins from that direction. After all of the pins

are driven the bars are tested for straightness, and if at all bowed they are corrected before the work is removed from the bench.

The apparatus for testing and straightening is shown in Figs. 47 and 48. The first of these views represents a straightedge clamped to an upright frame at the back of the bench plate, the straightedge coming on a level with the eyes of the workman as he sits at the front of the bench. Placing the work on the straightedge, with the window pane immediately at the rear, he can determine at once by the light test whether the bar is at all bowed up at the middle or elsewhere and estimate the amount of curvature. In case it is found that it requires straightening he places it, as in Fig. 48, on a pair of parallel bars which are pinned together to form a suitable support, and then with a narrow steel set and a light mallet he "sets" the bar at the required point.

The tops of the pins are now ready to be finished off to uniform height, milled and ground to the required flat and to the proper angles on the projecting ends, these operations being accomplished by holding the bar in a special fixture and finishing the pins complete to the desired dimensions, so that they bear a uniform relationship to each other and to the axis of the clearing bar in which they are secured.

Employment of Women in Our Industries

BY W. A. VIALL

This paper, which was read before the National Metal Trades Association at the Astor Hotel, New York, Apr. 24, outlines the experience of one of the major shops of this country in the employment of women.

THE employment of women in industry is such an old story that at times it seems as though a great deal of undue stress is being laid upon this special phase in the economic problems of the day. My only excuse for complying with the request of our president and inflicting this paper upon you is that the Brown & Sharpe Manufacturing Co. represents that large class of employer that has not employed women in the manufacturing side of its work, but under the pressure of present conditions has felt itself compelled to resort to measures that will help it in its output. It is also an example of a plant built and organized to use men only and that has had to rearrange its shops and adapt its organization to employ women. The fact that within 10 months we have placed 800 women at productive work may offer encouragement to others.

Prior to the war women were extensively employed in machine shops in Europe on work that always seemed to us in this country to be unsuited to them. This point of view, however, had its basis largely in education and tradition. It has been repellant to the minds of most employers to think of employing women in their machine shops and core rooms, but if one stops to analyze the situation certainly the work is no worse than that done by women in textile and other mills and the drudgery that is imposed upon them in thousands of homes where work, and hard work, occupies every minute of their waking hours.

In the matter of employing women, conditions in Providence are particularly good. It is a city of about 250,000 inhabitants and has a variety of industries. The jewelry industry has always employed women in large numbers; the textile mills have had abundant opportunity for women to work, and there are some of the metal trades using automatic machines that have used women for attendants for a great many years. In addition to these activities there are the department stores, which have been employing large numbers of women at wages not very remunerative, and the kitchen has also used a considerable amount of this help. In the case of the two latter classes employment in a factory has presented an attraction in that they have their Saturday afternoons and evenings free, although in the case of family circles the fact that a home is offered them is sometimes overlooked.

There are various nationalities represented in our city, and starting with a fair amount of Americans we have the Irish, Italians, French and Swedes in considerable numbers.

A few months before we began to employ women the American Locomotive Alco plant had finished a large order for fuses, after which it closed its shops. This threw many women out of work who had become accustomed to shop work. As soon as it became known that we were to employ women a large number offered themselves and we were able to select an excellent class as a nucleus, but as time passed we have had to content ourselves with some that do not compare altogether favorably with those first taken on.

As you know we manufacture not only machinery which entails the ordinary machine-shop operations but also a line of small tools, and we have manufactured sewing machines for more than 50 years, so that the shop presented a variety of opportunities. I am aware that many of our members have employed women in their works in operations requiring a deftness of hand seldom or never attained by men, and our experience is offered as a suggestion as to how to start in.

When we decided to add women to our force the first thing to be decided was where could we best employ them, what provision could we make to take care of them and what hours should they work. As the main points of operation we decided to place them in considerable numbers in the small-tool department, in the screw-machine department and in the sewing-machine department. In the latter department we do a large part of small-piece operations not only for sewing-machine work but for work all over the factory, and we have in it a good many milling and drilling machines.

An essential in taking care of this class of help is that the proper dressing, rest and toilet rooms shall be provided. We have arranged such quarters as best we could in a factory that was not originally planned to employ women. Rooms have been fitted up conve-

niently located to the centers where the largest numbers are employed, and while we have not gone into elaborate arrangements we have tried to provide sufficient space, so that each woman can have her locker and also a room where luncheons can be eaten at noon, for it is not conducive to good discipline to permit them to remain in the workrooms at noon. The rooms are equipped with lunch-room armchairs.

I believe it very important that a woman shall have charge of these rooms. It is not necessary that she devote all of her time to this work; she can be given other work and spend the rest of the time in taking care of the rooms and to answering such demands as may be made upon her by the women. It is essential that this woman shall have the confidence of the others, and this means that she must be able to give help and advice in matters that are not strictly related to business.

For employment purposes we fitted up a waiting room, with an entrance entirely separated from that of the men. It is not advisable to compel women to wait with a crowd of men such as is usually found in employment departments.

As to hours it was decided that nine hours would be the schedule, from 7 a.m. to 11 : 45 a.m. and from 1 to 5:15 p.m. daily except Saturdays, when they are from 7 a.m. to 12 m. By closing 15 minutes earlier at noontime, rush and danger are avoided, and help in maintaining that discipline that must prevail if the system is to be successful.

Attitude of the Men

We began to place women in the departments indicated previously, and we found that our work was helped by the attitude of the men. Perhaps the fact that we have not been placing these women in the works to displace men has had a good deal to do with it. We found that as we added women to the forces they would replace some men, especially the younger ones who had left, but there has been no plan on our part to throw out the men in order to replace them by women, and to a great extent their employment has been an addition to rather than a replacing of the men. Were we to use the men to the best advantage our plan would be to place men in those parts of the shop where they could do work more fitted to them, and make the change one of operations rather than one of industry. As we all know, men nowadays are not likely to do work that they do not like or want to do, so that probably some men left because of their change of work.

Having decided on the departments in which the new help was to be employed the question of instruction was decided. The women were placed among the men, in the same way that the men were placed as beginners, and instruction was given by the men who were usually doing this work. As a general rule we found this method effective.

While we employed these women on an hourly rate of wage during the period that they were being instructed, as soon as they became at all proficient they were placed on piecework. The time elapsing between their employment and their being placed on piecework compared favorably with that taken by the men. The results were so satisfactory that we increased the field in which they could be employed, until finally they were placed in various parts of the works in all of which their services have proved effective. In the screw-machine department women are running automatics and hand machines. Up to now they have done little in setting up either machines, but they keep the machines running and gage the work in a satisfactory manner. In the gear-cutting department they have taken hold well, and they are not only attending to the ordinary running of the machines but they are taking the work with the blueprint, setting up the machines and doing everything that an automatic gear-cutting machine operator is called upon to do.

Tool-Crib Work

They have been placed in tool-storage rooms with varying degrees of satisfaction. Here it is not so much a question of her ability as it is of her attitude toward her work and her fellow employees that makes for her efficiency. A toolroom is notably a place where visiting can be carried on, and it is incumbent upon the toolroom attendant to determine whether this habit shall be encouraged or discouraged.

We have placed some women on lathes doing light work, and here again it has been proved that this work can well be done by them.

Much could be said about the way that women are successfully doing various kinds of work, but I shall only enumerate them broadly as follows: Inspection, grinding (cylindrical as well as tool), lathes, screw machines (hand and automatic), small planing machines, hand lathes doing polishing and hand-tooling work, gear-cutting machines, blueprint room, stamping, filing, assembling of small-tool parts and general bench work, all being within the physical ability of the average woman. We were also able to replace many of the shop clerks with women, a thing that is not so easy when there are no other women in the department. There is safety in numbers in a machine shop as well as in other departments, and the more the women can be placed together the better the general results.

The success in employing women depends largely upon the management in the first instance and upon the foreman of the shops. In the departments where the foreman is interested he imparts to his subforemen the attitude that is to be observed toward the women, and those foremen who expect that the women are going to do well and who push along the teaching obtain the results that they expect.

Comparative Success of Men and Women

The question arises in the minds of all, Are the women as successful in the work as the men? In our works I feel that the employment of women is in the new-broom class. Not only on the part of the men who have the work to do is the result apt to be overestimated but a large number of women in our place appreciate that it is a new thing, and so an attitude toward the work is created that does not allow one to form a correct judgment as to results. Human nature is the same, whether in men or in women. We find those who are apt, interested and desirous of doing the very best they can; and there are also those who are interested for a while and then want to move about.

For some time the question of turnover seemed to be very much less among the women than among the men, but of late the percentage has become nearly as

large. This is due in part to the fact that other factories are raising wages and also to the spirit of seeking a change as spring approaches.

As I have said before, there are some jobs where deftness of hand counts in the day's work. It is felt by our people that in the running of certain types of machines where continued physical labor is demanded the staying power of women is not sufficient to carry them through, and consequently we are keeping them away from that class of work. Our experience is that in many cases they require more attention in the running of machines. If anything goes wrong with a machine they are not inclined to do anything to overcome it, but wait until somebody comes along to fix it. This is an advantage and it is also a disadvantage. All of us have had too many experiences with boys and young men who have attempted to "fix" things not to know that their help is not always desired; but the possession of a little ingenuity properly exercised helps to develop the skilled workman and to keep production coming.

Safety Measure

In days back the machine shop would have been no place for women to work under any circumstances, but with the modern safety-control mechanisms accidents are reduced to a minimum. We insist upon all women wearing some kind of cap that will protect the hair, and those who work among the machines must wear short sleeves. In our class of work the danger of the skirts being caught is not great enough to demand the wearing of overalls, so in this respect we have not followed the example of many employers.

The employment of women is one of many other questions confronting us at present, and it must be considered from the point of immediate war necessity. What will be the result after the war can well be left until that time. Women can perform many machine-shop operations, and perform them well, and that some of this work is admirably fitted for them is beyond question; but there are other operations for which we shall be forced to engage women because there will not be men to do them.

I think that we are all able to look at this question in a broad way, and while many of us have shops that are not fitted for the employment of women, with some thought and care they can be adapted for that purpose and be made comfortable and safe.

The question "What about the moral aspect?" is one, I think, that comes to the mind of everyone. So far as this may be answered, I think that conditions are no worse in shops than they are on the main streets of our cities, and if the management will strongly repress any indication of carelessness and undue familiarity on the part of the men a standard can be maintained that will be equal to that of any of the places where women are employed.

No words of mine are required to prove that women are valuable workers in the workshop. The experience of foreign countries in normal times, and of England particularly in these abnormal times, has proved it. I believe that what I have said shows that it does not mean a revolutionizing of methods to make use of the services of women, but even in plants not constructed in anticipation of the employment of women provision can be made to make their employment profitable. If added to the proper arrangement of quarters a careful oversight and proper selection of the work to be done is planned we shall find it possible to make material additions to our working forces when the demand for men for national service and in the heavier kinds of work will have crippled our industry.

Railroad Regulations

The War Trade Board announces that it has adopted as a part of its rules and regulations the regulations of the United States Railroad Administration as set forth in the circular here quoted:

"UNITED STATES RAILROAD ADMINISTRATION

"DIVISION OF TRANSPORTATION, CAR SERVICE SECTION

"WASHINGTON, D. C., APR. 25, 1918

"CIRCULAR NO. C. S. 2-A

"(Cancels Circular No. C. S. 2; also cancels Circulars 22, 27, 37, 37-A, 37-B, and all supplements thereto)

"To All Railroads:

"1. In accordance with the provisions of the proclamation of the President of the United States, dated Feb. 14, 1918, effective Feb. 20, 1918, all articles of commerce shall require an export license from the War Trade Board for exportation via any port or border point to whatsoever destination, except to points in the noncontiguous possessions of the United States.

"(For status of Canadian shipments, the articles enumerated in list appended hereto require individual license.)

"2. You will immediately instruct all concerned that the furnishing of equipment for shipments consigned, reconsigned, to be consigned, or intended for export shall be contingent upon (a) the issuance of said license; (b) the presentation of license number; (c) the marking of bill of lading 'For Export'; (d) the waybill bearing license number (license or partial-shipment authority may or may not accompany waybill, but must be in the hands of the Collector of Customs at the port of exit on or before arrival of freight at that port).

"3. Shipper's export declaration, of which there shall be four copies, must be delivered to the Collector of Customs at points of exit from the United States on or before arrival of shipment at such port. For shipments to noncontiguous possessions shipper's export declaration, in duplicate, only is required.

"4. All shipments are further subject to such regulations and permits as may be required by the various railroad committees controlling export shipments.

"5. The Car Service Section of the Division of Transportation of the United States Railroad Administration is authorized to permit the shipment of commodities intended for export prior to the issuance of an export license if said Car Service Section shall be satisfied that there is storage room available or that it is the custom of the trade to move such commodities to seaboard for storage or grading.

"6. With the exception of Par. 3 the foregoing for the present will not in any way apply to any commodities for the exportation of which a special license has been or shall be hereafter issued by the War Trade Board dispensing with the requirement of an individual license. Such special licenses are at present in force covering the following commodities: (a) Any shipments made on Government bills of lading by or con-

signed to the Navy Department or War Department, or by or to any of the bureaus or other subdivisions thereof, the billing of such shipments to be marked 'Export License RAC-18;' (b) raw cotton shipped to Great Britain, France, Italy or Japan, and their colonies, possessions and protectorates (not Sea Island or Egyptian cotton. which requires an individual license); (c) all shipments of coal or coke; (d) shipments to Canada and (or) Newfoundland of all commodities not on the export conservation list of the War Trade Board, as appended hereto, unless otherwise specified therein; (e) shipments to all countries other than Canada and Newfoundland of all commodities not on the export conservation list of the War Trade Board, provided that value of no one commodity in the shipment exceeds $100.

"7. That a shipment from one consignor to one consignee, which shall exceed one carload and which is intended for export, will only be permitted with the provision that the car or cars are loaded to full visible or carrying capacity.

"CAR SERVICE SECTION,
"W. C. KENDALL, Manager."

The appended list referred to in the above is the export conservation list of the War Trade Board dated Apr. 15, 1918.

The particular attention of exporters is called to Sec. 11, Par. D, which provides that in addition to the license number appearing on the waybill the license or partial-shipment authority must be in hands of the Collector of Customs at the port of exit on or before the arrival of the freight at that port or point of exit. Shipments made on or after this date may be detained at the point of exit if the license or partial-shipment authority is not on hand.

Attention of shippers is further directed to Clause 7, which reads as follows: "That a shipment from one consignor to one consignee, which shall exceed one carload and which is intended for export, will only be permitted with the provision that the car or cars are loaded to full visible or carrying capacity."

In order to make this rule effective the War Trade Board will incorporate in all export licenses hereafter issued a clause reading as follows: "This license is granted on condition that if shipments made under the authority of this license are in excess of one carload they shall be forwarded only in a car or cars loaded to full visible or carrying capacity."

Notice is hereby given to all shippers and exporters that a violation of any of the foregoing rules and regulations will be regarded by the War Trade Board as a sufficient ground for the revocation of any export license already issued as well as for the refusal of all applications for export licenses hereafter made by or on behalf of any person who has violated said rules and regulations.

VANCE C. MCCORMICK, Chairman.

A Ministry of Reconstruction

Among the other ways in which the business men of Great Britain are looking forward to living and business conditions after the war, it is interesting to note that they have formed a Ministry of Reconstruction, and in connection with this a committee on the relations between employers and the employed. This committee has issued a series of short reports on joint standing industrial councils, and something of an idea of what is proposed can be had from the following quotation from a pamphlet recently issued:

"It may be useful to present a brief outline of the proposals we have so far put forward:

"a. In the more highly organized industries (Group A) we propose a triple organization of national, district and workshop bodies, as outlined in our first report.

"b. In industries where there are representative associations of employers and employed, which however do not possess the authority of those in Group A industries, we propose that the triple organization should be modified by attaching to each National Industrial Council one or at most two representatives of the Ministry of Labor to act in an advisory capacity.

"c. In industries in both Groups A and B we propose that unorganized areas or branches of an industry should be provided on the application of the National Industrial Council and with the approval of the Ministry of Labor, with trade boards for such areas or branches, the trade boards being linked with the Industrial Council.

"d. In industries having no adequate organization of employees or employed, we recommend that trade boards should be continued or established, and that these should, with the approval of the Ministry of Labor, be enabled to formulate a scheme for an industrial council, which might include in an advisory capacity the 'appointed members' of the trade board."

REPORT ON WORK COMMITTEES

A supplementary report has also been issued on works committees to have regular meetings at fixed times, not less frequently than once a fortnight, and to "keep in the forefront the idea of constructive coöperation in the improvement of the industry to which they belong." A report on existing works committees is to be published shortly.

In connection with this Ministry of Reconstruction is a committee which has to deal with new industries of the engineering trade. One of the members is W. B. Lang of Johnstone, two others being William Taylor of Leicester and Sir. W. Rowan Thomson of Glasgow whose bonus-wage system is familiar to many shop managers. The office of this special committee is to deal with problems arising in the establishment of new industries. They are endeavoring to coördinate as far as possible the efforts of individual manufacturers with a view of preventing overlapping and at the same time to secure adequate production.

The warning is being given that in view of the inevitable shortage of engineering material after the war that government control will probably be continued, at least so far as materials are concerned, and a system of priority will have to be maintained. This committee in encouraging specialization in engineering matters, and in particular those branches of the industry which will employ the largest amount of labor relative to the entire cost of production. Manufacturers are also being warned that they must not look to this committee for the protection afforded by tariffs as political matters are not within its province.

Report of A.S.M.E. Committee on Limits and Tolerance in Screw Thread Fits*

The subject here treated is a report on the result of a comprehensive investigation undertaken by the American Society of Mechanical Engineers through its Committee on Limits and Tolerances in Screw Thread Fits. This report will be presented at the spring meeting of the Society at Worcester, Mass., June 4-7, 1918. The conclusions of the committee are based on data published by the United States Bureau of Standards, the Franklin Institute, the Navy Department, the British Engineering Standards Committee and other organizations, as well as on confidential information obtained from leading manufacturers. The report is only tentative and changes may be made in it.

THE Committee on Limits and Tolerances in Screw Thread Fits was assigned by the Council of the American Society of Mechanical Engineers the task "to prescribe the permissible tolerances in the commercial manufacture of taps, dies, bolts, nuts and screws, including the method of measuring of the same."

2. During the years following the appointment of this committee many meetings have been held, and work has been done through subcommittees involving a great amount of investigation and study.

Methods of Investigation

3. Careful study has been given to data already published, and assistance has been secured from the United States Bureau of Standards, the Franklin Institute, the Navy Department and other sources.

4. A request sent to many tap makers for confidential information showing the limits allowed for their commercial work led to a response by a number of leading manufacturers giving such information. This was tabulated and compared. Later some of the tap makers assisted by having over 4000 taps of commercial sizes from ¼ in. to 2 in., secured from a number of different makers, measured for errors in lead in order to obtain the average variation of commercial taps which are in use today.

5. Early in the investigation a meeting of screw manufacturers and users was called at the headquarters of the American Society of Mechanical Engineers in New York, at which about forty representatives were present, and the matter of tolerances and limits in screws was thoroughly discussed in the light of a tentative report which this committee had prepared. This meeting resulted in the appointment of a subcommittee consisting of E. H. Ehrman of the Chicago Screw Co., E. A. Darling of the Draper Co., and C. B. Young, engineer of tests of the Pennsylvania Railroad Co., to coöperate with the general committee by obtaining data from the screw manufacturers.

6. Through this committee and the officers of the A.S.M.E. over 5000 screws were obtained from the regular commercial stock of many different manufacturers, these representing work of various grades and sizes and with cut and rolled threads. These screws were measured and the results tabulated.

7. Sample screws and nuts were prepared having varying degrees of error in diameter and lead, and from these it was determined what would be the maximum error allowable, and charts were made to show the relation of taps and screws measured to these allowable limits.

8. Sample gages were also made to a closer limit than those now proposed by the committee in order to learn how close it was practicable to make commercial work. These gages were distributed without stating what the allowance was in order that the users might not be prejudiced by thinking the limits were closer than they could work to.

9. Comparisons have also been made with the allowances and tolerances recommended by the British Engineering Standards Committee.

10. The recommendations of the report are the outcome of all this study and investigation.

11. While separate diagrams have not been provided for manufacturers' standards and users' or consumers' standards it is expected that manufacturers will aim to work within the zones established by the diagrams so as to produce work that will come within these limits, and that gages will be so made as to insure this result.

12. Allowances to be provided for are wear of tools and unavoidable imperfection of workmanship.

Gaging Systems

13. The gaging tools required for the threaded hole are: (a) Threaded go plug of a length equal to the longest engagement of work; (b) threaded no-go plug made short and with clearance for full and root diameters; and for bolt or screw: (a) Threaded go ring of a length equal to the longest engagement of work; (b) threaded no-go ring made short and with clearance for full and root diameters.

14. The study given to gaging systems has led to the conclusion that no one system is best adapted to all needs, and that for a variety of work made in moderate quantities a gage for measuring errors of diameter and lead combined in the same instrument may give the best results, while for manufacturing in large quantities a fixed gage for one size only and having separate means for measuring errors in diameter and lead may be best.

15. There is also the need in many cases of master gages, inspection gages and workman's gages, each so made as to suit the particular needs.

16. A number of designs of gages for these various purposes have been submitted to 40 prominent manufacturers and users, and following their recommendations selections have been made which are illustrated and described in this report.[1]

17. The illustrations, Figs. 9 to 17, give general sug-

*Received by the Council, Feb. 15, 1918, and ordered printed for presentation at the spring meeting, Worcester, Mass., June 1918, of the American Society of Mechanical Engineers.

[1]Reference can also be made to "Report No. 38 on British Standards for Limit Gages for Screw Threads."

gestions only of what it is recommended to use, as it would require too voluminous a report to fully cover the ground.

18. It is believed that eventually three grades should be established to cover not only general work, such as is here provided, but also that of more restricted and more liberal tolerances. This report deals with limits and tolerances for general work only.

19. Tables covering medium-grade work for general use have been prepared for diameters from ¼ in. to 2 in., but the formulas can be used for sizes beyond this range. They can also be used for different numbers of threads for a given diameter within ordinary range provided the thread is of the U. S. S. form.

20. The variations which affect the fit between screw and nut are those of diameter, lead, including length of engaged thread, and angle of thread, besides others of a minor character, such as the crookedness of tap, the condition of its cutting edge, the kind of metal being tapped, etc. The first three of these variations have been definitely taken into consideration in the tables included in this report, and it is believed that the allowance is sufficient to provide also for the other variations mentioned, unless they are extreme.

21. The effect of errors of lead on the quality of fit is proportional to the length of fit, but the effect of this is modified by the error in pitch diameter. Thus if a tap, for example, is materially oversize it can have a greater error of lead than would be the case if it were nearer to the standard size and still give satisfactory results in use, because the error in lead counteracts the increased diameter of the tapped hole to an extent dependent on the length of fit in the tapped hole.

22. The available variation when the length of fit is not in excess of one diameter are shown by the triangular zones of Tables 1 to 18. They are such that any screw having a diameter and error of lead which would come within such zones would enter any tapped hole which would also pass like inspection in the zone established for holes, and the extremes which would pass inspection as to looseness would not be so loose but that they would be considered mechanically satisfactory for general work.

Zones Based on Engagement

23. The zones in Tables 1 to 18, as has been stated, are based on the engagement between screw and tapped hole with a length of fit equal to one diameter. If the length of fit is greater than one diameter there is a possibility of interference in extreme cases, such as where a screw having the longest allowable lead is screwed into a hole of a depth greater than one diameter of screw, which has been tapped with a tap having the shortest allowable lead.

24. Under these conditions, however, unless the length considerably exceeds 1½ diameters of the screw, the flow or distortion of metal when forced by the wrench will allow the parts to be screwed together. Actual tests made under the direction of the committee show this to be so. After the first engagement, where the fit might seem unduly tight, it would be materially easier—in fact, for many uses it would be better than a shaky fit even if within the prescribed limits.

25. For this reason it is believed that taps, nuts and screws passing inspection within these limits, even where it is not known what length of thread may be required in actual use, can be used with the expectation that the work will be interchangeable even when the length of engagement is greater than one diameter, although theoretically there might be the interference in lead above pointed out. The keeping within the prescribed limits would be a radical improvement over the variations of taps and screws in general use today because of a common standard serving as a bull's-eye at which all would aim.

26. If in any case it should be important to entirely avoid interference in lead, the narrower zones shown by the triangles for the larger-sized screws having a length equal to the length of fit between screw and nut to be used will show the limiting zone. This method can be used in any case where greater accuracy is desired, and is further explained in Pars. 49 to 51. The plan here submitted is based on having the maximum screws basic in pitch, outside and root diameters.

Tapped Holes

27. Generally stated all tapped holes should be above basic standard and all screws below, the more above or below in pitch diameter the greater the allowance possible in error of lead while still maintaining a satisfactory fit.

28. In Tables 1 to 18 the figures for taps are held to a limit slightly above the largest allowable screws to provide for wear of the tap, the greatest allowance being made at perfect lead where a reduction in diameter due to wear would be most objectionable. In applying the tables and diagrams to the use of fixed gages a rectangle representing a given maximum and minimum in pitch diameter and a given error in lead within the triangular zone can be established. Work failing to pass inspection with such gages can be then measured for diameter and lead, and if coming within the triangular zone even though outside the limits of the gages need not be thrown out but can be accepted for use.

Charts and Tables for Limits and Tolerances Shown in Tables 1 to 18 Inclusive

29. When a screw or nut has an error in lead the amount of that error varies directly as the length of thread on screw or depth of threaded hole, i.e., the longer the screw or the deeper the hole the greater the total error in lead; and where a definite quality of fit between a screw and nut is desired less error in lead per inch can be allowed for a long thread than for a short one.

30. In these tables and charts, therefore, the length of thread is made the governing feature, and any chart applies equally well to a screw or nut of any diameter or pitch for the length of thread specified.

31. The limits for the lengths of threads, as adopted and shown by the charts are 0 for the minimum limit and once the nominal diameter of U. S. S. thread for the maximum limit. In this way each chart is especially applicable to a definite size and becomes a standard for that size between the lengths of thread specified.

32. Another factor in the fit between a screw and nut is the pitch diameter measured on the V of the thread. For a 60-deg. thread of a given length the error in pitch diameter bears a definite relation to the error in lead.

33. This is illustrated in Fig. 1, where *ABC* and *DEF* represent two threads 1 in. apart on a standard-

$\frac{1}{4}$ (0.250) INCH 20 THREADS U.S.S.
BASIC PITCH DIAMETER 0.2175
Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 18 PITCH TOOL = 0.0069		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 22 PITCH TOOL = 0.0057	
	MIN.	MAX.		MAX.	MIN.
OUTSIDE DIAMETER	0.2519	0.2557	0.2500	0.2500	0.2440
ROOT "	0.1867	0.1877	0.1850	0.1850	0.1792

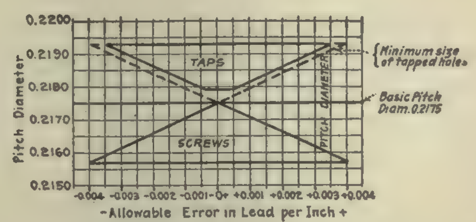
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 0.2193	MAX 0.2193	0.0035	0.0035	0.2157 MIN.
MIN. 0.2179	MIN. 0.2175	0.0004	0.0000	0.2175 MAX.

Tolerance for Thread Angle ± 30 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT 0 TO $\frac{1}{4}$ INCH (ONCE THE DIAM.)

NOTE: In Practice these can be recommended for length of thread engagement to one and one half diam's ($\frac{3}{8}$") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH: TAP	ALLOWABLE ERROR IN LEAD PER INCH: TAPPED HOLE
0.2179	0.0004	±0.0005	±0.0009
0.2180	0.0005	±0.0007	±0.0011
0.2185	0.0010	±0.0018	±0.0022
0.2190	0.0015	±0.0029	±0.0033
0.2193	0.0018	±0.0035	±0.0040

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM.
0 0000	0.0000	0.2175
±0.0012	0.0005	0.2170
±0.0022	0.0010	0.2165
±0.0033	0.0015	0.2160
±0 0040	0.0018	0.2157

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TABLE 1

$\frac{5}{16}$ (0.3125) INCH 18 THREADS U.S.S.
BASIC PITCH DIAMETER 0.2764
Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 16 PITCH TOOL = 0.0078		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 20 PITCH TOOL = 0.0062	
	MIN.	MAX.		MAX.	MIN.
OUTSIDE DIAMETER	0.3144	0.3186	0.3125	0.3125	0.3059
ROOT "	0.2414	0 2464	0.2403	0.2403	0.2342

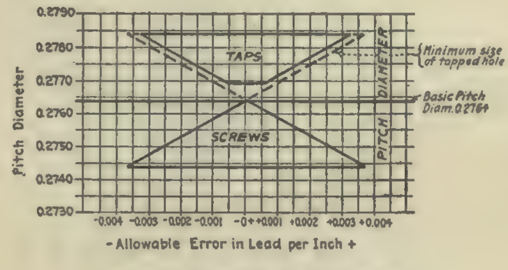
LIMITS ON PITCH DIAMETER AT PERFECT LEAD.

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 0.2784	MAX. 0.2784	0.0040	0.0040	0.2744 MIN.
MIN 0.2769	MIN. 0.2764	0.0005	0.0000	0.2764 MAX.

Tolerance for Thread Angle ± 30 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO $\frac{5}{16}$ INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's ($\frac{15}{32}$") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25.



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH: TAP	ALLOWABLE ERROR IN LEAD PER INCH: TAPPED HOLE
0.2769	0.0005	±0.0006	±0.0010
0.2770	0.0006	±0.0008	±0 0011
0.2775	0.0011	±0.0016	±0.0021
0.2780	0.0016	±0.0025	±0 0030
0.2784	0.0020	±0.0033	±0.0037

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM.
±0.0000	0.0000	0.2764
±0.0008	0.0004	0.2760
±0.0017	0.0009	0.2755
±0 0027	0.0014	0.2750
±0.0037	0.0019	0.2744

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TABLE 2

$\frac{3}{8}$ (0.375) INCH 16 THREADS U.S.S.
BASIC PITCH DIAMETER 0.3344
Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 14 PITCH TOOL = 0.0089		U.S.S BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 18 PITCH TOOL = 0.0069	
	MIN	MAX		MAX.	MIN.
OUTSIDE DIAMETER	0.3770	0.3815	0 3750	0.3750	0.3677
ROOT "	0.2949	0 3001	0.2936	0.2936	0.2871

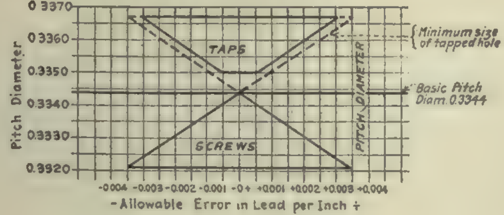
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 0.3367	MAX. 0.3367	0.0046	0.0046	0.3321 MIN.
MIN 0 3347	MIN. 0.3344	0.0003	0.0003	0.3344 MAX.

Tolerance for Thread Angle ± 30 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO $\frac{3}{8}$ INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's ($\frac{9}{16}$") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH: TAP	ALLOWABLE ERROR IN LEAD PER INCH: TAPPED HOLE
0.3350	0.0006	±0.0005	±0.0009
0.3355	0.0011	±0.0013	±0.0017
0.3360	0.0016	±0.0020	±0.0024
0.3365	0.0021	±0.0028	±0.0032
0.3367	0.0023	±0.0031	±0.0035

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM
±0.0000	0.0000	0.3344
±0.0006	0.0004	0.3340
±0.0014	0.0009	0.3335
±0.0021	0.0014	0.3330
±0.0029	0.0019	0.3325
±0.0035	0.0023	0.3321

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TABLE 3

$\frac{7}{16}$ (0.4375) INCH 14 THREADS U.S.S.
BASIC PITCH DIAMETER 0.3911
Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 13 PITCH TOOL = 0.0096		USS BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS [illegible] PITCH TOOL = 0.0078	
	MIN.	MAX.		MAX.	MIN.
OUTSIDE DIAMETER	0.4396	0.4444	0.4375	0.4375	0.4292
ROOT "	0.3461	0.3516	0.3447	0.3447	0.3378

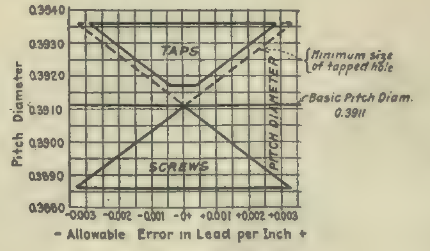
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 0.3936	MAX. 0.3936	0.0050	0.0050	0.3886 MIN.
MIN. 0.3917	MIN. 0.3911	0.0006	0.0000	0.3911 MAX.

Tolerance for Thread Angle ± 30 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO $\frac{7}{16}$ INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's ($\frac{21}{32}$") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH: TAP	ALLOWABLE ERROR IN LEAD PER INCH: TAPPED HOLE
0.3917	0.0006	±0.0004	±0.0008
0.3920	0.0009	±0.0008	±0.0012
0.3925	0.0014	±0.0015	±0.0019
0.3930	0.0019	±0 0021	±0.0025
0.3935	0.0024	±0.0028	±0.0032
0.3936	0.0025	±0.0033	±0.0033

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM
±0.0000	0.0000	0.3911
±0.0008	0.0006	0.3905
±0.0015	0.0011	0.3900
±0.0021	0.0016	0.3895
±0.0028	0.0021	0.3890
±0.0033	0.0025	0.3886

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TABLE 4

$\frac{1}{2}$ (0.500) INCH 13 THREADS U.S.S.
BASIC PITCH DIAMETER 0.4501
Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 12 PITCH TOOL=0.0104		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 14 PITCH TOOL=0.0089	
	MIN.	MAX.		MAX.	MIN.
OUTSIDE DIAMETER	0.5021	0.5073	0.5000	0.5000	0.4911
ROOT "	0.4016	0.4074	0.4001	0.4001	0.3928

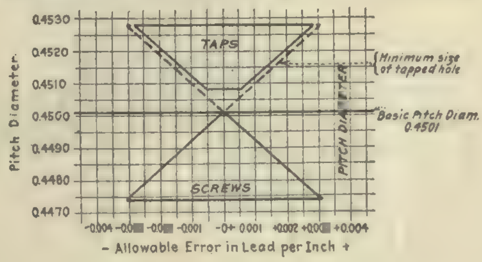
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 0.4528	MAX. 0.4528	0.0054	0.0054	0.4474 MIN.
MIN. 0.4508	MIN. 0.4501	0.0007	0.0000	0.4501 MAX.

Tolerance for Thread Angle ± 30 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO ½ INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's (¾") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25.



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM.	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
0.4508	0.0007	±0.0006	±0.0008
0.4510	0.0009	±0.0009	±0.0010
0.4515	0.0014	±0.0013	±0.0016
0.4520	0.0019	±0.0020	±0.0022
0.4525	0.0024	±0.0025	±0.0028
0.4528	0.0027	±0.0028	±0.0031

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM.
±0.0000	0.0000	0.4501
±0.0007	0.0006	0.4495
±0.0013	0.0011	0.4490
±0.0018	0.0016	0.4485
±0.0024	0.0021	0.4480
±0.0030	0.0026	0.4475
±0.0031	0.0027	0.4474

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TABLE 5

$\frac{9}{16}$ (0.5625) INCH 12 THREADS U.S.S.
BASIC PITCH DIAMETER 0.5084
Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 11 PITCH TOOL=0.0114		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 13 PITCH TOOL=0.0096	
	MIN.	MAX		MAX	MIN.
OUTSIDE DIAMETER	0.5646	0.5701	0.5625	0.5625	0.5530
ROOT "	0.4559	0.4618	0.4542	0.4542	0.4466

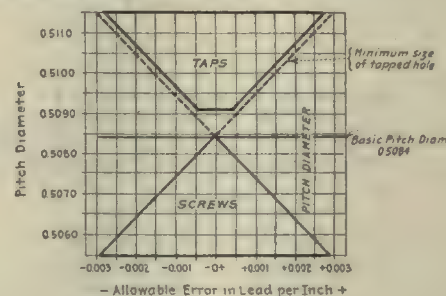
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 0.5112	MAX 0.5112	0.0056	0.0056	0.5056 MIN
MIN. 0.5091	MIN. 0.5084	0.0007	0.0000	0.5084 MAX.

Tolerance for Thread Angle ± 30 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO 9/16 INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's (27/32") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLES
0.5091	0.0007	±0.0005	±0.0007
0.5095	0.0011	±0.0009	±0.0011
0.5100	0.0016	±0.0014	±0.0016
0.5105	0.0021	±0.0019	±0.0022
0.5110	0.0026	±0.0025	±0.0027
0.5113	0.0033	±0.0027	±0.0029

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM
±0.0000	0.0000	0.5084
±0.0004	0.0004	0.5080
±0.0010	0.0009	0.5075
±0.0015	0.0014	0.5070
±0.0020	0.0019	0.5065
±0.0025	0.0024	0.5060
±0.0029	0.0029	0.5055

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TABLE 6

$\frac{5}{8}$ (0.625) INCH 11 THREADS U.S.S.
BASIC PITCH DIAMETER 0.5660
Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 10 PITCH TOOL=0.0125		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 12 PITCH TOOL=0.0104	
	MIN.	MAX.		MAX.	MIN.
OUTSIDE DIAMETER	0.6272	0.6330	0.6250	0.6250	0.6147
ROOT "	0.5087	0.5148	0.5069	0.5069	0.4990

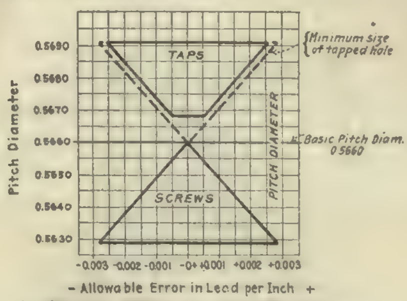
LIMITS ON PITCH DIAMETER AT PERFECT LEAD.

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 0.5691	MAX. 0.5691	0.0062	0.0062	0.5629 MIN.
MIN. 0.5668	MIN. 0.5660	0.0008	0.0000	0.5660 MAX.

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO 5/8 INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's (15/16") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25.



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM.	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
0.5668	0.0008	±0.0006	±0.0008
0.5670	0.0010	±0.0008	±0.0009
0.5675	0.0015	±0.0012	±0.0014
0.5680	0.0020	±0.0016	±0.0018
0.5685	0.0025	±0.0021	±0.00[illegible]
0.5690	0.0030	±0.0025	±0.0027
0.5691	0.0031	±0.0026	±0.0028

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM.
0.0000	0.0000	0.5660
±0.0005	0.0005	0.5655
±0.0009	0.0010	0.5650
±0.0014	0.0015	0.5645
±0.0018	0.0020	0.5640
±0.0023	0.0025	0.5635
±0.0027	0.0030	0.5630
±0.0028	0.0031	0.5629

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TABLE 7

$\frac{3}{4}$ (0.750) INCH 10 THREADS U.S.S.
BASIC PITCH DIAMETER 0.6851
Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 9 PITCH TOOL=0.0139		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 11 PITCH TOOL=0.0114	
	MIN	MAX		MAX	MIN
OUTSIDE DIAMETER	0.7522	0.7585	0.7500	0.7500	0.7387
ROOT "	0.6221	0.6284	0.6201	0.6201	0.6118

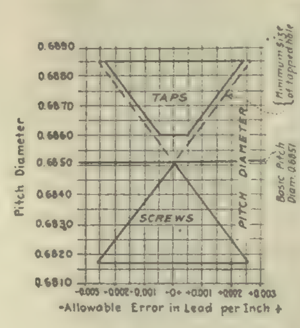
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX 0.6885	MAX 0.6885	0.0068	0.0068	0.6817 MIN
MIN. 0.6860	MIN. 0.6851	0.0009	0.0000	0.6851 MAX

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO ¾ INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's (1⅛") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
0.6860	0.0009	±0.0005	±0.0007
0.6865	0.0014	±0.0009	±0.0011
0.6870	0.0019	±0.0012	±0.0015
0.6875	0.0024	±0.0016	±0.0018
0.6880	0.0029	±0.0020	±0.0022
0.6885	0.0034	±0.0024	±0.0026

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM.
0.0000	0.0000	0.6851
±0.0005	0.0006	0.6845
±0.0009	0.0011	0.6840
±0.0012	0.0016	0.6835
±0.0016	0.0021	0.6830
±0.0020	0.0026	0.6825
±0.0024	0.0031	0.6820
±0.0026	0.0034	0.6817

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TABLE 8

7/8 (0.875) INCH 9 THREADS U.S.S.

BASIC PITCH DIAMETER 0.8029

Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 8 PITCH TOOL=0.0156		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 10 PITCH TOOL=0.0125	
	MIN.	MAX.		MAX.	MIN.
OUTSIDE DIAMETER	0.8773	0.8840	0.8750	0.8750	0.8625
ROOT "	0.732[illegible]	0.7395	0.7307	0.7307	0.7219

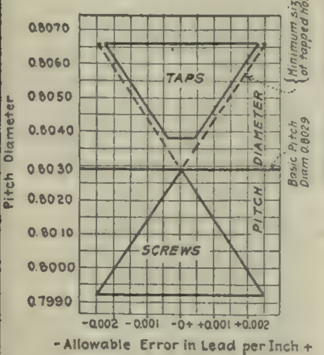
LIMITS ON PITCH DIAMETER AT PERFECT LEAD.

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 0.8066	MAX. 0.8066	0.0054	0.0054	0.8012 MIN.
MIN. 0.8038	MIN. 0.8029	0.0009	0.0000	0.8029 MAX.

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO 7/8 INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's (1 5/16) because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25.



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
0.8038	0.0009	±0.0004	±0.0006
0.8040	0.0011	±0.0005	±0.0008
0.8045	0.0016	±0.0009	±0.0011
0.8050	0.0021	±0.0012	±0.0015
0.8055	0.0026	±0.0016	±0.0018
0.8060	0.0031	±0.0019	±0.0021
0.8065	0.0036	±0.0022	±0.0024
0.8066	0.0037	±0.0023	±0.0025

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM.
±0.0000	0.0000	0.8029
±0.0003	0.0004	0.8025
±0.0006	0.0009	0.8020
±0.0010	0.0014	0.8015
±0.0013	0.0019	0.8010
±0.0016	0.0024	0.8005
±0.0020	0.0029	0.8000
±0.0023	0.0034	0.7995
±0.0025	0.0037	0.7992

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TABLE 9

1 INCH 8 THREADS U.S.S.

BASIC PITCH DIAMETER 0.9188

Outside and Root Measurements.

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 7 PITCH TOOL=0.0179		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 9 PITCH TOOL=0.0139	
	MIN	MAX.		MAX.	MIN.
OUTSIDE DIAMETER	1.0023	1.0092	1.0000	1.0000	0.8961
ROOT "	0.8401	0.8469	0.8376	0.8376	0.8283

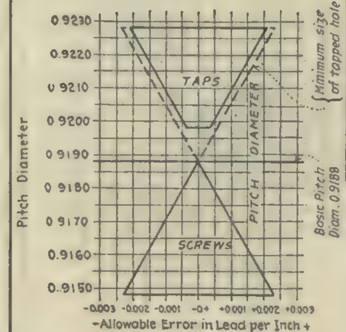
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 0.9228	MAX 0.9228	0.0080	0.0080	0.9148 MIN.
MIN. 0.9198	MIN. 0.9188	0.0010	0.0000	0.9188 MAX.

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO 1 INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's (1½") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25.



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
0.9198	0.0010	±0.0004	±0.0006
0.9200	0.0012	±0.0005	±0.0007
0.9205	0.0017	±0.0008	±0.0010
0.9210	0.0022	±0.0011	±0.0013
0.9215	0.0027	±0.0014	±0.0016
0.9220	0.0032	±0.0017	±0.0019
0.9225	0.0037	±0.0019	±0.0022
0.9228	0.0040	±0.0021	±0.0023

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR [illegible] LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM.
0.0000	0.0000	0.9188
±0.0002	0.0003	0.9185
±0.0005	0.0008	0.9180
±0.0008	0.0013	0.9175
±0.0010	0.0018	0.9170
±0.0013	0.0023	0.9165
±0.0016	0.0028	0.9160
±0.0019	0.0033	0.9155
±0.0022	0.0038	0.9150
±0.0023	0.0040	0.9148

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TABLE 10

1 1/8 (1.125) INCH 7 THREADS U.S.S.

BASIC PITCH DIAMETER 1.0322

Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 6 PITCH TOOL=0.0208		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 8 PITCH TOOL=0.0156	
	MIN	MAX		MAX.	MIN.
OUTSIDE DIAMETER	1.1274	1.1347	1.1250	1.1250	1.1093
ROOT "	0.9422	0.9494	0.9394	0.9394	0.9294

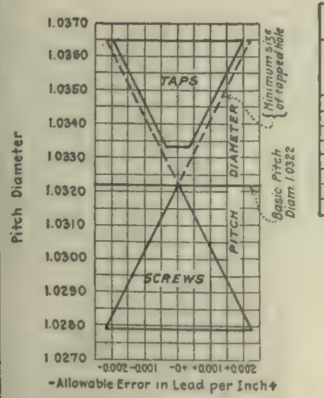
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 1.0365	MAX 1.0365	0.0086	0.0086	1.0279 MIN.
MIN. 1.0333	MIN. 1.0322	0.0011	0.0000	1.0322 MAX.

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO 1 1/8 INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's (1 11/16") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25.



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM.	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
1.0333	0.0011	±0.0004	±0.0006
1.0336	0.0013	±0.0005	±0.0007
1.0340	0.0018	±0.0007	±0.0009
1.0345	0.0023	±0.0010	±0.0012
1.0350	0.0028	±0.0012	±0.0014
1.0355	0.0033	±0.0015	±0.0017
1.0360	0.0038	±0.0018	±0.0020
1.0365	0.0043	±0.0020	±0.0022

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM
±0.0000	0.0000	1.0322
±0.0004	0.0007	1.0315
±0.0006	0.0012	1.0310
±0.0009	0.0017	1.0305
±0.0011	0.0022	1.0300
±0.0014	0.0027	1.0295
±0.0016	0.0032	1.0290
±0.0019	0.0037	1.0285
±0.0021	0.0042	1.0280
±0.0022	0.0043	1.0279

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TABLE 11

1 1/4 (1.250) INCH 7 THREADS U.S.S.

BASIC PITCH DIAMETER 1.1572

Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 6 PITCH TOOL=0.0208		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 8 PITCH TOOL=0.0156	
	MIN.	MAX.		MAX.	MIN.
OUTSIDE DIAMETER	1.2524	1.2605	1.2500	1.2500	1.2343
ROOT "	1.0673	1.0744	1.0644	1.0644	1.0544

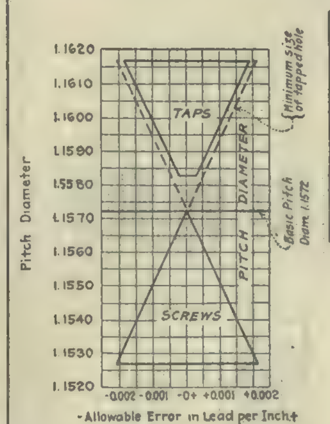
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 1.1617	MAX. 1.1617	0.0090	0.0090	1.1527 MIN.
MIN. 1.1583	MIN. 1.1572	0.0011	0.0000	1.1572 MAX.

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO 1 1/4 INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's (1 7/8") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25.



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE — READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM.	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
1.1583	0.0011	±0.0003	±0.0005
1.1585	0.0013	±0.0004	±0.0006
1.1590	0.0018	±0.0006	±0.0008
1.1595	0.0023	±0.0009	±0.0011
1.1600	0.0028	±0.0011	±0.0013
1.1605	0.0033	±0.0013	±0.0015
1.1610	0.0038	±0.0016	±0.0018
1.1615	0.0043	±0.00[illegible]	±0.0020
1.1617	0.0045	±0.0019	±0.0021

FOR A SCREW OR BOLT — READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM
±0.0000	0.0000	1.1572
±0.0003	0.0007	1.1565
±0.0006	0.0012	1.1560
±0.0008	0.0017	1.1555
±0.0010	0.0022	1.1550
±0.0013	0.0027	1.1545
±0.0015	0.0032	1.1540
±0.0017	0.0037	1.1535
±0.0020	0.0042	1.1530
±0.0021	0.0045	1.1527

TABLE 12

$1\frac{3}{8}$ (1.375) INCH 6 THREADS U.S.S.

BASIC PITCH DIAMETER 1.2668

Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS $5\frac{1}{2}$ PITCH TOOL=0.0227		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 7 PITCH TOOL=0.0179	
	MIN.	MAX.		MAX	MIN.
OUTSIDE DIAMETER	1.3777	1.3865	1.3750	1.3750	1.3568
ROOT "	1.1618	1.1695	1.1585	1.1585	1.1475

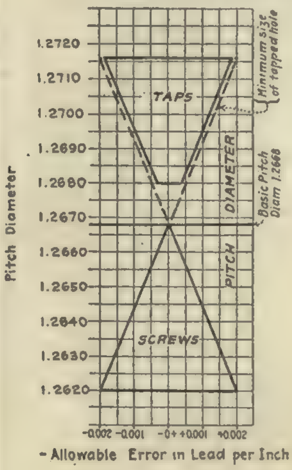
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 1.2716	MAX. 1.2716	0.0096	0.0096	1.2620 MIN.
MIN. 1.2680	MIN. 1.2688	0.0012	0.0000	1.2668 MAX.

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT 0 TO $1\frac{3}{8}$ INCH (ONCE THE DIAM.)

NOTE: In Practice these can be recommended for length of thread engagement to one and one half diam's ($2\frac{1}{16}$") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25.



ALLOWABLE ERRORS IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR A TAPPED HOLE
READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM.	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
1.2680	0.0012	±0.0004	±0.0005
1.2685	0.0017	±0.0006	±0.0007
1.2690	0.0022	±0.0008	±0.0009
1.2695	0.0027	±0.0010	±0.0011
1.2700	0.0032	±0.0012	±0.0014
1.2705	0.0037	±0.0014	±0.0016
1.2710	0.0042	±0.0016	±0.0018
1.2715	0.0047	±0.0018	±0.0020
1.2716	0.0048	±0.0019	±0.0020

FOR A SCREW OR BOLT
READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM.
±0.0000	0.0000	1.2668
±0.0003	0.0008	1.2660
±0.0005	0.0013	1.2655
±0.0007	0.0018	1.2650
±0.0010	0.0023	1.2645
±0.0012	0.0028	1.2640
±0.0014	0.0033	1.2635
±0.0016	0.0038	1.2630
±0.0018	0.0043	1.2625
±0.0020	0.0048	1.2620

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TABLE 13

$1\frac{1}{2}$ (1.500) INCH 6 THREADS U.S.S.

BASIC PITCH DIAMETER 1.3918

Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS $5\frac{1}{2}$ PITCH TOOL=0.0227		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 7 PITCH TOOL=0.0179	
	MIN.	MAX.		MAX.	MIN.
OUTSIDE DIAMETER	1.5024	1.5115	1.5000	1.5000	1.4818
ROOT "	1.2868	1.2944	1.2835	1.2835	1.2726

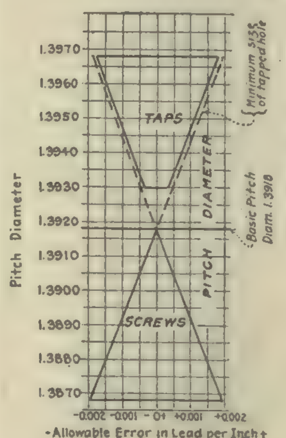
LIMITS ON PITCH DIAMETER AT PERFECT LEAD.

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 1.3968	MAX. 1.3968	0.0100	0.0100	1.3868 MIN.
MIN. 1.3931	MIN. 1.3918	0.0013	0.0000	1.3918 MAX.

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO $1\frac{1}{2}$ INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's ($2\frac{1}{4}$") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25.



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE
READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM.	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
1.3930	0.0012	±0.0004	±0.0005
1.3940	0.0022	±0.0008	±0.0009
1.3950	0.0032	±0.0011	±0.0012
1.3960	0.0040	±0.0015	±0.0016
1.3968	0.0050	±0.0018	±0.0019

FOR A SCREW OR BOLT
READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM
±0.0000	0.0000	1.3918
±0.0003	0.0008	1.3910
±0.0007	0.0018	1.3900
±0.0011	0.0028	1.3890
±0.0014	0.0038	1.3880
±0.0018	0.0048	1.3870
±0.0019	0.0050	1.3868

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TABLE 14

$1\frac{5}{8}$ (1.625) INCH $5\frac{1}{2}$ PITCH U.S.S.

BASIC PITCH DIAMETER 1.5069

Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 5 PITCH TOOL=0.0250		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 6 PITCH TOOL=0.0208	
	MIN.	MAX.		MAX.	MIN.
OUTSIDE DIAMETER	1.6275	1.6375	1.6250	1.6250	1.6053
ROOT "	1.3924	1.4003	1.3888	1.3888	1.3773

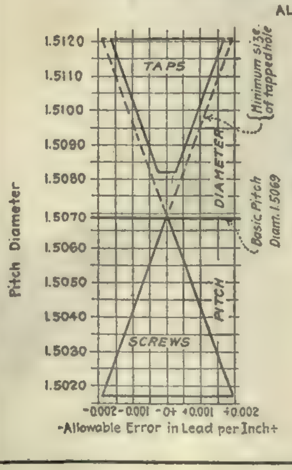
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 1.5121	MAX. 1.5121	0.0104	0.0104	1.5017 MIN.
MIN. 1.5082	MIN. 1.5069	0.0013	0.0000	1.5069 MAX.

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO $1\frac{5}{8}$ INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's ($2\frac{7}{16}$") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25.



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE
READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM.	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
1.5082	0.0013	±0.0003	±0.0005
1.5090	0.0021	±0.0006	±0.0008
1.5100	0.0031	±0.0009	±0.0011
1.5110	0.0041	±0.0013	±0.0015
1.5120	0.0051	±0.0016	±0.0019
1.5121	0.0052	±0.0017	±0.0019

FOR A SCREW OR BOLT
READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM.
±0.0000	0.0000	1.5069
±0.0004	0.0009	1.5060
±0.0007	0.0019	1.5050
±0.0011	0.0029	1.5040
±0.0014	0.0039	1.5030
±0.0018	0.0049	1.5020
±0.0019	0.0052	1.5017

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TABLE 15

$1\frac{3}{4}$ (1.750) INCH 5 THREADS U.S.S.

BASIC PITCH DIAMETER 1.6201

Outside and Root Measurements.

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS $4\frac{1}{2}$ PITCH TOOL=0.0278		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS $5\frac{1}{2}$ PITCH TOOL=0.0227	
	MIN.	MAX		MAX.	MIN.
OUTSIDE DIAMETER	1.7525	1.7630	1.7500	1.7500	1.7284
ROOT "	1.4942	1.5024	1.4902	1.4902	1.4780

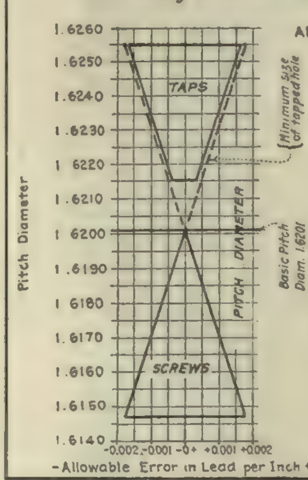
LIMITS ON PITCH DIAMETER AT PERFECT LEAD.

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 1.6256	MAX. 1.6256	0.0109	0.0109	1.6147 MIN.
MIN. 1.6215	MIN. 1.6201	0.0014	0.0000	1.6201 MAX.

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO $1\frac{3}{4}$ INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's ($2\frac{5}{8}$") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25.



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE
READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM.	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
1.6215	0.0014	±0.0004	±0.0005
1.6225	0.0024	±0.0007	±0.0008
1.6235	0.0034	±0.0010	±0.0011
1.6245	0.0044	±0.0014	±0.0015
1.6255	0.0054	±0.0017	±0.0018

FOR A SCREW OR BOLT
READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM.
0.0000	0.0000	1.6201
±0.0002	0.0006	1.6195
±0.0005	0.0016	1.6185
±0.0009	0.0026	1.6175
±0.0012	0.0036	1.6165
±0.0016	0.0046	1.6155
±0.0018	0.0054	1.6147

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TABLE 16

thread gage. Let *GHI* and *KLM* represent two actual spaces cut by a tap of the same pitch diameter with an error in lead equal to *BH* and *LE*. Then the stock *ABHG* and *LMFE* would interfere with the entrance of the threaded gage. But if the tap was increased in radius by the amount *RH*, its lead remaining the same, then it would cut the spaces *ARS* and *UTF* and the thread gage would enter full length and bear along the surfaces *AB* and *FE*.

34. From this it follows that to obtain a fit for a definite length of thread the pitch diameter can be made to

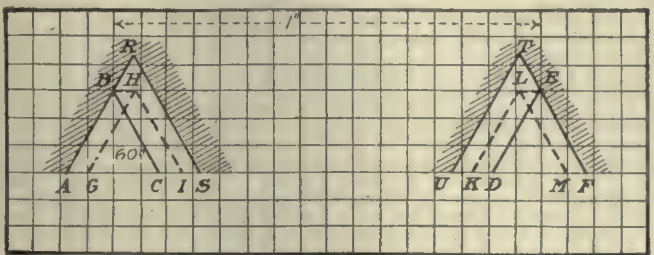


FIG. 1. EFFECT OF VARIATION IN LEAD

compensate for any error in lead within reasonable limits.

35. This relation between the pitch diameter and lead when plotted on the chart becomes a straight line.

36. In Fig. 2 a tap or screw with perfect lead and pitch diameter would fall at the intersection of the two zero lines at *A* and, we will assume, would cut a perfect thread for a threaded hole 1 in. deep, i.e., a hole in which a standard-thread plug gage would fit.

37. Another tap having an error in lead of 0.0010 in. per inch but having an increased pitch diameter of 0.00173 in. would fall at *B′* and for a hole 1 in. deep would be the equivalent of the first tap. If two nuts 1 in. thick were tapped one with each of these taps, a

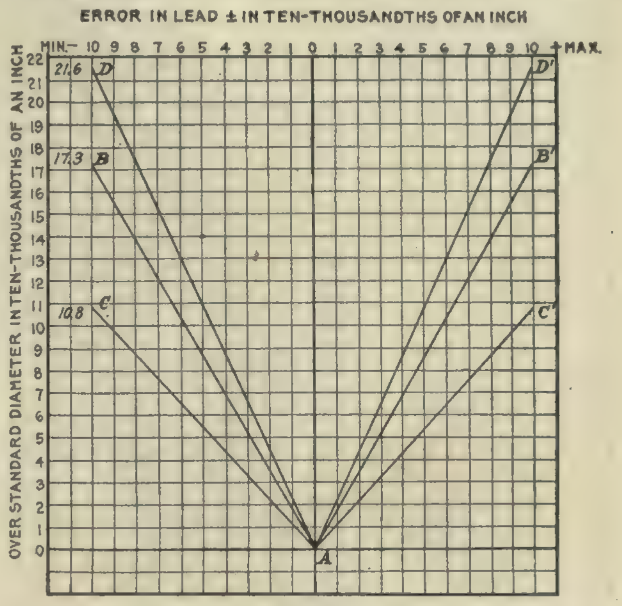


FIG. 2. EFFECT OF VARIATION IN LENGTH OF FIT BETWEEN SCREW AND NUT

standard-thread plug gage when clear through the nut would fit with equal shake in both nuts.

38. The line *AB′* passing through zero represents all oversize threads 1 in. long with a long or plus lead that are equivalent to a standard or perfect thread. The line

1 7/8 (1.875) INCH 5 PITCH U.S.S.

BASIC PITCH DIAMETER 1 7451

Outside and Root Measurements

	FOR A TAP OR NUT FLAT AT BOTTOM OF THREAD SAME AS 4½ PITCH TOOL=0.0278		U.S.S. BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 5½ PITCH TOOL=0.0227	
	MIN.	MAX.		MAX.	MIN.
OUTSIDE DIAMETER	1.8775	1.8880	1.8750	1.8750	1.8534
ROOT "	1.6192	1.6273	1.6152	1.6152	1.6031

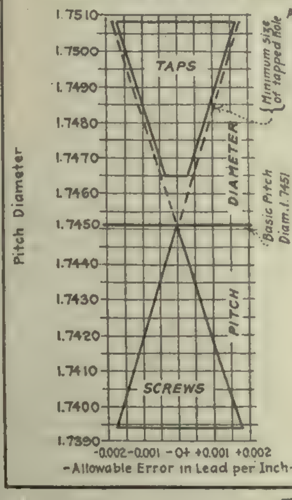
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 1.7508	MAX. 1.7508	0.0114	0.0114	1.7394 MIN.
MIN. 1.7465	MIN. 1.7451	0 0014	0.0000	1.7451 MAX.

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO 1 7/8 INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's (2 13/16") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
1.7465	0.0014	±0.0003	±0.0004
1.7470	0.0019	±0.0005	±0.0006
1.7480	0.0029	±0.0008	±0.0009
1.7490	0.0039	±0.0011	±0.0012
1.7500	0.0049	±0.0014	±0.0016
1.7508	0.0057	±0.0017	±0.0018

FOR A SCREW OR BOLT READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM.
±0.0000	0.0000	1.7451
±0.0003	0.0011	1.7440
±0.0006	0.0021	1.7430
±0.0010	0.0031	1.7420
±0.0013	0.0041	1.7410
±0.0016	0.0051	1.7400
±0.0018	0.0057	1.7394

TABLE 17

2 INCH 4½ THREADS U.S.S.

BASIC PITCH DIAMETER 1.8557

Outside and Root Measurements

	FOR A TAP OR NUT FLAT ON BOTTOM OF THREAD SAME AS 4 PITCH TOOL=0.0313		U.S.S BASIC SIZES	FOR A SCREW OR BOLT FLAT AT ROOT OF THREAD SAME AS 5 PITCH TOOL=0.0250	
	MIN.	MAX		MAX	MIN
OUTSIDE DIAMETER	2.0025	2.0139	2.0000	2 0000	·1.9761
ROOT "	1 7158	1.7243	1 7113	1 7113	1.6984

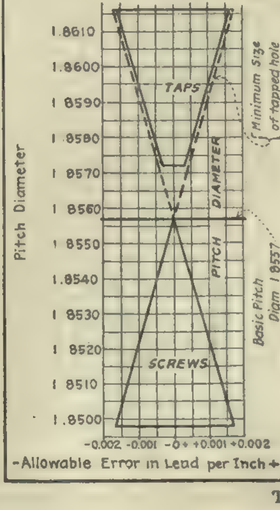
LIMITS ON PITCH DIAMETER AT PERFECT LEAD

TAP	TAPPED HOLE	CLEARANCE		SCREW OR BOLT
		TAP	HOLE	
MAX. 1.8616	MAX. 1.8616	0.0118	0.0118	1.8498 MIN.
MIN. 1.8572	MIN. 1.8557	0.0015	0.0000	1.8557 MAX.

Tolerance for Thread Angle ± 15 Minutes

CHART AND TABLE FOR TAPS, NUTS, SCREWS ETC. WITH LENGTH OF THREAD ENGAGEMENT, 0 TO 2 INCH (ONCE THE DIAM.)

NOTE: In practice these can be recommended for length of thread engagement to one and one half diam's (3") because of the partial rectifying of errors in lead by "flow of metal" see Pars. 24 and 25



ALLOWABLE ERROR IN LEAD PER INCH FOR ACTUAL PITCH DIAMETER

FOR A TAP OR TAPPED HOLE READ FROM LEFT TO RIGHT

ACTUAL PITCH DIAM	AMOUNT OVER BASIC	ALLOWABLE ERROR IN LEAD PER INCH	
		TAP	TAPPED HOLE
1.8572	0.0015	±0.0003	±0.0004
1.8580	0.0023	±0.0006	±0.0007
1.8590	0.0033	±0.0009	±0.0010
1.8600	0.0043	±0.0012	±0.0012
1.8610	0.0053	±0.0014	±0.0015
1.8616	0.0059	±0.0016	±0.0017

FOR A SCREW OR BOLT READ FROM RIGHT TO LEFT

ALLOWABLE ERROR IN LEAD PER INCH	AMOUNT UNDER BASIC	ACTUAL PITCH DIAM
±0.0000	0.0000	1.8557
±0.0002	0.0007	1.8550
±0.0005	0.0017	1.8540
±0.0008	0.0027	1.8530
±0.0010	0.0037	1.8520
±0.0014	0.0047	1.8510
±0.0017	0.0059	1.8498

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TABLE 18

	TAP			SCREW	
Nom. diam. and threads per inch	Basic pitch diameters	Min. and max. add. to basic pitch diam.	Min. and max. pitch diam.	Max. and min. reduction from basic pitch diam	Max. and min. pitch diam.
¼—20	0.2175	0.0004 0.0018	0.2179 0.2193	0.0000 0.0018	0.2175 0.2158
5/16—18	0.2764	0.0005 0.0020	0.2769 0.2784	0.0000 0.0020	0.2764 0.2744
⅜—16	0.3344	0.0006 0.0023	0.3350 0.3367	0.0000 0.0023	0.3344 0.3321
7/16—14	0.3911	0.0006 0.0025	0.3917 0.3936	0.0000 0.0025	0.3911 0.3886
½—13	0.4501	0.0007 0.0027	0.4508 0.4528	0.0000 0.0027	0.4501 0.4474
9/16—12	0.5084	0.0007 0.0029	0.5091 0.5113	0.0000 0.0029	0.5084 0.5055
⅝—11	0.5660	0.0008 0.0031	0.5668 0.5691	0.0000 0.0031	0.5660 0.5629
¾—10	0.6851	0.0009 0.0034	0.6860 0.6885	0.0000 0.0034	0.6851 0.6817
⅞—9	0.8029	0.0009 0.0037	0.8038 0.8066	0.0000 0.0037	0.8029 0.7992
1—8	0.9188	0.0010 0.0040	0.9198 0.9228	0.0000 0.0040	0.9188 0.9148
1⅛—7	1.0322	0.0011 0.0043	1.0333 1.0365	0.0000 0.0043	1.0322 1.0279
1¼—7	1.1572	0.0011 0.0045	1.1583 1.1617	0.0000 0.0045	1.1572 1.1527
1⅜—6	1.2668	0.0012 0.0048	1.2680 1.2716	0.0000 0.0048	1 2668 1.2620
1½—6	1.3918	0.0013 0.0050	1.3931 1.3968	0.0000 0.0050	1.3918 1.3868
1⅝—5½	1.5069	0.0013 0.0052	1.5082 1.5121	0.0000 0.0052	1.5069 1.5017
1¾—5	1.6201	0.0014 0.0055	1.6215 1.6256	0.0000 0.0055	1.6201 1.6147
1⅞—5	1.7451	0.0014 0.0057	1.7465 1.7508	0.0000 0.0057	1.7451 1.7394
2—4½	1.8557	0.0015 0.0059	1.8572 1.8616	0.0000 0.0059	1.8557 1.8498

TABLE 19 MINIMUM AND MAXIMUM PITCH DIAMETERS OF TAPS AND SCREWS AT PERFECT LEAD FOR U. S. STD.

MEDIUM GRADE FOR GENERAL WORK. ALL DIMENSIONS IN INCHES

TAP OR NUT								SCREW			
	Outside Diam.			Root Diam.							
1	2	3	4	5	6	7	8	9	10	11	12
Nominal diam. and threads per inch	Decimal basic outside diam.	Addition to basic O. D.	Min. and max. O. D.	U. S. S. root diam.	Pitch of tool for tap and width across point	New basic root diam.	Min. and max. root diam.	Max. and min. outside diam.	Pitch of tool for thread and width across point	New basic root diam.	Max. and min. root diam.
¼—20	0.2500	0.0019 0.0057	0.2519 0.2557	0.1850	[illegible] 0.0069	0.1863	0.1860 0.1908	0.2500 0.2440	22 0.0057	0.1841	0.1850 0.1792
5/16—18	0.3125	0.0019 0.0061	0.3144 0.3186	0.2403	16 0.0078	0.2418	0.2414 0.2464	0.3125 0.3059	20 0.0062	0.2391	0.2403 0.2347
⅜—16	0.3750	0.0020 0.0065	0.3770 0.3815	0.2936	14 0.0089	0.2955	0.2949 0.3001	0.3750 0.3677	18 0.0069	0.2921	0.2936 0.2871
7/16—14	0.4375	0.0021 0.0070	0.4396 0.4445	0.3447	13 0.0096	0.3459	0.3461 0.3517	0.4375 0.4292	16 0.0078	0.3428	0.3447 0.3377
½—13	0.5000	0.0021 0.0073	0.5021 0.5073	0.4001	12 0.0104	0.4015	0.4016 0.4074	0.5000 0.4911	14 0.0089	0.3989	0.4001 0.3928
9/16—12	0.5625	0.0022 0.0076	0.5647 0.5701	0.4542	11 0.0114	0.4559	0.4559 0.4618	0.5625 0.5530	13 0.0096	0.4528	0.4542 0.4466
⅝—11	0.6250	0.0022 0.0080	0.6272 0.6330	0.5069	10 0.0125	0.5089	0.5087 0.5148	0.6250 0.6147	12 0.0104	0.5053	0.5069 0.4990
¾—10	0.7500	0.0022 0.0085	0.7522 0.7585	0.6201	9 0.0139	0.6225	0.6221 0.6284	0.7500 0.7387	11 0.0114	0.6181	0.6201 0.6118
⅞—9	0.8750	0.0023 0.0090	0.8773 0.8840	0.7307	8 0.0156	0.7337	0.7329 0.7395	0.8750 0.8626	10 0.0125	0.7283	0.7307 0.7219
1—8	1.0000	0.0023 0.0092	1.0023 1.0092	0.8376	7 0.0179	0.8416	0.8401 0.8469	1.0000 0.9861	9 0.0139	0.8346	0.8376 0.8283
1⅛—7	1.1250	0.0024 0.0105	1.1274 1.1355	0.9394	6 0.0208	0.9444	0.9423 0.9494	1.1250 1.1093	8 0.0156	0.9356	0.9394 0.9294
1¼—7	1.2500	0.0024 0.0105	1.2524 1.2605	1.0644	6 0.0208	1.0696	1.0673 1.0744	1.2500 1.2343	8 0.0156	1.0606	1.0644 1.0544
1⅜—6	1.3750	0.0024 0.0115	1.3774 1.3865	1.1585	5½ 0.0227	1.1618	1.1618 1.1694	1.3750 1.3568	7 0.0179	1.1533	1.1585 1.1476
1½—6	1.5000	0.0024 0.0115	1.5024 1.5115	1.2835	5½ 0.0227	1.2868	1.2868 1.2944	1.5000 1.4818	7 0.0179	1.2783	1.2835 1.2726
1⅝—5½	1.6250	0.0025 0.0122	1.6275 1.6372	1.3888	5 0.0250	1.3928	1.3925 1.4003	1.6250 1.6053	6 0.0208	1.3855	1.3888 1.3773
1¾—5	1.7500	0.0025 0.0130	1.7525 1.7630	1.4903	4½ 0.0278	1.4950	1.4942 1.5024	1.7500 1.7284	5½ 0.0227	1.4863	1.4903 1.4780
1⅞—5	1.8750	0.0025 0.0130	1.8775 1.8880	1.6152	4½ 0.0278	1.6200	1.6192 1.6274	1.8750 1.8534	5½ 0.0227	1.6113	1.6152 1.6030
2—4½	2.0000	0.0025 0.0139	2.0025 2.0139	1.7113	4 0.0313	1.7173	1.7158 1.7243	2.0000 1.9761	5 0.0250	1.7085	1 7113 1.6984

TABLE 20 OUTSIDE AND ROOT DIAMETERS FOR TAPS AND SCREWS — U. S. S.T.D.
MEDIUM GRADE FOR GENERAL WORK. ALL DIMENSIONS IN INCHES

¼-IN. 20 U. S. S. BASIC PITCH DIAM. 0.2175		5/16-IN. 18 U. S. S. BASIC PITCH DIAM. 0.2764		⅜-IN. 16 U. S. S. BASIC PITCH DIAM. 0.3344		½-IN. 13 U. S. S. BASIC PITCH DIAM. 0 4301	
Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.
0.2179	±0.0005	0.2769	±0.0005	0.3350	±0.0005	0.4508	±0.0006
0.2185	±0.0018	0.2775	±0.0016	0.3355	±0.0013	0.4515	±0.0013
0.2190	±0.0029	0.2780	±0.0025	0.3360	±0.0020	0.4520	±0.0019
0.2193	±0.0035	0.2784	±0.0033	0.3365	±0.0028	0.4525	±0.0025
				0.3367	±0.0031	0.4528	±0.0028

⅝-IN. 11 U. S. S. BASIC PITCH DIAM. 0.5660		¾-IN. 10 U. S. S. BASIC PITCH DIAM. 0.6851		⅞-IN. 9 U. S. S. BASIC PITCH DIAM. 0.8029		1-IN. 8 U. S. S. BASIC PITCH DIAM. 0.9188	
Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.
0.5668	±0.0006	0.6860	±0.0005	0.8038	±0.0004	0.9198	±0.0004
0.5675	±0.0012	0.6865	±0 0009	0.8045	±0.0009	0.9205	±0.0008
0.5680	±0.0016	0.6870	±0.0012	0.8050	±0.0012	0.9210	±0.0011
0.5685	±0.0021	0.6875	±0.0016	0.8055	±0.0016	0.9215	±0.0014
0.5690	±0.0026	0.6880	±0.0020	0.8060	±0.0019	0.9220	±0.0017
		0.6885	±0.0024	0.8066	±0.0023	0.9225	±0.0019
						0.9228	±0.0021

1¼-IN. 7 U. S. S. BASIC PITCH DIAM. 1.1572		1½-IN. 6 U. S. S. BASIC PITCH DIAM. 1.3918		1¾-IN. 5 U. S. S. BASIC PITCH DIAM. 1.6201		2-IN. 4½ U. S. S. BASIC PITCH DIAM. 1.8557	
Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.
1.1583	±0.0003	1.3930	±0.0004	1.6215	±0.0004	1.8572	±0.0004
1.1590	±0.0006	1.3940	±0.0008	1.6225	±0.0007	1.8580	±0.0006
1.1595	±0.0009	1.3950	±0.0011	1.6235	±0.0010	1.8590	±0.0009
1.1600	±0.0011	1.3960	±0.0015	1.6245	±0.0014	1.8600	±0.0012
1.1605	±0.0013	1.3965	±0.0017	1.6255	±0.0017	1.8610	±0.0014
1.1610	±0.0016	1.3968	±0.0018			1.8615	±0.0016
1.1617	±0.0019						

TABLE 21 INSPECTION LIMITS FOR U. S. S. TAPS

ALL DIMENSIONS IN INCHES

¼-IN. 20 U. S. S. BASIC PITCH DIAM. 0.2175		5/16-IN. 18 U. S. S. BASIC PITCH DIAM. 0.2764		⅜-IN. 16 U. S. S. BASIC PITCH DIAM. 0.3344		½-IN. 13 U. S. S. BASIC PITCH DIAM. 0.4501	
Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.
0.2170	±0.0012	0.2760	±0.0008	0.3340	±0.0006	0.4495	±0.0007
0.2165	±0.0022	0.2755	±0.0017	0.3335	±0.0014	0.4490	±0.0013
0.2160	±0.0033	0.2750	±0.0027	0.3330	±0.0021	0.4485	±0.0018
0.2157	±0.0040	0.2745	±0.0037	0.3325	±0.0029	0.4480	±0.0024
				0.3321	±0.0035	0.4474	±0.0031

⅝-IN. 11 U. S. S. BASIC PITCH DIAM. 0.5660		¾-IN. 10 U. S. S. BASIC PITCH DIAM. 0.6851		⅞-IN. 9 U. S. S. BASIC PITCH DIAM. 0.8029		1-IN. 8 U. S. S. BASIC PITCH DIAM. 0.9188	
Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.
0.5655	±0.0005	0.6845	±0.0005	0.8025	±0.0003	0.9185	±0.0002
0.5650	±0 0009	0.6840	±0.0009	0.8020	±0.0006	0.9180	±0.0005
0.5645	±0.0014	0.6835	±0.0012	0.8015	±0.0009	0.9175	±0.0008
0.5640	±0.0018	0.6830	±0.0016	0.8010	±0.0013	0.9170	±0.0010
0.5635	±0.0023	0.6825	±0.0020	0.8005	±0.0016	0.9165	±0.0013
0.5629	±0.0028	0.6820	±0.0024	0.8000	±0.0020	0.9160	±0.0016
		0.6817	±0.0026	0.7992	±0.0025	0.9155	±0.0019
						0.9148	±0.0023

1¼-IN. 7 U. S. S. BASIC PITCH DIAM. 1.1572		1½-IN. 6 U. S. S. BASIC PITCH DIAM. 1.3918		1¾-IN. 5 U. S. S. BASIC PITCH DIAM. 1.6201		2-IN. 4½ U. S. S. BASIC PITCH DIAM. 1.8557	
Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.	Actual pitch diam.	Allowable error in lead per in.
1.1565	±0.0003	1.3910	±0.0003	1.6195	±0.0002	1.8550	±0.0003
1.1560	±0.0006	1.3900	±0.0007	1.6190	±0.0004	1.8540	±0.0005
1.1550	±0.0010	1.3890	±0.0011	1.6180	±0.0007	1.8530	±0.0008
1.1540	±0.0015	1.3880	±0.0015	1.6170	±0.0010	1.8520	±0.0011
1.1530	±0.0020	1.3870	±0.0018	1 6160	±0.0014	1.8510	±0.0014
1.1527	±0.0021	1.3868	±0.0019	1.6150	±0.0017	1.8496	±0.0017
				1.6147	±0.0018		

TABLE 22 INSPECTION LIMITS FOR U. S. S. SCREWS

ALL DIMENSIONS IN INCHES

A, B similarly represents all oversize threads 1 in. long with a short or minus lead.[2]

39. The lines AC and AC' represent taps equivalent to standard for threads $\frac{3}{4}$ in. long and AD and AD' for

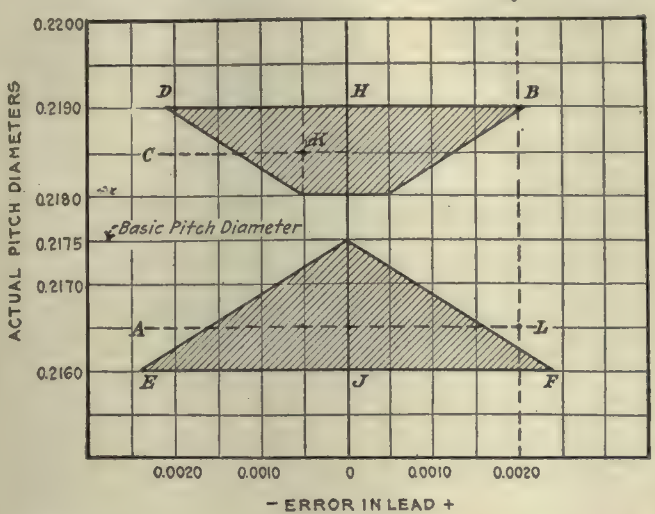


FIG. 3. METHOD OF USING THE CHARTS SHOWN IN TABLES 1 TO 18

threads 1.25 in. long, the amount over standards for CC' and DD' being respectively $\frac{3}{4}$ and $1\frac{1}{4}$ times B (17.3) for a lead error of 0.001 in.

40. The oblique lines on the charts, Tables 1 to 18,

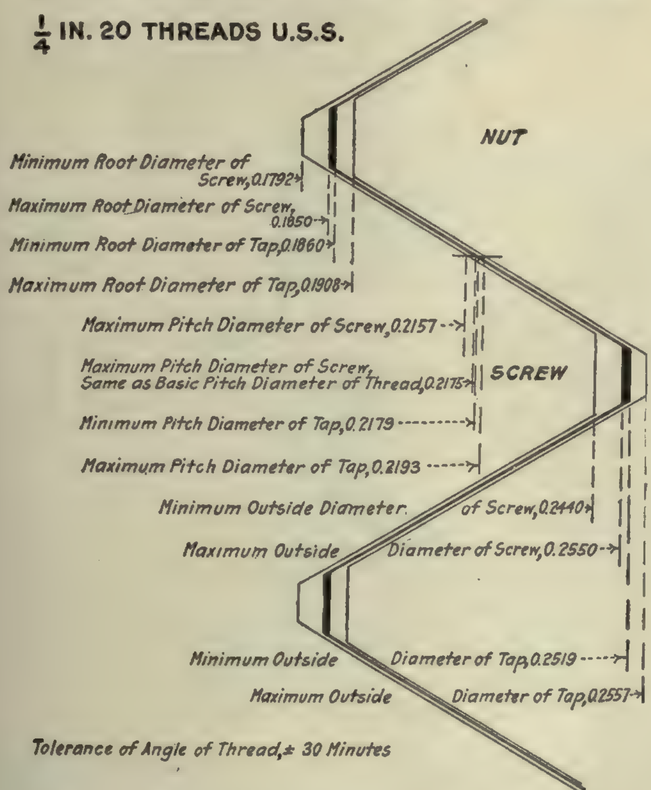


FIG. 4. RELATION OF SCREW AND NUT, SHOWING MAXIMUM AND MINIMUM ALLOWANCES

are similar lines for the maximum length of thread specified in the table alongside of each chart. For screws these lines pass through zero and represent equivalents of perfect screws. For taps and nuts these lines pass through a point slightly above the zero point in order to keep all taps and nuts slightly over standard.

[2]The shorter the length of thread the more nearly horizontal this line becomes, and for a zero length of thread it becomes horizontal, coinciding with the horizontal zero line O. A. Similarly the greater the length of thread the more nearly vertical this line becomes.

41. In Fig. 3 the points HJ where the upper and lower lines intersect the perfect lead line represent the extreme limits for the pitch diameters of a nut and screw with perfect lead, and the distance between these two points represents the maximum diametrical shake between any nut and screw falling within the shaded areas or zones of the chart, while the average shake would be about one-half of this maximum shake.

SYMBOLS USED IN FORMULÆ

Basic full or external diameter	$= D$
Basic pitch diameter	$= E$
Basic root diameter	$= K$
Number of threads per inch	$= n$
Normal lead	$= L$

SCREWS

Max. external diam. $= D$

Max. pitch diam. $= E$

Max. root diam. $= K$

Min. external diam. $= D - \left(\frac{0.102}{n} + \frac{0.054}{n + 40}\right)$

Min. pitch diam. $= E - (0.0045 \times \sqrt{D} - 0.0005)$

Min. root diam. $= K - \left(\frac{0.033}{n} + \frac{25}{n + 40}\right)$

Max. error (± normal) allowable in lead per inch. Length of engagement up to one diam. $= \frac{0.57735\,(0.0045 \times \sqrt{D} - 0.0005)}{D}$

(This formula also applies to tapped holes.)

TAPS AND TAPPED HOLES

Max. external diam. $= D + \frac{0.04}{n} + \frac{0.224}{n + 40}$

Max. pitch diam. $= E + 0.0045 \times \sqrt{D} - 0.0005$

Max. root diam. $= K + \frac{0.033}{n} + \frac{0.25}{n + 40}$

Min. external diam. $= D + \frac{0.112}{n + 40}$

Min. pitch diam. $= E + \frac{0.0045 \times \sqrt{D} - 0.0005}{4}$

Min. root diam. $= K + \frac{0.02}{n}$

TAPS ONLY

Max. error (± normal) allowable in lead = in lead of screw

Max. error (± normal) allowable in lead of screw $- \frac{\left(\text{Max. error } (\pm \text{ normal}) \text{ allowable in lead of screw}\right)^2}{0.03}$

FORMULAS FOR MEDIUM-FIT SCREWS, NUTS, TAPS, ETC. SUITED FOR GENERAL USE

42. It is assumed that a tap makes a hole the exact counterpart of itself, therefore taps and nuts are referred to as having identically the same pitch diameter and lead.

43. *For a Tap.*—(a) Find the actual pitch diameter of the tap with a V thread micrometer. Look in left-hand column at the bottom of the table for taps for the required size (Tables 1 to 18) for this diameter. If the

diameter is less than the first figure or greater than the last figure of the column the tap is not within the limits required. (b) When the diameter is found in the table read to the right in the next column the amount it is over basic pitch diameter. Read again to the right in the third column the allowable "errors in lead" for this pitch diameter. (c) Next find the actual error in lead per inch with some lead measuring instrument. If the actual error is within the limits given in the third column then the tap is correct for both pitch diameter and lead.

44. Example: For ¼ in., 20 thread tap; for threads from 0 to ¼ in. long refer to Table 1, and under "For a Tap or Nut." Suppose the pitch diameter of a tap is 0.2185 in. Find this figure in the first column; to the right the next column shows the tap as 0.0010 in. over basic pitch diameter, and the third column shows that its lead must be between 0.0018 in. fine (minus) to 0.0018 in. coarse (plus) per inch to be within the limits of this table.

45. *For a Screw.*—(d) Find the actual pitch diameter of the screw with a V-thread micrometer. Look in the last column at the bottom of the tables for screws for the required size (Tables 1 to 18) for this diameter. If the diameter is less than the first figure or greater than the last figure in the column the screw is not within the limits required. (e) When the diameter is found read to the left in the next column to the left the amount that it is under basic pitch diameter. Read again in the third column to the left the allowable error in lead for this pitch diameter. (f) Next find the actual error in lead per inch with some lead measuring instrument. If the actual error is within the limits given in the third column to the left, then the screw is correct for both pitch diameter and lead.

46. Example: For ¼-in. 20-thread screw. For threads from 0 to ¼ in. long refer to Table 1, and under "For a Screw or Bolt." Suppose the pitch diameter of a screw is 0.2160 in. Find this figure in the last column; the

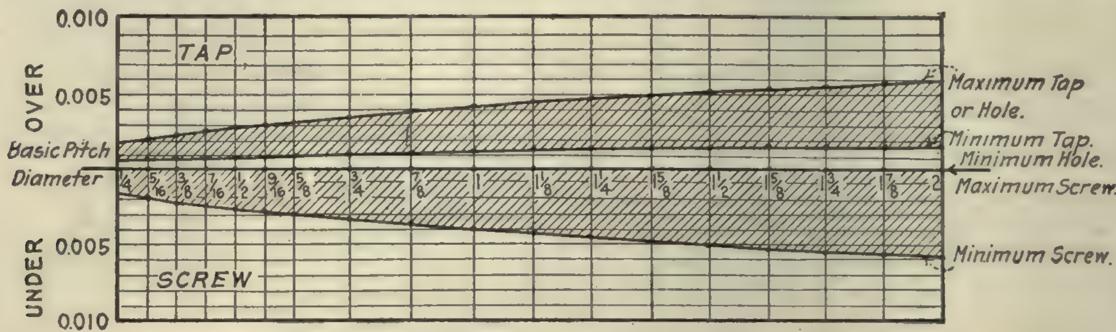


FIG. 5. MAXIMUM AND MINIMUM CLEARANCE, PITCH DIAMETER

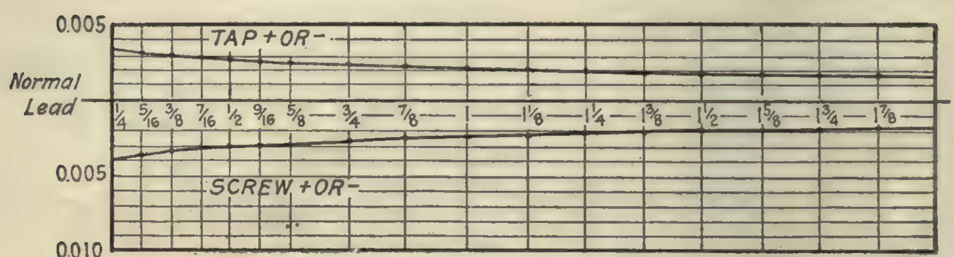


FIG. 6. ALLOWABLE VARIATION IN LEAD OVER OR UNDER NORMAL FOR MAXIMUM ERROR IN DIAMETER

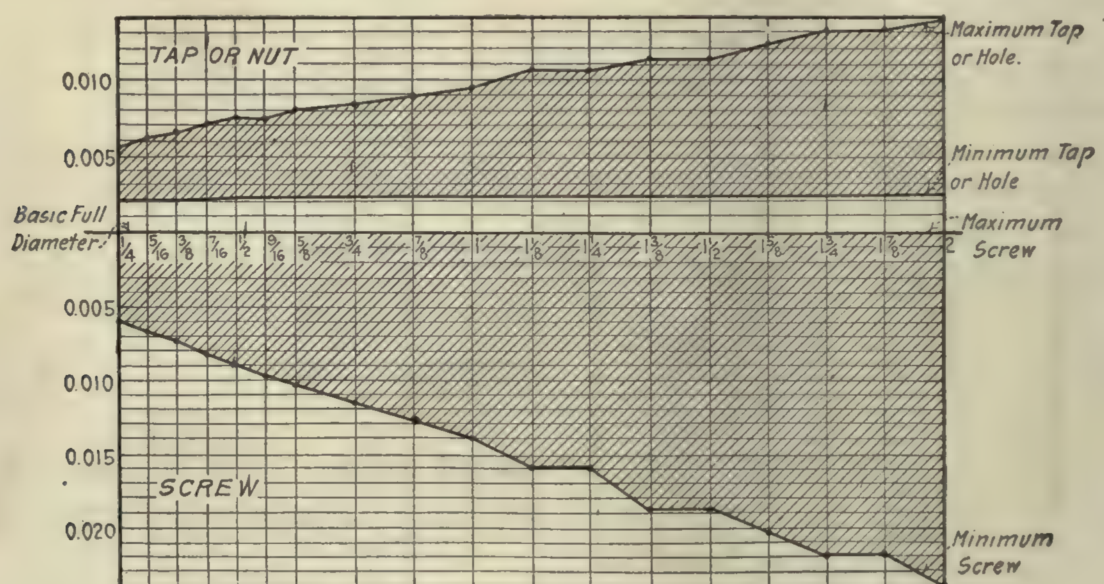


FIG. 7. MAXIMUM AND MINIMUM CLEARANCE, FULL OR EXTERNAL DIAMETER

next column to the left shows the screw as 0.0015 in. under basic pitch diameter, and the third column to the left shows that its lead must be between 0.0034 in. fine (minus) and 0.0034 in. coarse (plus) to be within the limits of the table.

47. *For Screws and Taps.*—(g) If the actual pitch diameter for either tap or screw is within the range of the tables but the exact diameter is not given in the proper column it can be interpolated or reckoned as between the two nearest values given, and a proportionate and corresponding limit can be likewise interpolated in order to find the error in lead allowable for the actual pitch diameter in hand.

48. Example: Same table. Suppose the pitch diameter of a tap is 0.2188 in. In the first column for taps it would come between 0.2185 in. and 0.2190 in. and the value for the next column would be ⅗ of the way between 0.0010 in. and 0.0015 in. or 0.0013 in., and the value for the third column would be three-fifths of the way between 0.0018 in. and 0.0029 in., or 0.0025 in.

49. If the length of engagement is greater than that provided for in the tables reference can be made to the table for a larger size having the required length, and the allowable variations in lead thus found.

50. Example: Suppose a ¼-in. 20 screw is to extend into a tapped hole to a depth of ½ in., or two diameters. Refer to the diagram, Table 5, for a hole ½ in. deep, this being for ½ in. 13, which allows for a fit ½ in. long. This will show by the angular lines what variations in lead are allowable, bearing in mind that the variations in pitch diameter must still be kept within the limits given in Table 1 for ¼ in.

51. Example: Suppose a 1-in. 8 bolt is to be used with a nut ¾ in. thick. Refer to the diagram, Table 8, which allows for a fit ¾ in. long. This allows for a greater variation in lead than the diagram for 1 in., Table 10. The greater limits in pitch diameter allowed for 1 in. can also be used, however.

52. The diagram, Fig. 4, illustrates the relation of the screw to the tapped hole, showing maximum and minimum allowances.

53. As the formulas given for external and root diameters are based on the number of threads per inch the maximum and minimum limits are not changed by a

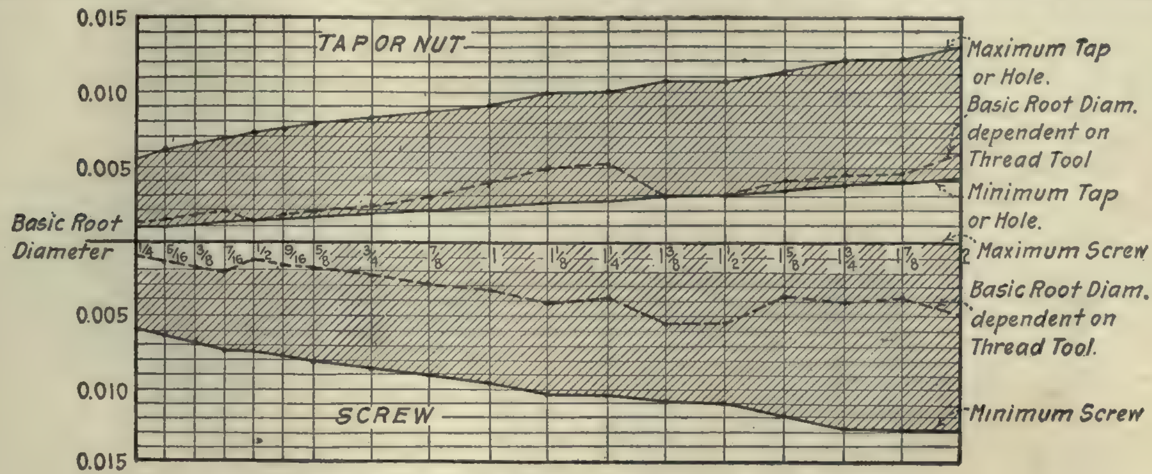


FIG. 8. MAXIMUM AND MINIMUM CLEARANCE, ROOT DIAMETER

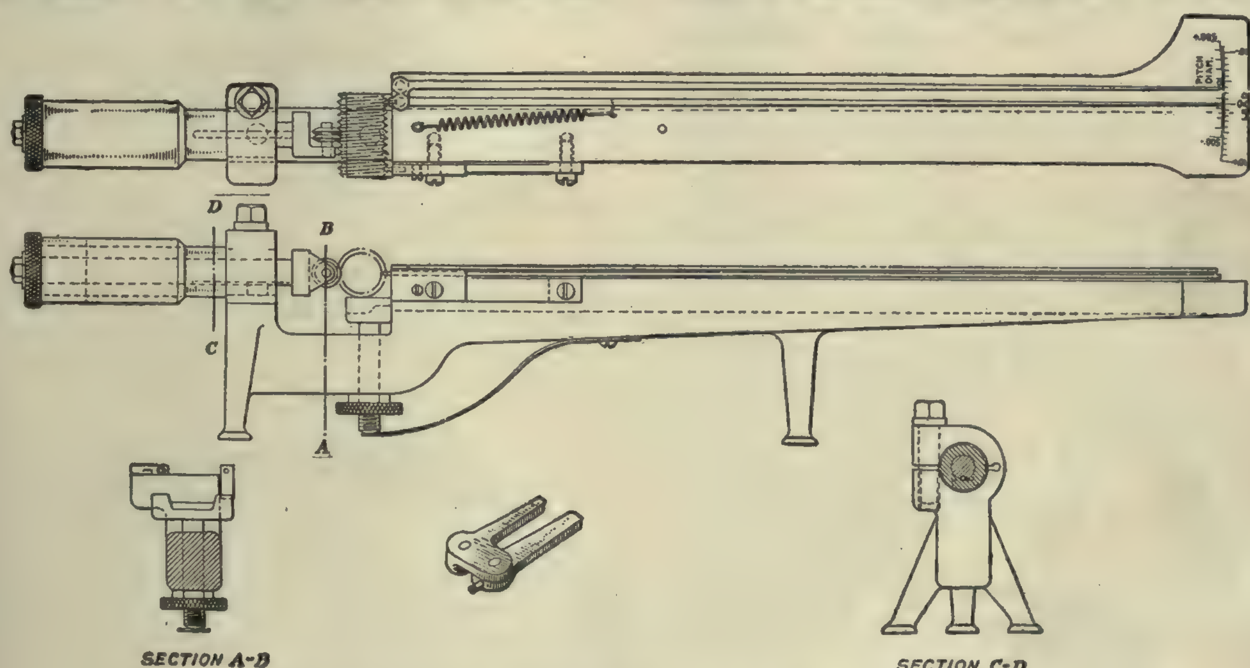


FIG. 9. COMBINED LEAD AND DIAMETER MEASURING GAGE, WITH COMPOUND LEVERS

change in diameter and the allowances given in the formulas for the U. S. Standard diameter and pitch can be used.[3] (See page 921, second column.)

54. Example: 1 in. diameter, 20 threads to the inch. For external diameter for ¼ in. 20 it will be found from the formula (or by reference to Fig. 7) that the maximum for screws is basic while the minimum is 0.0060 under. The maximum for tap or nut is +0.0057 in., while the minimum is +0.0019 in., these allowances being always the same for 20 threads to the inch for any diameter. The allowances for pitch diameter and lead, however, are based on formulas having the diameter as a factor.

55. Example: 1 in. diameter, 20 threads to the inch. It will be found by the formula (or by reference to Figs.

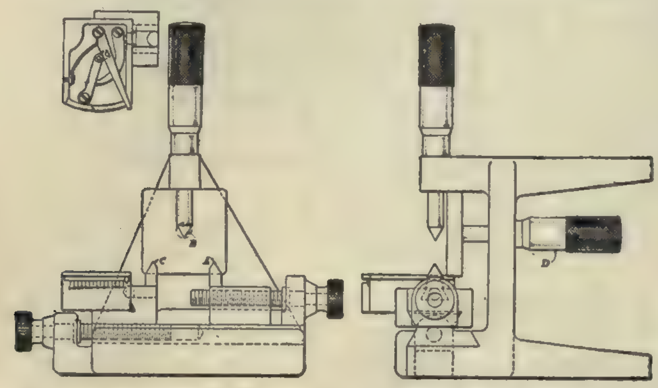


FIG. 10. COMBINED LEAD AND DIAMETER MEASURING GAGE, WITH MICROMETER AND LEVER INDICATOR READINGS

5 and 6) that the maximum pitch diameter of screw is basic. Minimum pitch diameter $= 1 - (0.0045 \times \sqrt{1 - 0.005}) = 1 - 0.004 = 0.996$ min. pitch diam. of screw.

Maximum pitch diameter of tap $= 1 + 0.004 = 1.004$ in.

Minimum pitch diameter of tap $= 1 + \dfrac{0.004}{4} = 1.001$ in.

Maximum error ($\mp$ normal) allowable in lead of screws if the length of engagement = 1 diameter (in this example 1 in.) =

$$\frac{0.57735(0.0045 \times \sqrt{1} - 0.005)}{1} = 0.0023 \text{ max. error in lead}$$

56. If, however, the length of engagement is only ½ in. instead of 1 in. a proportionately greater error in lead can be allowed.

$0.0023 \div \frac{1}{2} = 0.0046$ in. maximum error in lead for 1 in. 20 threads with ½ in. length of engagement.

Maximum error in lead for tap for 1 in. length of engagement

$$0.0023 - \frac{0.0023^2}{0.03} = 0.0017 \text{ max. error in lead}$$

For ½ length of engagement, $0.0017 \div \frac{1}{2} = 0.0034$.

To Find Position of a Tap or Screw in the Chart, Fig. 3

57. First, find its actual pitch or angular diameter as measured with a V-thread micrometer. Subtract from this diameter the basic pitch diameter as given in the table. The difference will be its deviation from basic pitch diameter. If plus, lay off its value to scale above the horizontal coördinate line, and if minus, below the horizontal line.

58. Second, find the "error in lead per inch" with a lead-measuring instrument. If the lead is coarse, equal plus, lay off its value to scale to the right of the vertical coördinate line, or if fine, equal minus, lay it off to the left of the vertical line.

59. The point where these first and second values intersect is the position of the tap or screw on the chart. If it is within the shaded area the tap or screw is within the prescribed limits, and if outside of the shaded area it is not up to the standard represented by the chart and

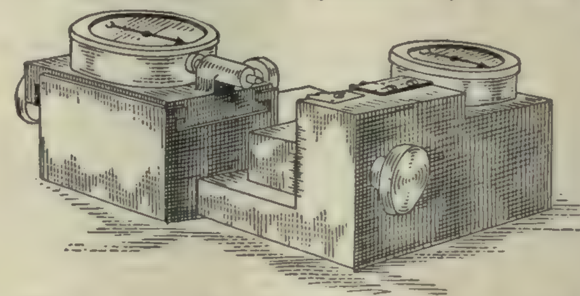


FIG. 11. GAGE WITH DIAL INDICATOR READINGS

table. Taps and nuts must fall within the shaded area above the horizontal line, while screws and bolts must fall within the shaded area below the horizontal line.

60. Example for a tap: Suppose a tap measured 0.001 in. over basic pitch diameter; this value would fall on the horizontal line CK (Fig. 3), and if its lead should be 0.0005 in. fine or minus in 1 in., this value would fall on the vertical dotted line passing through K, and the tap falls within the area of the chart.

61. Example for a screw: Suppose a screw measured 0.0010 in. under basic pitch diameter it would then fall

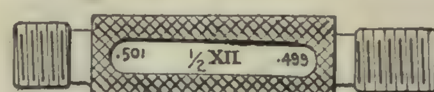


FIG. 12. PLUG GAGE

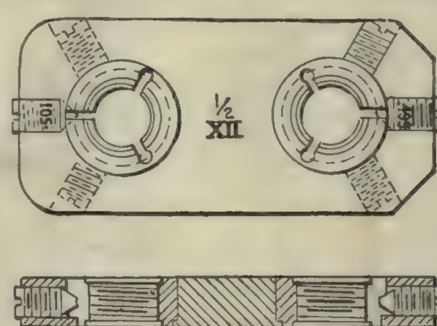


FIG. 13. ADJUSTABLE RING GAGE

on the horizontal line A, L (Fig. 3), and if its lead were 0.0020 in. coarse or plus it would fall on the vertical dotted line passing through L and the screw falls outside the area of the chart.

62. In order to ascertain whether the work comes within the required limits as represented by the triangular zones of the tables it is desirable to measure simultaneously both the pitch diameter and the lead of the piece.

63. Among the tools suggested for accomplishing this purpose are the following: Fig. 9 shows a gage which is adjustable for a range of diameters, the micrometer thimble being used to obtain the readings for the diameter. An adjustable block supports the work so that it

[3]These limits can also be obtained by reference to Figs. 7 and 8.

will be held parallel to the center line and can be set to be measured on the center line. The grooved roll fits over the thread and is free sideways to allow for variations in lead. This roll is set to the standard pitch diameter of the work and is adjusted by the micrometer thimble. The floating point is so connected that the longer lever shows the variation in lead and the shorter lever variations in pitch diameter, each pivoting about its own center. The work is placed between the points as shown by the dotted section and the variations from

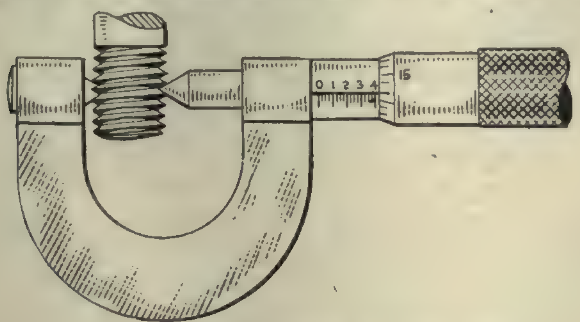


FIG. 14. SCREW-THREAD MICROMETER

standard or pitch diameter and lead are read directly in thousandths of an inch.

64. In Fig. 10 is a combination gage for diameter and lead. Point *A* is adjustable longitudinally by means of a micrometer screw so that it can be placed in proper relation to *B*, which is adjustable for different diameters, the pitch diameter of work being read directly by means of its micrometer. The point *C* is connected to the indicator, variations being read directly on the scale in thousandths of an inch. A block supports the work in proper

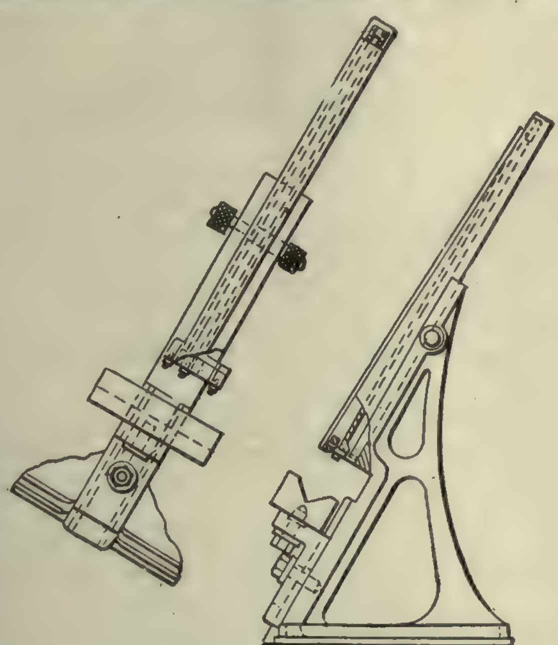


FIG. 15. LEAD-MEASURING GAGE

relation to the gage points and is set by means of the micrometer *D*.

65. A combination gage for pitch diameter and lead having a fixed point and two adjustable points is shown in Fig. 11. The variations in both cases are read on the dial indicators in thousandths of an inch. Indicators must be set to a standard before testing the work. An adjustable block may be set by a vernier, or micrometer, so that work resting on it will have its center line in line with the gage points.

66. In Figs. 12 and 13 is shown the type of gages now generally in use for measuring screw threads. Gages of this type do not determine the combined error of lead and diameter but are satisfactory for many classes of work. If the thickness or length of gage corresponds with the length of fit between the screw and nut or tapped hole, work which will pass inspection by the gages will interchange in use, and thus the desired result will be attained.

67. Where expensive special tools are not available good results can be obtained by measuring the diameter with an ordinary screw-thread micrometer shown in Fig. 14, and the lead, with the lead-measuring indicator, shown in Fig. 15. By the combined use of gages shown in Figs. 14 and 15, it can readily be determined whether

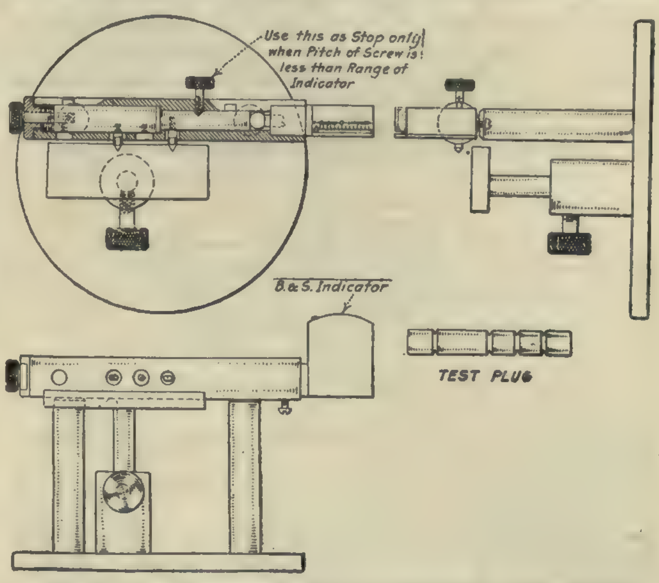


FIG. 16. LEAD MEASURING GAGE WITH INDICATOR READING

the work will come within the triangular zones on the tables, and thus pass inspection.

68. Another lead-measuring instrument is shown in Fig. 16. This uses a commercial test indicator for noting the variations from correct lead.

69. Fig. 17 shows a simple gage which might be provided at small expense where a block of a thickness of about one or one and one-half diameters is tapped at one end for approximately standard pitch diameter and correct lead, while the other end is made thin and tapped under standard pitch diameter so as to be used as a minimum-diameter gage. A screw which will pass through the standard or thicker gage but will not pass through the thin gage may be presumed to be within the required limits of tolerances for variation in both lead and pitch diameter.

70. Many other designs of measuring instruments having points of excellence have been submitted to the committee, but it has been thought best here to show simply typical and suggestive designs which can be developed in detail to suit particular needs.

71. Tables 19 and 20 give minimum and maximum diameters for U. S. S. taps, nuts and screws, while Tables 21 and 22 give inspection limits for taps and screws with the varying allowance in lead for different diameters within the limits specified.

72. The letter symbols given below are those recommended by the U. S. Bureau of Standards:

Allowance.—Variation in dimensions to allow for different qualities of fit.

Angle Diameter.—Same as pitch or effective diameter.

Angle of Thread, "A."—The total or included angle between the sides or slopes of a thread in a plane passing through the axis of the screw or nut.

Clearance.—The space between a screw and a threaded hole.

Clearance Angle.—Allowance on the angles or slopes of the thread for screw threads to fit together.

Clearance, Bottom.—Allowance or space at bottom of a thread to prevent a bearing at this point and to provide space for dirt.

Clearance, Outside.—Allowance between outside diameter of screw and bottom of tapped hole.

Core Diameter, "K."—English term for the root or bottom diameter of a screw and the small diameter of a nut. In the case of the nut it is measured between the crests of the thread (see root diameter).

Crest.—English term for the top or most prominent part of a thread, whether on the screw or in the nut.

Effective Diameter, "E."—English term for pitch diameter and defined as the length of a line drawn through the axis and at right angles to it, measured between the points where the line cuts the slopes of the thread.

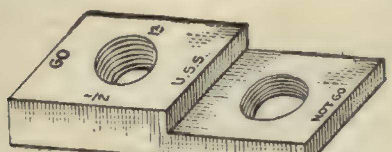


FIG. 17. CHEAP GAGE FOR TEMPORARY USE

External Diameter, "D."—Same as full diameter or outside diameter.

Finger Fit.—Where the screw fits the tapped hole so as to just be screwed in with the fingers.

Flow of Thread.—The movement of metal in a screw or nut, or both, when screwed together by force to fit in spite of an error in lead.

Flute.—The groove cut in taps and reamers to form cutting edges and to allow room for chips.

Franklin Institute Thread.—The *form* of thread adopted by the Franklin Institute in 1864. It is a 60-deg. angle thread with ⅛ of the vertical height cut from the top and filled in at the bottom. It is not confined to any special series of pitches.

Full Diameter, "D."—English term for outside diameter.

Gage, Check or Checking.—Gage for checking or testing other gages.

Gage, Limit.—A gage for insuring that any given dimension is within the tolerance laid down for the class of work to be produced.

Gage, Master.—A gage which is kept as a standard solely for comparing reference gages.

Gage, Reference.—A gage used by the manufacturer and by which the workman's gage is tested. A copy of the master gage.

Gage, Shop or Workman's.—A gage used by the workman in everyday practice. It is tested by or with the reference gage.

Gage, Standard.—English term for master gage.

Land.—The space between flutes on a tap or reamer. It includes the cutting edge and the supporting metal behind it.

Lead, "L."—The distance a screw advances in one turn. In a single-thread screw this is the same as pitch.

Lead, Normal, "L."—Correct lead.

Lead per Inch.—The lead multiplied by its reciprocal. For a perfect thread this equals one inch.

Limits.—Two sizes expressed by positive dimensions, the larger being termed the maximum, and the smaller the minimum, limit.

Limit Gage.—See gage, limit.

Outside Diameter, "D."—Diameter at the outside of the thread. External or full diameter.

Pitch.—The distance from a given point on one thread to a similar point on the next thread, along the axis of the screw. The same as lead for a single thread. The reciprocal of threads per inch.

Pitch Diameter, "E."—Same as effective diameter. Also defined as the diameter of a screw at a point midway of the depth of the thread. Equal to the outside diameter less the depth of one thread. This depth equals:

For V-threads $= \dfrac{0.866}{\text{thds. per inch}}$ For U.S.S. $= \dfrac{0.6495}{\text{thds. per inch}}$

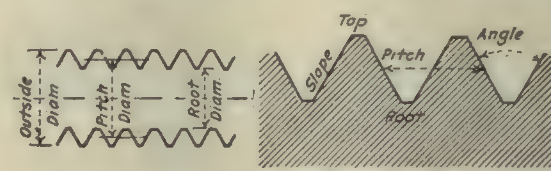


FIG. 18. DIAGRAMS SHOWING ELEMENTS OF THREAD

Relief.—The reduced diameter behind the cutting edge of a tap.

Root.—Bottom or smallest diameter of thread whether in screw or nut.

Root Diameter, "K."—The smallest diameter whether for a screw or in a nut.

Slope of Thread.—The angular part which connects the large and small diameters of a thread.

Standard Gage.—English term for master gage (see gage, master).

Thread, Modified V.—A form of thread having a 60-deg. angle and such that if carried to a sharp point it would measure to the nominal size, but with the top or bottom, or both, modified usually by being flattened according to conditions or individual ideas.

Thread, U. S. S.—The standard adopted by the United States Government, which uses the Franklin Institute form of thread with a definite pitch for each diameter (see Franklin Institute Thread).

Thread, V—A form of thread having a 60-deg. angle and sharp at top and bottom. Impossible in practice and always more or less modified, whether intentionally or not.

Thread, Whitworth.—A thread having a 55-deg. angle and a rounded top and bottom. The proportions are:

Depth $= \dfrac{0.640327}{\text{thds. per inch}}$ Radius of top and bottom $= \dfrac{0.37329}{\text{thds. per inch}}$

Thread Micrometer.—A micrometer caliper with special points for measuring the pitch or angle diameter of the screw.

Threads per Inch, "n."—Number of threads in one inch of length.

Tolerance.—The allowable variation in size, equal to the difference between the minimum and maximum limits.

Turns per Inch, "N."—The number of turns required to advance one inch. Equal to the threads per inch of a single-thread screw.

Wrench Fit.—Where the screw fits the tapped hole so tightly as to require a wrench to screw into place. Used for cylinder studs in steam engines and for similar work.

Respectfully submitted,

LUTHER D. BURLINGAME, Chairman; ELLWOOD BURDSALL, FREDERIC G. COBURN, FRED H. COLVIN, A. A. FULLER, JAMES HARTNESS, WILL R. PORTER, FRANK O. WELLS, WALTER F. WORTHINGTON, CHARLES D. YOUNG,

Committee on Tolerances in Screw Thread Fits.

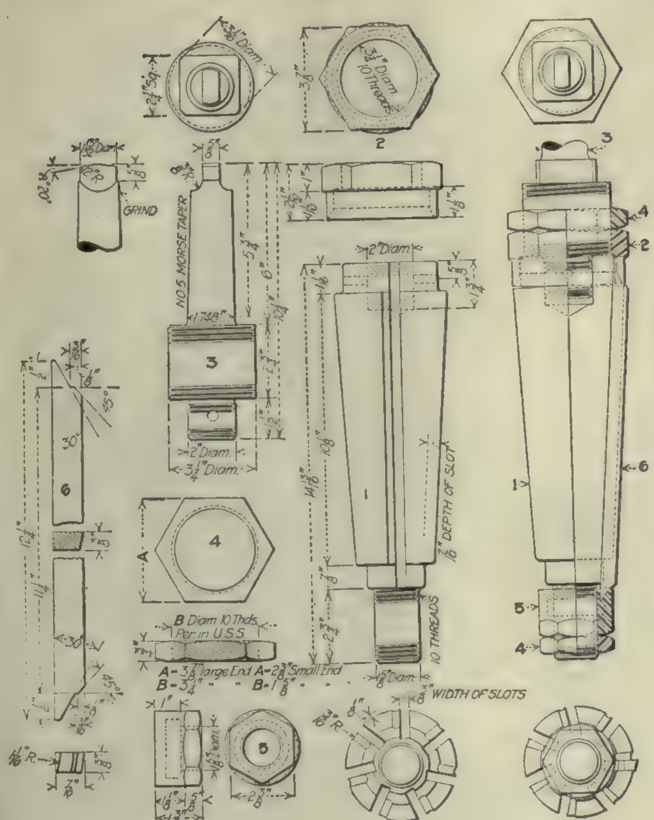
Penetration of Carbon—Erratum

On page 756, first column, seventh paragraph, the first line should read "Until the temperature of the muffle reaches about 900 deg. C." instead of 300.

An Adjustable Taper Reamer

By G. E. Baldwin

The drawing shows an adjustable reamer for reaming tapered holes for wristpins, knuckle pins and piston rods of locomotives. All parts of this tool are made of machine steel with the exception of the cutters, which are of tool steel properly hardened and ground. Parts 3 and 6 are the same size for all holes, while parts 1, 2, 4 and 5 are made to accommodate the various diameters for which the tool is to be used.



AN ADJUSTABLE TAPER REAMER

The principal advantage of this reamer is that parts can be replaced when they become worn.

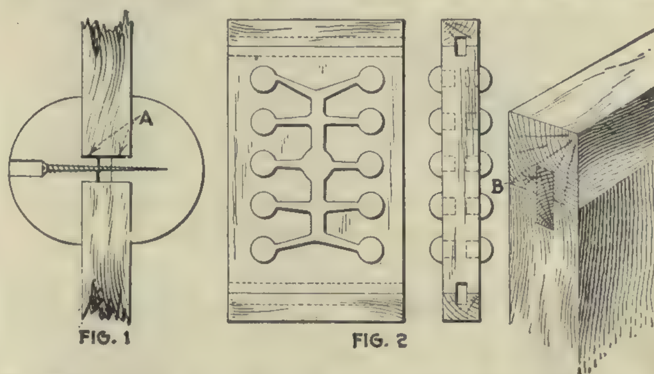
Plate Patterns

By George Compo

The discussion on plate patterns by M. E. Duggan was interesting, but I cannot agree with him on all points. The responsibility of obtaining a well-made pattern rests upon the foreman, who should carefully inspect the work before its acceptance.

In making iron plates I never have them less than $\frac{5}{8}$ in. in thickness, and wood plates never less than 1 in. The wooden boards are made of good straight-grained teakwood, which I consider superior to cherry for this purpose, as teakwood even of narrow widths, when well battened on the ends, will not twist as does cherry. The patterns are made from sycamore and are given three light coats of varnish.

I do not approve of Mr. Duggan's method of placing and transferring pattern halves, as no matter how accurately the paper is cut the accuracy is changed by the thickness of the knife blade. Also in setting the paper to the edge of the reverse side of the plate it will be difficult to insure accurate registration.



FIGS. 1 AND 2. DETAILS OF PATTERN PLATE AND PATTERN-SETTING METHODS

My method of setting turned patterns is very simple and perfectly accurate. When the positions have been marked on the plate, holes are drilled to match tenons *A* already turned on the patterns, as detailed in Fig. 1.

Pattern halves on one side are bored in the center for screws; both patterns are shellacked on the joint, put in place, and the screw put in and tightened up. This renders it practically impossible for the patterns to get out of register.

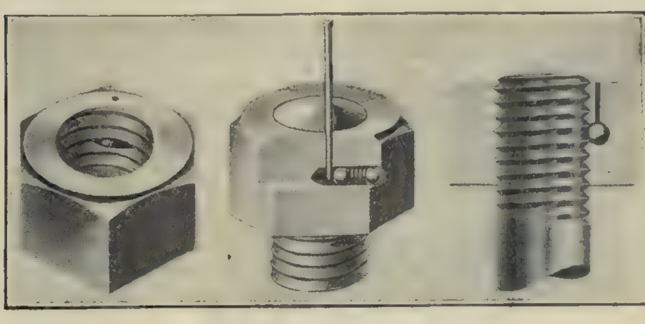
The assembled board is shown in Fig. 2, where at *B* is a detail of the form of battened edge that I use on our wood plates. This system is carried out as far as practicable with both wood and iron plates.

As an aid to preservation the wood plates have their edges bound with half-round iron. To prevent their being damaged on the ordinary pattern shelves and to avoid the bulky boxes mentioned by Mr. Duggan they are kept stored in special racks in both the foundry and the pattern storehouse.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist"

Evertite "Sta-Lok" Nuts

The illustration shows a locknut which has been recently placed on the market by the Evertite Nut Corporation, Marquette Building, Detroit, Mich. It is known as the "Sta-Lok" nut. As will be noticed the locking device consists of a hardened-steel ball running

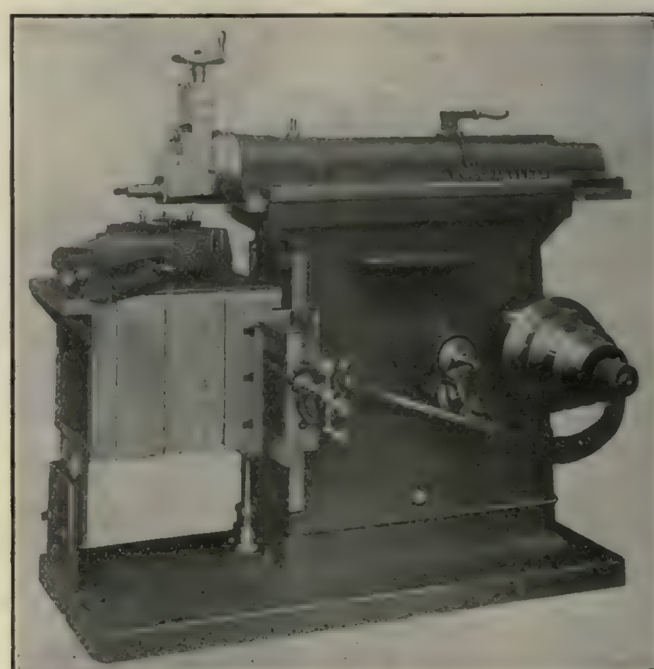


EVERTITE "STA-LOK" NUTS

in a groove between the bolt threads. This ball is maintained in contact with the threads by means of a spring which causes it to immediately wedge and lock the nut the moment the latter starts to unscrew. The illustration at the center shows the method of unlocking, this being to insert a small finish nail which forces the steel ball back out of contact with the thread of the bolt, thus allowing the nut to be unscrewed. The action of the ball is, of course, such that the nut can be screwed on to the bolt without any difficulty or without the use of the finish nail as shown. The nuts are manufactured from bar-screw stock and have a special type of filleted head. The nuts are carried in stock in various sizes of U. S. A. and S. A. E. thread. The illustration at the left is looking into a nut while that at the right is a cross-section taken at right angles to the hole in which the steel ball runs.

Hollingsworth Shaping Machines

The Hollingsworth Machine Tool Co., Covington, Ky., is now manufacturing a line of back-geared crank shaping machines made in 16-, 18-, 21- and 24-in. sizes. It is claimed that the construction of the machines is very rigid. All flat bearings are hand scraped, and the wearing surfaces are provided with adjustable gibs. The shafts run in bronze bushings which can be removed and replaced in case of wear. The pulley shaft is supported at the outer end as well as at two other points in its length. Cut gearing is used throughout. Swivel bolts in the head allow the tool head to be set and held at any angle up to 90 deg., and a dial is provided, graduations indicating the amount of swivel. A micrometer dial is also provided for the feed screw. The table is bolted to the slotted saddle and is provided with T-slots on both the sides and the top. It can be easily removed and work attached to the saddle if this is desirable. A swivel vise is used, the base being graduated to 360 deg. It is provided with steel-faced jaws.



BACK-GEARED CRANK SHAPING MACHINE

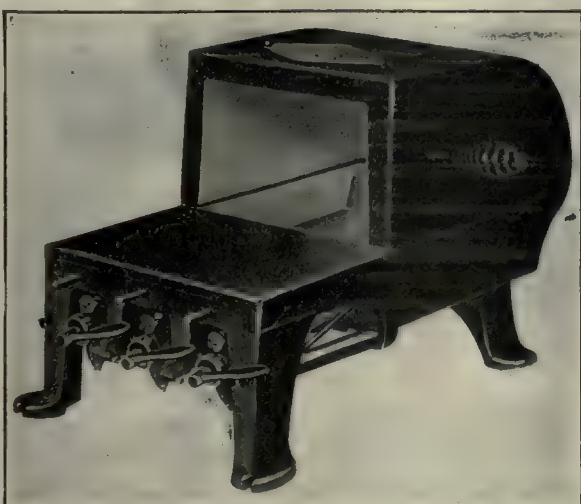
Size of machine, 18 in.; horizontal travel of table, 22½ in.; vertical travel of table, 15 in.; vertical movement of head, 8 in.; ram speeds, eight, 9 to 106 per minute; length of table top, 14 in.; width of table top, 15½ in.; height of table side, 15½ in.; vise jaws, 2¼ x 10½ in.; opening of vise, 9 in.; back-gear ratios, 6 and 14½ to 1; keywaying capacity under ram, 2⅜ in.; size of countershaft pulleys, 12 x 4 in.; width of belt, 2½ in.; extreme length of stroke, 18½ in.; shipping weight, 3000 lb.

The elevating screw is of the telescoping type and has a ball-bearing thrust washer below the table. A table support is provided at the outer end. A pivot shaft at the bottom of the column supports the rocker arm and other parts, thus relieving the ram from any dead-weight. The connection between the rocker arm and the ram is by means of a double link which pulls down

on the ram during the cutting stroke, thus tending to equalize the upward thrust of the tool. It is claimed that this construction eliminates much vibration. The length of the stroke may be adjusted either while the machine is in motion or at rest. As previously stated the machine is made in four sizes, the specifications given under the illustration being those of the 18-in. size. The machine can also be furnished for motor drive if desired.

Johnson No. 108 Bench Furnace

The bench furnace illustrated is for heating small parts and is one of the late products of the Johnson Gas Appliance Co., Cedar Rapids, Iowa. The device is known as the company's No. 108, and the fuel used is gas. A work-rest block that is furnished with it affords a rest for the work, while a baffle plate partially closes the mouth of the furnace. It is claimed that these features in connection with the angle of the burners and the curved shape of the hood make it possible to



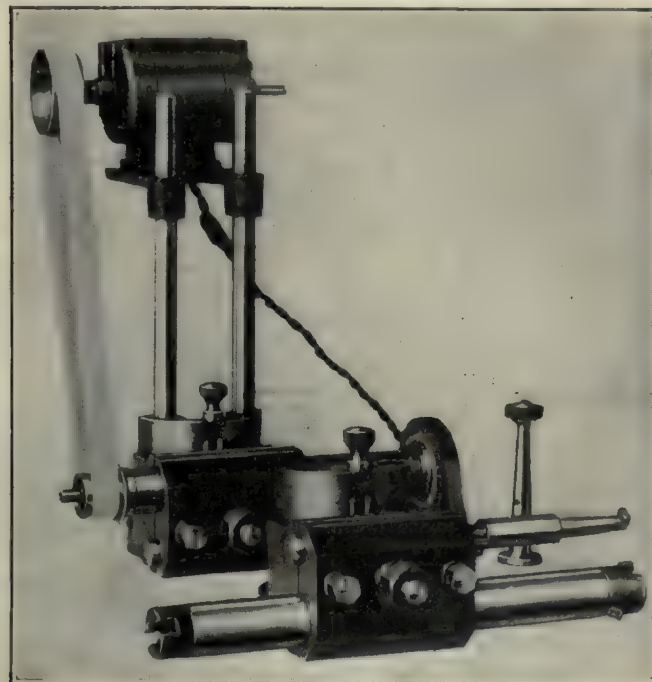
JOHNSON NO. 108 BENCH FURNACE

Size of firebox, $6\frac{1}{4}$ x 5 x $6\frac{1}{2}$ in.; size of mouth, 4 x 6 in.; length, 16 in.; height, $9\frac{1}{2}$ in.; weight, 43 lb.; maximum gas consumption, 40 cu.ft. an hour; size of supply pipe, $\frac{1}{2}$ in.

secure very uniform results. The flame is said to be of a neutral nature and so does not have to be baffled. The furnace may also be used for heating two 14-lb. soldering irons.

Nelson Boring and Grinding Attachment for Lathes

A combination boring-bar and grinding-wheel attachment for use on lathes and shapers is now being marketed by the Nelson Tool Co., 1605 West Lake St., Chicago, Ill. The device is placed over the toolpost and is held in place by means of the regular toolpost screw which is tightened down upon a bar slipped through the hole. An adjustment is provided which permits the bar or wheel to be raised or lowered to any necessary position, this adjustment being accomplished by means of the thumbscrew shown between the two vertical bars holding the motor. It will be noticed that the motor is supported on two vertical bars, this construction making it possible to raise or lower the motor as desired in order to tighten the belt or to provide for the use of pulleys of various sizes. The boring bars are hollow and are provided with an internal-tension rod for drawing the tool bit into position. This arrangement, it is claimed, gives a strong and rigid boring bar. In the illustration the boring at-

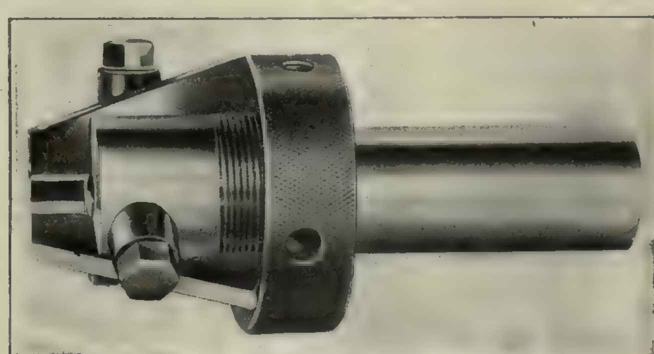


BORING AND GRINDING ATTACHMENT FOR LATHES

tachment is shown in front of the grinding attachment to which the motor is attached. The two are readily interchangeable. These attachments are now made in three sizes for use on varying sizes of work.

Genesee Adjustable Tools for Hollow-Milling Work

The Genesee Manufacturing Co., Rochester, N. Y., has recently placed on the market a line of adjustable hollow-milling cutters, one of which is shown in the illustration. The device is made of machine steel, the wearing



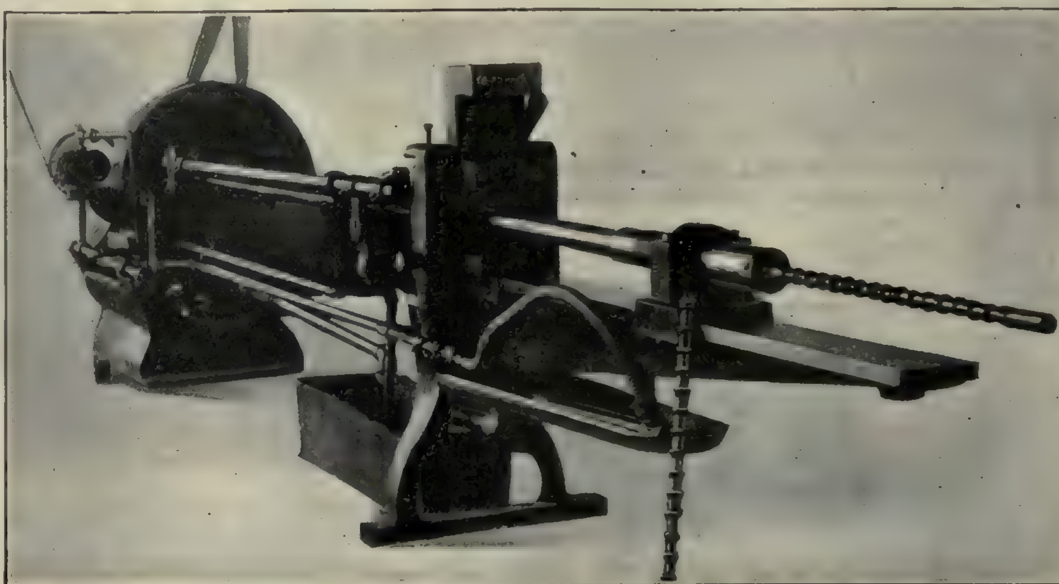
GENESEE ADJUSTABLE, HOLLOW-MILLING TOOL

parts being casehardened and the screws heat treated. The blades are of various types of steel as desired. The shank is drilled completely through, allowing the stock to pass through the tool. Two types are made, Style "A" having the blades set radial for brass or other comparatively soft material and Style "B" having the blades set at an angle of 12 deg. for cutting steel. The blades are secured in place by screws with the rear ends

resting against the ring by which adjustment is made. The four smaller sizes have three blades, while the three larger sizes have five. The blades in the seven sizes range in size from $\frac{3}{16}$ x $\frac{1}{2}$ x $2\frac{1}{4}$ in. to $\frac{3}{8}$ x $\frac{7}{8}$ x $3\frac{1}{4}$ in. A complete set will handle work from $\frac{1}{4}$ to 2 in. in diameter.

Lapointe Rifling Machine

The illustration shows a machine made by the J. N. Lapointe Co., New London, Conn., for broaching the rifling in one-pounder gun barrels. The picture shows one of these one-pounder gun barrels mounted in position for broaching. The broaching of the rifling is done in two operations, using a roughing and a finishing broach. The length of the part rifled is 44 in. There are 12 helical grooves approximately 0.015 in. deep with a uniform right-hand twist of one turn in 40 in. The rifling operation is accomplished by means of a master bar, which gives the proper turning to the broaching tool. The broaches used are also milled to correspond with the lead required. The master spiral bar is pulled by means of a roller-thrust bearing and operates through a spiraling block that causes the bar to rotate. The gun is mounted in a fixture and clamped so as to hold it in perfect alignment and also to prevent it from revolving. By referring to the cut it will be noticed that there is a large, flexible tube and pipe in the oil pan under the front end of the machine. This pipe is slipped over the end of the broach and into the bore of the gun, which at this end is large enough to admit this oil pipe. The broach is also provided with oil channels, so that every pocket between the cutting teeth is filled with oil as it enters the work, and is constantly flushed by the high pressure under which the oil is forced in. This prevents the chips from cutting dry and welding to the face of the teeth, which results in a very smooth finish. The time for broaching grooves is approximately 15 minutes.



LAPOINTE BROACHING MACHINE FOR RIFLING GUN BARRELS

Industrial Electric Tractors

The Industrial Truck Co., Holyoke, Mass., has recently placed on the market a new line of electric tractors for use in factories, shops, etc. The tractors are manufactured in two types with end or center control, and with either two- or four-wheel drive as desired. The steer is through all four wheels and the two-wheel drive machine can be converted into a four-wheel drive by purchasing a few extra parts such as the worm and wheel housing, differential, etc. The frame is built of commercial, rolled, channel-section steel, and the bumper plates are of boiler plate bent on the corners and riveted to the frame. To accommodate different types of trailers the coupler castings are of the three-step type. Removable side doors are provided for changing batteries and the hinged top plates allow easy access for flushing or inspection. The battery equipment is of the Edison or lead-plate type as desired. The frame and battery box can be lifted from the chassis by the removal of four nuts, leaving the entire driving mechanism accessible for inspection or repair. Power is transmitted from the motor through a single-reduction worm and gear, a differential and a universal joint to the wheels. The universal joint is inclosed in a dust- and oil-proof case and is capable of operating at an angle of 43 deg. Ball bearings are used throughout on the wheels. Two brakes are provided, one operated by the left foot and the other operated by the right foot. To operate the tractor the

ELECTRIC TRACTOR

Length over bumpers, 87 in.; width over all, $40\frac{3}{8}$ in.; wheelbase, 40 in.; tread, 30 in.; height of platform, 26 in.; ground clearance, $4\frac{1}{4}$ in.; gearing, single reduction; tires, 20 x $3\frac{1}{2}$ in.; steer, four wheel; turning radius of outside wheel, $56\frac{5}{8}$ in.; turning radius of outside corner, $63\frac{3}{8}$ in.; speeds, four forward and four reverse, five miles per hour with a trailer load of 20,000 lb. and seven miles per hour with empty trailers; motor, 5 hp.; springs, coil type, four in number; weight without battery, 2400 lb.

driver must be sitting in the seat with his left foot pressing the emergency-brake pedal. On removing the foot from the left pedal the brake is applied, the controller handle is thrown out and the controller placed in neutral position. After this has happened it is impossible to again start the machine without first releasing the emergency brake and bringing the controller handle back to neutral. An additional safety device is found in the tilting steering wheel, which is so located that the operator must tilt the wheel to leave his seat. This arrangement is connected with the controller-shaft clutch so that the battery current cannot be applied until the wheel is in running position. An electric horn is operated by a push-button in the controller handle. The machine is also built in the locomotive style for any gage from 24 to 56½ in., and except for the absence of differential, universal-joint drive mechanism and steering mechanism and the substitution of flanged steel wheels for rubber-tired ones, this machine contains the same features as the tractor. One of the features claimed for this line of tractors is that the parts are interchangeable and the power unit is identical with those used in the operating and load-carrying trucks manufactured. This is claimed to reduce the number of spare or repair parts to a minimum.

Talcott Belt Fasteners

The illustrations show two types of belt fasteners that are now being marketed by W. O. & M. W. Talcott, 91 Savin St., Providence, R. I. Fig. 1 show the "Ideal"

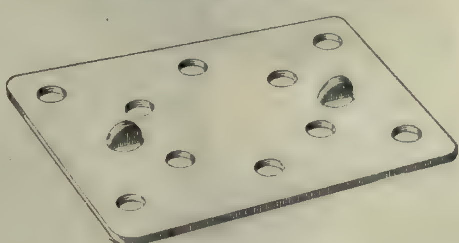


FIG. 1. "IDEAL" BELT FASTENER

belt fastener that is used for rubber canvas, balata and textile belts. It is used either between the layers of the belt or on the side of the belt away from the pulley. When used on the outside of the belt the fasteners are

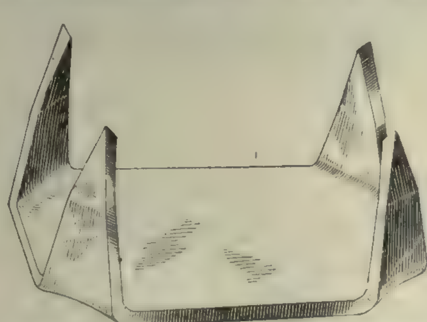


FIG. 2. "ACME" STEEL BELT HOOK

curved somewhat to conform to the pulley. These fasteners are secured to the belt by means of rivets, and two small lips shown prevent the fastener from moving out of place. Fig. 2 shows the "Acme" steel belt hooks, which are for leather, rubber or canvas belt. The construction is such that when the hooks are driven into the belt the edges are drawn tightly together, after which the points are bent over with a hammer. Both styles of belt fasteners are made in a number of sizes to meet various conditions and sizes of belts.

"Lea" Thread-Lead Testing Machine

The thread-lead testing machine shown in front and rear views in Figs. 1 and 2 is the design of Charles Lea, and is being manufactured and sold by the West & Dodge Co., 167 Olive St., Boston, Mass. The base has a three-point bearing—two stationary and one adjustable—making it easy and quick to level. The thread-contact point and the Brown & Sharpe micrometer head are carried on a ball-bearing carriage, or slide, so delicately adjusted that the operator can blow it back

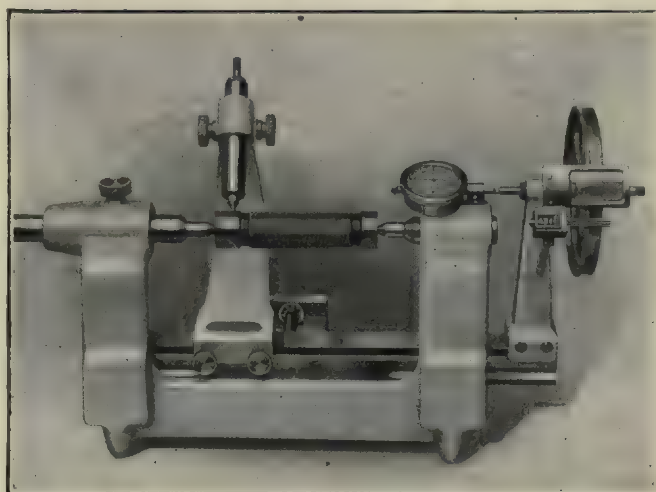


FIG. 1. FRONT VIEW OF "LEA" THREAD-TESTING MACHINE

and forth with his breath when the contact point is not engaged. The thread-contact point is held to its work by means of a spring, and it may be moved from one thread to another by pulling it back by means of the small knurled handle shown. The thread gage to be tested is carried between centers. To test the lead

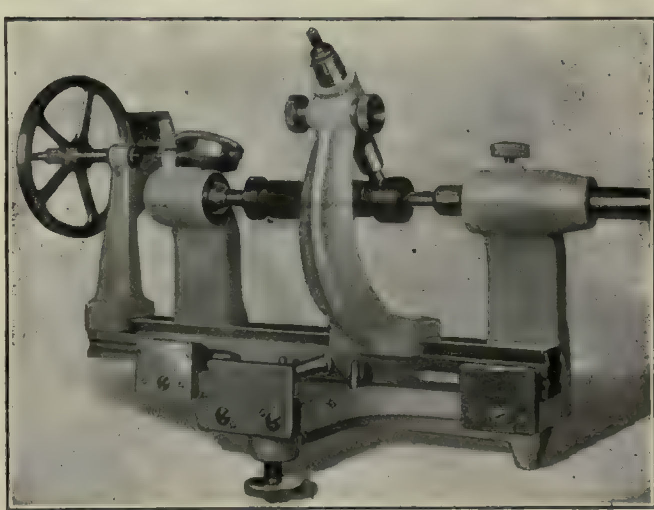


FIG. 2. REAR VIEW OF THE MACHINE

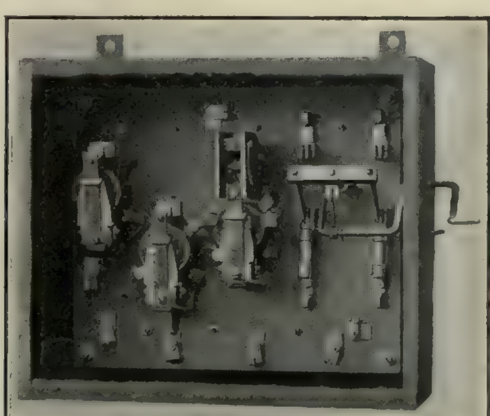
the contact point is placed in position in one of the threads and then the micrometer spindle is adjusted so that the pointer on the Ames dial indicator points to zero. The thread-contact point is then moved along

one, two or more threads, as the case may be, and the micrometer readings taken and compared to the theoretical amount. Drunken threads are easily detected by turning the gage part way around and again measuring.

In doing the measuring the micrometer spindle is adjusted so as to bring the dial indicator pointer again to zero. From this it will be seen that the dial indicator is not used to actually measure with, but only to show the correct amount of pressure to apply to the micrometer spindle. It will be noticed that the micrometer sleeve carries a graduated gearwheel which meshes with a pinion attached to a special Veeder counter. By the use of the large graduated wheel, readings are obtained to 0.0001 in. As the wheel turns it operates the counters, so that the operator can read his measurements directly and instantly, which greatly adds to the speed with which a gage may be inspected. In using the micrometer no damage is done in case the spindle overruns considerably. Where it is not advisable to depend on micrometer readings, Johansson blocks may be used between the dial spindle and the micrometer spindle. A plug is also provided so that the dial indicator may be removed and a solid plug used in place of the indicator spindle. Johansson blocks can then be used between the contact points as before. The machine will test thread gages up to 6 in. in diameter and 6 in. long. It weighs approximately 60 lb.

Westinghouse Automatic Starter for Direct-Current Motors

The Westinghouse Manufacturing Co., East Pittsburgh, Penn., is now marketing the automatic starter illustrated, which is especially adapted for starting direct-current motors of 10 hp. and under. The complete mechanism is inclosed in a dust-proof case approximately 15 in. high, 17 in. long and 10 in. deep, which may be locked to prevent tampering. The line switch, which is of the knife type, is operated from the outside of the case by a crank handle extending through one end, and

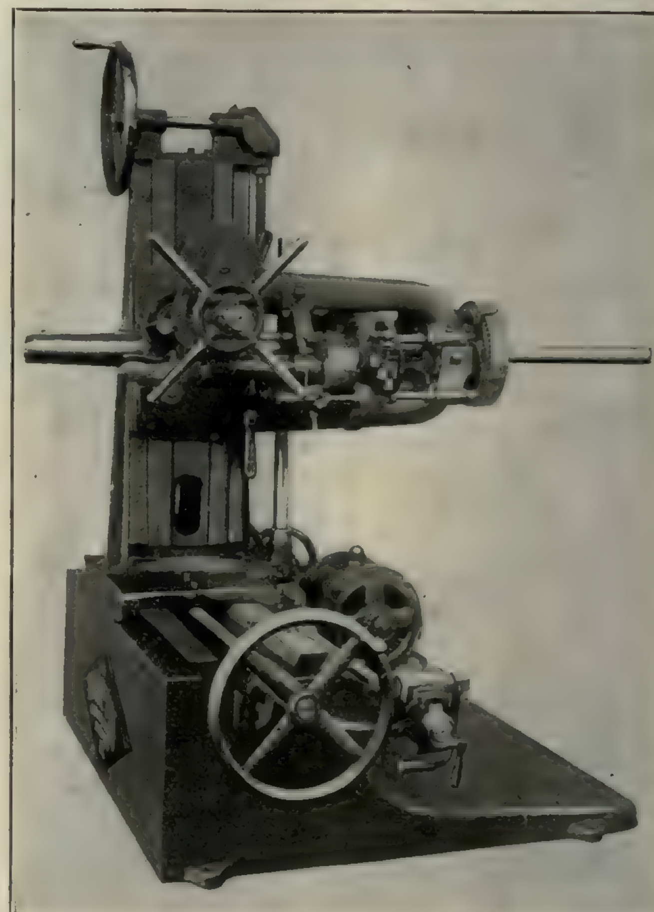


AUTOMATIC STARTER FOR SMALL DIRECT-CURRENT ELECTRIC MOTORS

the switch may be locked in either off or on position. The counter em.f. method of acceleration is used, and as the time of acceleration is dependent on the motor load, protection is insured against too rapid acceleration. For ordinary work two points of acceleration are maintained by the use of one accelerating contractor, but where exceptionally heavy loads are carried, two accelerating contractors are used, giving three points of acceleration. Provision is made for protection against failure of power, and this feature may be so arranged that the motor will be restarted when the power returns or so that it will require the services of an operator to start it. The latter arrangement is, of course, valuable where unexpected starting of the machine would involve danger. The starters are built both with and without provision for dynamic braking and may also be had with a field rheostat for adjustable speed service.

Rockford Horizontal Drilling, Boring and Tapping Machine

The combination horizontal drilling, boring and tapping machine shown in the illustration is one of the recent products of the Rockford Drilling Machine Co., Rockford, Ill. The machine is particularly designed for



DRILLING, BORING AND TAPPING MACHINE

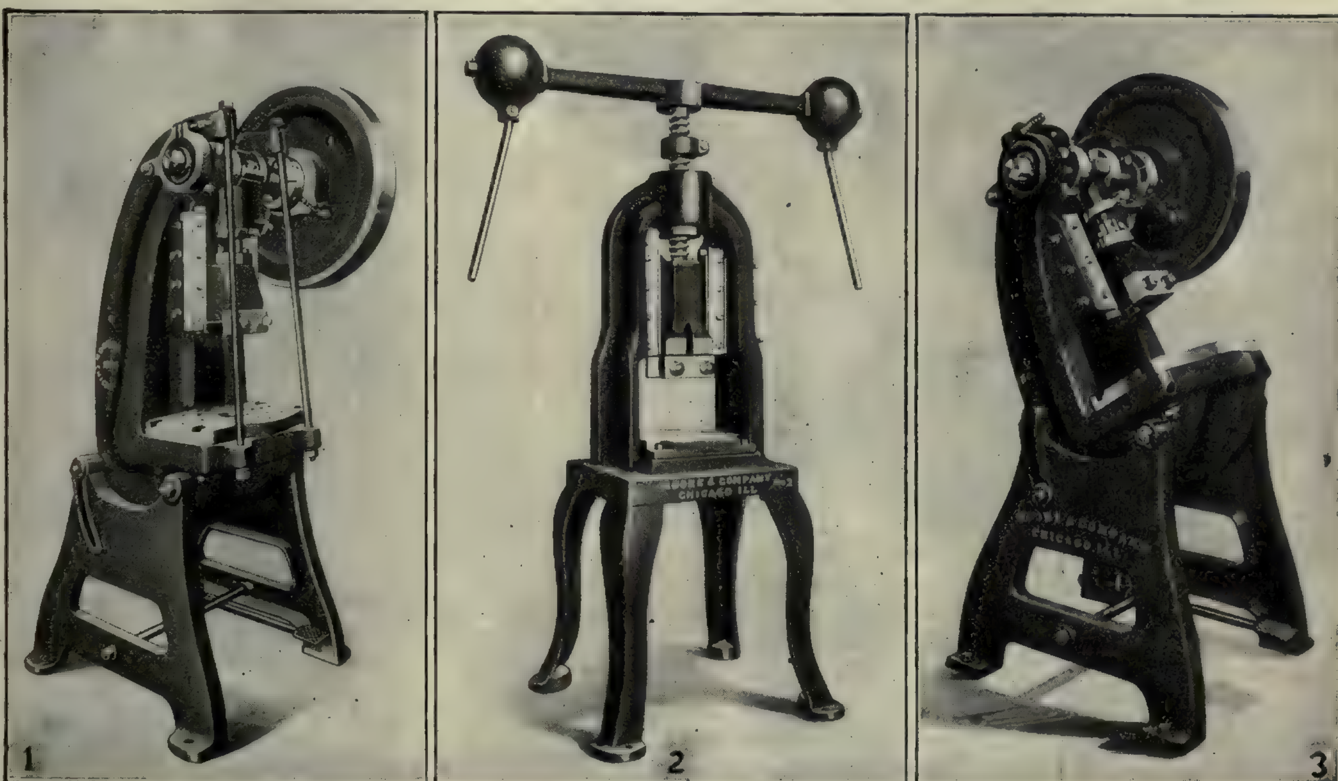
Diameter of spindle, 2 1/16 in.; spindle travel, 25 in.; diameter of spindle sleeve, $3\frac{5}{8}$ in.; feeds per revolution of spindle, seven, 0.005, 0.007, 0.010, 0.014, 0.020, 0.030 and 0.040 in.; hole in spindle, No. 5 Morse taper; drive slot in end of spindle, $\frac{5}{8}$ x $\frac{5}{8}$ in.; spindle speeds with three- or four-step cone, 9 to 245 r.p.m.; spindle speeds with two-step cone, 30 to 185 r.p.m.; spindle speeds with gear box, 30 to 250 r.p.m.

use on large parts where the regular table cannot be used to advantage, and has vertical and horizontal movements of the head and column which permit the spindle to work over an area 18 in. high by 36 in. long. The company is also prepared to furnish machines which will do work over areas up to 36 in. high and 15 ft. long in case they are desired. Floor plates and work tables are furnished to meet the customer's specifications. The machine may be had in any one of four types of drive,

viz., two-, three- or four-step cone pulleys with planetary back gears and double friction countershaft; gear box giving nine speeds with tight and loose pulleys; constant-speed motor with gear box; and variable-speed motor drive with back gears giving two ranges of speed.

Moore Presses

The illustrations show three different types of presses now being manufactured by Moore & Co., Grand Ave. and Franklin St., Chicago, Ill. In building these presses it has been the intention of the manufacturer to provide a large die bed and also to give the punch ram a large lift. This is for the purpose of allowing the use of large dies for comparatively light work that would otherwise have to be done on punch presses of greater size, which would be more powerful than necessary for the work. Fig. 1 shows the No. 4 power punch press. It is equipped with a flywheel of the solid-web type and is provided with a positive clutch. The shaft is machined from a steel forging and the brake is claimed to be of large size and very effective. The press is shown with rods in place in front, but these can be quickly removed where the work is not heavy enough to necessitate their use. Fig. 2 shows the No. 2 screw press. It is equipped with a forged steel lever carrying large weights at each end. As will be noticed they have handles projecting from their lower sides, which obviate the necessity of reaching for the lever. The forged-steel screw is provided with a locknut to assist in trying out forming dies, etc. A hardened-steel plate is used in the slide where the ends of the screw bears, and the nut holding the screw is threaded the full length. Fig. 3 shows the company's No. 3 power punch press. Like the No. 4 press it is equipped with a solid-web flywheel, positive clutch, forged-steel shaft and a brake that is claimed to be large and effective.



FIGS. 1 TO 3. THREE DIFFERENT TYPES OF MOORE PRESSES

Fig. 1—No. 4 power punch press. Weight, 2800 lb.; weight of flywheel, 575 lb.; size of flywheel, 30 x 4½ in.; speed of flywheel, 115 r.p.m.; diameter of round opening in bed, 8 in.; oblong opening in bed, 12 x 6 in.; opening through back, 12 in.; center of slide to frame, 6½ in.; die space on top of bolster plate, with stroke down and adjustment up, 8½ in.; distance from bed to gibs, 12¾ in.; standard stroke, 2½ in.; adjustment of slide, 3 in.; thickness of bolster plate, 2 in.; square hole in slide for punch-holder shanks, 2 in.; floor space over all, 40 x 44 in.; bolster plate, 15 x 22 in.; slide, 9 x 9 in.

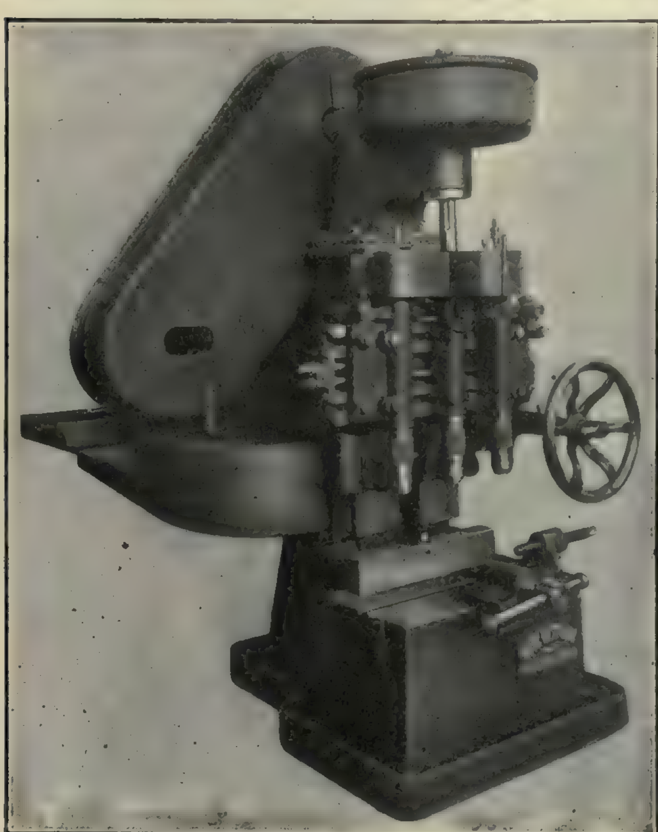
Fig. 2—No. 2 screw press. Weight, 1978 lb.; standard opening in bed, 8 x 8 in.; width between uprights, 16 in.; width between gibs, 7½ in.; distance from bed to slide without bolster plate and with slide up, 12 in.; maximum movement of crosshead, 8¾ in.; face of crosshead, 7 x 8 in.; square hole in slide for punch shanks, 2 in.; top of bolster plate, 15¼ x 15¼ in.; thickness of bolster plate, 2 in.; diameter of steel screw, 3 in.; pitch of thread on screw, 1 in.; length of operating lever, 60 in.; weight of lever with two balls, 325 lb.; height of press with slide up, 84 in.; floor space of legs, 30 x 35 in.

Fig. 3—No. 3 punch press. Weight 1800 lb.; weight of flywheel, 370 lb.; size of flywheel, 26 x 4 in.; speed of flywheel, 125 r.p.m.; round opening in bed, 7 in. in diameter; oblong opening in bed, 11 x 6 in.; opening through back, 11 in.; depth of throat, 5½ in.; die space on top of bolster plate with stroke down and adjustment up, 6¾ in.; distance from bed to gibs, 8⅛ in.; standard stroke, 2 in.; adjustment of slide, 2 in.; thickness of bolster plate, 1⅞ in.; square hole in slide for punch-holder shanks, 2 in.; floor space over all, 36 x 38 in.; bolster plate, 14 x 21 in.; face slide, 7 x 7½ in.

Newton Rail-Drilling Machine

The machine illustrated is a three-spindle rail-drilling machine that is one of the recent designs of the Newton Machine Tool Works, Inc., 23d and Vine St., Philadelphia, Penn. It is intended for drilling the holes required in the ends of rails simultaneously. All spindles operate separately and can be removed from the cross-rail when desired. All important bearings are bronze bushed, and all spindles, spindle gears and the rack pinions are of nickel steel. The gears are inclosed and fully covered, which is also true of the motor-connecting belt. A pump, piping, etc., are provided for lubricant. The motor is mounted on a bracket at the left side of the machine and connected by a belt to the main driving pulleys at the back. From here the drive

is through bevel and spur gears to the spindles at the top of the saddle. The saddle is counterweighted and has hand and power feed, the latter being available in two steps, 0.04 and 0.007 in. per spindle revolution. The table is equipped with an adjustable back plate, a clamping end screw and a reversing end slot. The spindles are equipped with special holding chucks for driving drills of special rail design. Lubricant is held in a tank



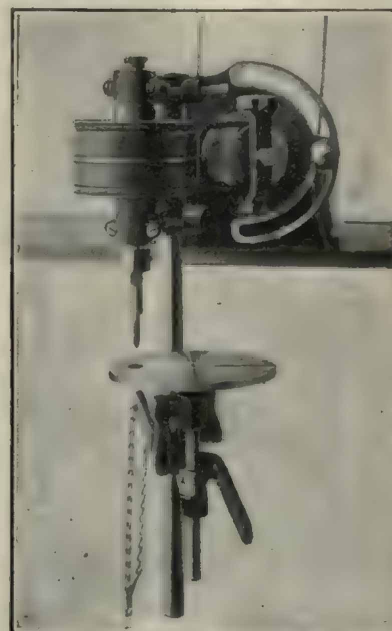
MULTIPLE-SPINDLE RAIL-DRILLING MACHINE

Diameter of spindles, $1\frac{7}{8}$ in.; minimum distance between spindle centers, $3\frac{1}{2}$ in.; maximum distance between spindle centers, 9 in.; maximum distance from top of table to end of spindles, $19\frac{1}{2}$ in.; size of work table, 16 x 30 in.

in the base of the machine, which is surrounded by an oil tank. The central spindle is stationary, while the two outside spindles are adjustable by hand-operated screws from a minimum center distance of $3\frac{1}{2}$ in. to a maximum distance between adjacent spindle centers of 9 in.

Lichtenberg Type "P" Universal Tapping Machine

H. Lichtenberg, 82 Beaver St., New York City, has placed on the market a new tapping machine, which is shown in the illustration. The tapping mechanism consists of a forward and reverse friction drive supported between two arms which are pivoted on the rod carrying the work table. The friction drive is rotated by means of a round belt which connects with a grooved pulley on the main shaft. A device is included for adjusting the tension of this belt, and this may be accomplished either while the machine is at rest or in motion. It will be noticed that the tap simply revolves while the work-holding table is moved to feed the work. The main support is pivoted on the base and has a semicircular adjustment sector by means of which the machine may be swung into any position from horizontal with the tap pointing to the right, to horizontal with the tap pointing to the left. It will be seen that this feature allows the machine to be used either as a horizontal or vertical tapping machine or at any other intermediary position which may be more convenient for the work in hand. A handwheel may also be mounted on the end of the spindle in case hand-tapping operations are desired. It will be noticed that the feed lever is provided with an extension to the rear by means of which the machine may be operated by a foot treadle when being used in a vertical position. The work table



LICHTENBERG TYPE "P" TAPPING MACHINE

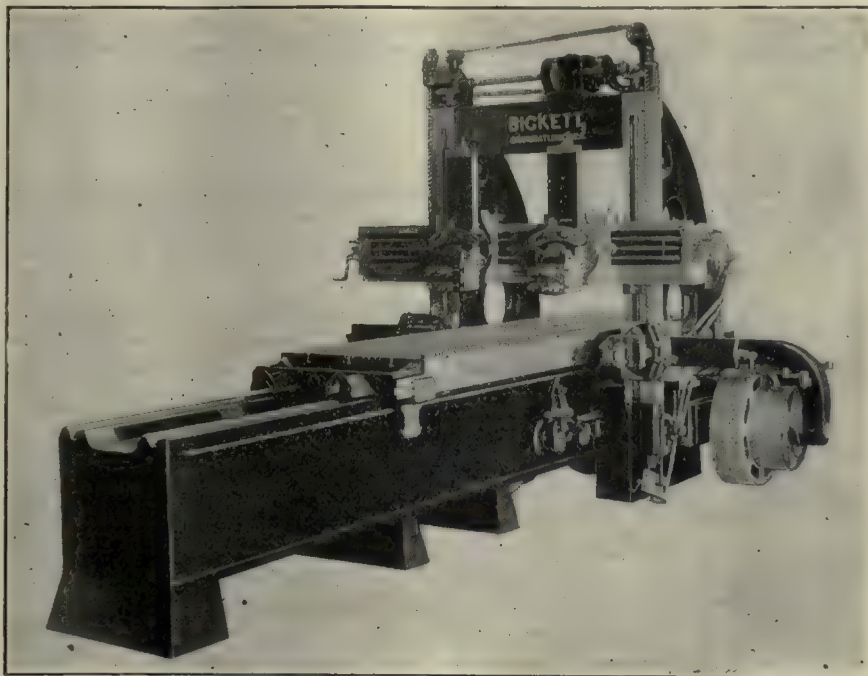
Diameter of table, 6 in.; distance from center of shaft to slide rod, $3\frac{1}{2}$ in.; vertical adjustment of table, 6 in.; diameter of driving pulley, 5 in.; width of driving pulley, $1\frac{1}{4}$ in.; bench space 7 x 8 in.; weight 40 lb.

can be adjusted to tap work to a given depth and may be swung out of the way or removed entirely if desired. The hand-tapping attachment consists of a $\frac{1}{2}$-in. steel rod with a driving wheel and handle on one end, while the other end is threaded to accommodate the chuck. This spindle is slipped through the spindle of the tapping attachment and the chuck screwed on the lower end. The capacity for machine tapping is up to $\frac{3}{16}$ in. in steel and up to $\frac{1}{4}$ in. in brass and similar alloys. The capacity for hand-tapping work is up to $\frac{1}{2}$ in.

Bickett Planing Machines

The Bickett Machine and Manufacturing Co., Cincinnati, Ohio, is now marketing a changed and greatly enlarged line of planing machines, one of the chief features of which is claimed to be the extremely sturdy construction. The machines are now made in the following sizes: 36 x 36 in. heavy, 42 x 36 in. heavy widened, 44 x 36 in. heavy widened, 42 x 42 in. standard, 42 x 42 in. heavy, 48 x 42 in. heavy widened, 52 x 42 in. heavy widened and 44 x 44 in. standard. The dimensions given under the illustration are those applying to the 42 x 42-in. standard type. The cross-rail has been fitted with square and bevel gibs, the former insuring accurate alignment. The heads on the cross-rail are gibbed with a wedge on one side that is con-

trolled by a single screw so arranged that any slack may be readily taken up. The feed mechanism consists of a ratchet and pawl which is operated at the end of each stroke. At the end of the stroke the pawl falls into place in such a way that it gives a positive-feed stroke. At the end of the feed stroke the pawl is automatically disengaged during the return stroke of the bed.

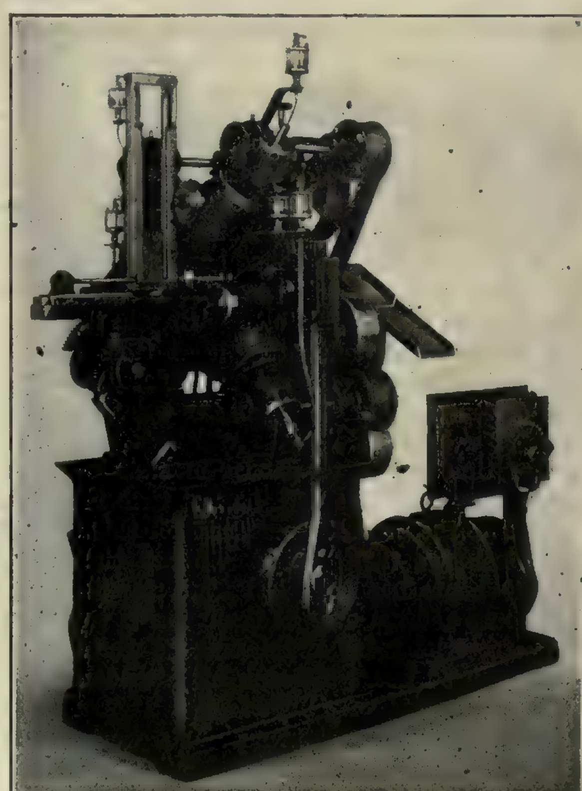


BICKETT PLANING MACHINE

These machines are made in a number of sizes, the specifications of the 42 x 42-in. size being as follows: Width of table, 38 in.; thickness of table, 6 in.; distance center to center of Vs, 17½ in.; depth of bed, 22 in.; face of housing, 7½ in.; depth of cross-rail, 13 in.; length of down feed on rail head, 12 in.; face of bull wheel and rack, 5 in.; width of driving pulley, 3⅝ in.; height 108 in.; width, 102½ in.; speed of table, 50 ft. per minute; weight with 8 ft. table, 22,000 lb.

Langelier Multiple-Spindle Drilling Machine for Ignition Tubes

The Langelier Manufacturing Co., Arlington, Cranston, R. I., has recently placed on the market the four-way, 22-spindle drilling machine shown in the illustration, which is for the purpose of drilling ignition tubes. It is somewhat similar to the one described on page 724. The machine drills 22 holes 0.141 in. in diameter through brass tubing with a wall thickness of 0.035 in., and it is claimed the output of tubes is 20 per minute, the machine being entirely automatic in operation. The tubes are pushed from the magazine at the front of the machine into the jig in which are located guide bushings. The tubes are held firmly while being operated upon, and after being completed are pushed to the rear of the machine, where they fall into a chute. The jig is provided with a chamber into which is led compressed air and oil, these keeping the inside of the jig free from chips and the oil lubricating the drills. The feeding mechanism is provided with a collapsing arrangement to avoid breakage in case a tube should be jammed for any cause. The magazine slide can be quickly removed or replaced when it is desired to remove the drills. Four multiple-drilling spindle heads are mounted radially 90 deg. apart on a faceplate that is trunnioned and fastened to the frame of the machine. Each drill head is mounted in a feed sleeve that is actuated by a double-pinion and ring gear located concentrically inside of the faceplate. The ring gear is connected by intermediate compound gears to a cam bar that is operated by the camshaft in the base of the machine. Each feed sleeve is provided with a cut-out that permits the individual drill heads to be adjusted to their proper positions. The main spindles are mounted on ball bearings and are driven by spiral gears completely inclosed and running in oil. Ball bearings are also used for the spiral gear shafts, which extend to the rear of the machine and are driven by endless belts passing over the pulleys with which they are equipped. Intermediate idle pulleys are used and the upper one is mounted with a screw adjustment. The feeding mechanism is controlled by two face cams, one on the outside of the base for feeding the drill heads and the other on the inside of the base for operating the feed plunger. The camshaft is driven by a worm and worm gear and is provided with a clutch. The spindles operate at a speed of 2800 r.p.m. and an oil-feed pump is belted to the motor shaft to supply the cutting oil. The machine occupies floor space 30 in. wide by 60 in. long, and is 68 in. high. It is driven by a 5-hp. electric motor of Westinghouse manufacture and weighs 3000 lb.



LANGELIER MULTIPLE-SPINDLE DRILLING MACHINE

Editorials

Keeping the Workman on the Job

AMONG many manufacturers the biggest problem with respect to the labor situation today is keeping continually on the job those workmen who cannot stand prosperity.

A few days ago an official of one of the big agricultural implement manufacturing concerns said that his men were holding back 40 per cent., or in other words were only delivering 60 per cent., of the amount of output which they had given in normal times. This is a rather broad assertion, and while it is questionable whether the actual deficiency in output is really as large as stated, still the general complaint of employers is that their men now do less when at work and stay away from the shops oftener than previously.

The official in the case above mentioned has devoted much of his time to welfare work among the employees, and the concern with which he is connected has probably done more than the average shop in the way of health insurance, accident prevention, improvement in working conditions, adequate lunch facilities and similar projects which should tend to hold the workman to his job. However, so far they have done nothing in respect to paying bonuses for attendance at work, a matter to which many advanced employment experts are at present giving their thoughts.

With the idea of encouraging steady attendance by their employees, most of whom are highly skilled machinists, and at the same time urging them to thrift and war-saving work, the Queen City Machine Tool Co. of Cincinnati has adopted a unique scheme of giving war-saving thrift stamps as a bonus to those employees who are constant in their shop attendance. This has two advantages—first it gives the men a worthwhile bonus, and secondly it is in such form that the men are further encouraged to save rather than to spend as might be the case had the bonus been given in money. Besides these advantages it promotes in the workman the idea that he is doing his bit to help win the war.

If a workman unfortunately loses time during a given month because of accident or sickness, rather than further discourage him the company provides for the payment of a graduated bonus which depends on the amount of time lost in a calendar month.

Continuous attendance with no lost time in a 30-day period carries the highest bonus, and for this the workman is given five thrift stamps. When time not exceeding 10 hours has been lost four stamps, and for over 10 hours and not over 30 the bonus is two stamps. In many factories today if the average workman loses no more than 30 hours a month his attendance record would be considered very high.

There is still a further bonus. If a workman loses no time in three consecutive months he receives 15 thrift stamps and the company adds one to make the necessary 16 that is required to give him a $5 war-saving stamp. Up to now about 10 per cent. of the employees are receiving the $5 war stamps—a very remarkable record.

Another interesting feature of this shop is that in order to take care of the pressure of war work on machine-tool builders it runs every evening until 6:30. The men thus put in 7½ hours' extra time every week, for which they are given 10 hours. This scheme avoids long overtime hours two or three nights a week, which is the custom in many shops, does not unduly tire the men and lets them out in time for them to have their customary evening amusement.

Consideration is also given to the man who remains 30 days in the shop. By that time it is believed that he is of more worth than he was at the time when he was hired, so his rate of pay is automatically advanced 2½ cents an hour. Other workmen can increase their rates by decreasing for a certain period the time consumed on any regular job. Although the shop does not run any piecework very close watch is kept of the time required for the regular operations, and when a workman can show that for several consecutive periods he has reduced the time previously required to perform an operation he is entitled to a raise. This puts all the men on their mettle to push the work through, and they become anxious to make all possible improvements.

Attempted Unpatriotic Profiteering

NOT long ago it was decided to refit one of the large passenger-carrying ships for use as a transport. Bids were called for asking firms to name a contract price and time limit for the work. The bids came from four firms, the first two being connected, though not openly. The highest bid was $210,500, with 40 days' time limit; the next from the "underground connected" firm was for $195,000, 40 days' time; the third bid was for $128,500 and 20 days; the fourth was for $65,875 and the time *11 days*.

Examination of the fourth bidder's experience, standing and reputation for good work proved satisfactory and he was given the contract. The work was well done and on time, and we could quote the actual profit, but will only say that it was ample.

An examination of the foregoing figures (and we have the names of each bidder in our files) would show that the next lowest bidder, if he had been given the contract, would have reaped a *profit* at least equal to what the whole job actually did *cost* the Government. The highest bidder would have cleared approximately $150,000 on a job which was done by a firm not so well equipped for $65,875! Profiteers of the type of the first three bidders are as surely on the side of the Hun as any Prussian. Every dollar they steal from the Government by contracts at exorbitant prices takes that much out of the pockets of the people and away from our boys over there.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., May 25, 1918—There is considerable talk from time to time in regard to the unfair way in which both officers and privates are sometimes subjected to special expenses. A glance in some of the tailors' windows in Washington and other cities will show very clearly that officers' uniforms and equipment are certainly sold at a very high price. Inquiry at the War Department, however, reveals the fact that it is not necessary for officers to pay exorbitant prices for all their equipment, as much of it can be secured from the depot quartermaster at the prices named in the following list:

CLOTHING AND EQUIPAGE AUTHORIZED FOR SALE TO OFFICERS, VIZ., EQUIPMENT C

Equipment C	Articles	Price
1	Belt, waist, each	$0.17
2	Breeches, wool, pair	2.72
2	Breeches, cotton, pair	1.19
	Chevrons, cotton, O. D., pair	.45
	Chevrons, O. D., pair	.47
2	Coats, cotton, O. D., each	1.65
2	Coats, woolen, O. D	4.97
	Coats, denim, each	1.17
	Cords, hat, each	.65
4	Drawers, summer, pair	.30
1	Riding gloves, pair	1.75
1	Hats, denim, each	.23
1	Hats, service, each	1.28
21	Laces, breeches, pair	.02
2	Laces, leggin, pair	.02
2	Laces, shoe, pair	.02
2	Shirts, flannel, O. D., each	3.03
6	Stockings, cotton, pair	.10
6	Stockings, wool, light weight, pair	.25
2	Tags, identification and tape	.01
4	Undershirts, summer, pair	.35
1	Overcoat,	12.50
2	Shoes, russet, pair	4.50
1	Slickers, each	3.85
	Leggings, canvas, foot, pair	.88
	Trousers, denim, pair	1.17
	Equipage	
1	Bags, barrack	$0.48
1	Bar, mosquito, single	3.75
1	Basin, canvas	.36
2	Blankets, O. D., light weight	4.50
1	Bucket, canvas	.76
1	Cot, canvas	2.72
1	Locker, trunk	6.30
1	Rolls, bedding	7.15
1	Rolls, clothing	3.18
1	Sacks, bed	1.05
1	Whistle, Kingley	.23
1	Whistle, siren	.39

It is of course quite possible that the articles bought at the depot quartermaster's might not have exactly the same tone or style as those purchased from a smart tailor, and if the officer feels that the extra style is worth the added price he can have no great kick coming at the cost of some of these articles even though they are sold at what is undoubtedly an exorbitant price.

There are so many opportunities to go wrong in handling such a stupendous problem as the organization of the new army in a nonmilitary country that it is refreshing to find instances of this kind where there is apparently no reasonable cause for complaint.

The question of priority is becoming increasingly difficult, and from present appearances is likely to become more so as time goes on.

Manufacturers of small machinery which can by no stretch of the imagination be called nonessentials are finding it increasingly difficult to obtain pig iron. Some of the furnaces are requesting that they report as to where every pound of their castings go to, so as to assist the furnaces in securing orders for coke with which to operate their plants.

It is of course easy to understand the reasons which prompt these inquiries, but it sometimes seems as though the present Government method of distributing iron and coke does not sufficiently bear in mind the fact that many small concerns are manufacturing goods for stock and that nearly all of this will eventually go into Government service either directly or indirectly.

On the other hand it is utterly impossible for the manufacturer of such things as chucks, pumps, grinding machines and similar small machines to know in advance exactly where his machines are going. If no one manufactures these for stock there will soon be no open market from which the Government can obtain immediate deliveries and on which it depends to a considerable extent. It can be readily seen that it is impossible for the manufacturers in question to give the ultimate destination of their products, and yet this seems to be one of the requirements at the present time if sufficient pig iron is to be obtained for continuing the business.

The theory seems to be that everyone who is selling goods to the United States Government has a large contract which will require several months to complete and that the exact tonnage for this contract can be figured out in advance. This entirely eliminates the small orders for products taken from the shelf and which, until very recently at least, have formed a goodly share of the Government orders.

It certainly seems necessary for someone to devise a means whereby small manufacturers of this kind can secure the pig iron necessary to carry on their work without furnishing an exact list of every contract into which the castings made will enter. In fact, as can readily be seen, it is utterly impossible to do this in the cases named and on the other hand maintain a supply of needed products for Government use. If the small manufacturers themselves can get together and offer some practical suggestions as to how this can be accomplished it will be very helpful, and will, I am sure, be appreciated by those in charge of this work. We must not forget that there is much to be done and that helpful ideas are always in order.

Personals

C. G. Tarkington is now in charge of the Mechanical Appliance Co.'s Washington office, 1407 L St. NW., Washington, D. C.

R. W. Ellingham has resigned from the Bilton Machine Tool Co., Bridgeport, Conn., to enter the employ of the Heald Machine Co. as works manager.

Palmer D. Weeks, formerly with the Dale-Brewster Machinery Co., has organized the D. Weeks Machine Tool Co. with offices at 1270 Broadway, New York.

I. G. Stutsman has been appointed manager of the Milwaukee office of Manning, Maxwell & Moore. Mr. Stutsman was for several years superintendent of the frog and switch shop of the Chicago, Milwaukee & St. Paul Railroad at Tomah, Wis., and more recently master mechanic for the Four Lakes Ordnance Co., Madison, Wis.

Charles A. Coffin, chairman of the board of directors of the General Electric Co. of Schenectady, N. Y., and head of the Franco-American Clearing House in New York, is the only officer of the Legion of Honor in America. This honor was recently bestowed upon Mr. Coffin by the ex-assistant French War Secretary, Justin Godart, in recognition of his work at the Franco-American Clearing House and for his efforts to develop a system of scholarships for Americans in French universities.

Archer A. Landon, Buffalo, N. Y., vice president of the American Radiator Co., has accepted an appointment to have charge of a division of aircraft production. Mr. Landon has had wide experience in directing production on a large scale. For many years he has been intrusted with that responsibility at home and abroad for the American Radiator Co., which operates a large number of plants in this country, and before the war was one of the largest American manufacturers in Europe.

Business Items

The John Wilfert Co. of New York, Brooklyn, St. Louis and Buenos Ayres will market and distribute the products of the Hawes Foundry and Equipment Co.

The Machinery Co. of America, Grand Rapids, Mich., manufacturer of grinding machines for slitting saws, will be located at Big Rapids, Mich., after June 1, 1918.

The Tyler Manufacturing Co., 64 Pearl St., Boston, Mass., is the new name of the Bantam Manufacturing Co. There is no change in the personnel or management.

The Eastern Flexible Conduit Co., 594 Johnson Ave., Brooklyn, N. Y., has changed its name to Eastern Tube and Tool Co., Inc. This company has added to its present line the manufacture of drill chucks and small tools.

A. Gulowsen of Christiania, Norway, manufacturer of the "Grei" heavy-oil engine, has incorporated the Gulowsen Grei Engine Co. at Seattle, Wash., and is erecting a large modern factory for supplying the American trade.

The J. R. Stone Tool and Supply Co. of Detroit, Mich., is now located at Warren and Woodward Aves., where it has leased for a long term of years 10,000 sq.ft. of floor space for its machinery and supplies display and salesrooms.

The Malm Engineering Co., Philadelphia, has leased the exclusive rights to manufacture rotary punching machinery under patents belonging to the Malm Machine Co., Dayton, Ohio. Its offices and works are located in Philadelphia.

The Hawes Foundry and Equipment Co., with a capitalization of \$250,000, recently announced the acquisition of the Central Bronze Co., which will coöperate with its other plants in turning out a complete line of bronze valves and fittings for steam-engineering and industrial work.

Driver-Harris Co., Harrison, N. J., has elected the following officers: Frank L. Driver, president; Arlington Bensel, first vice president; Leon O. Hart, second vice president; Frank L. Driver, Jr., third vice president; Percival E. Reeves, treasurer; Stanley M. Tracy, assistant treasurer; M. C. Harris, secretary. Wilbur B. Driver, formerly vice president, has retired from active participation in the business.

Trade Catalogs

Improved Rivett Thread Tool. The Rivett Lathe and Grinder Co., Brighton District of Boston, Mass. Booklet. Pp. 20; $8\frac{1}{2}$ x $11\frac{1}{2}$ in. Containing a detailed description and also several illustrations.

The Trackless Train. Mercury Manufacturing Co., Chicago, Ill. An eight-page paper 8 x 11 in.; published monthly in the interest of better industrial-haulage systems. Upon request it will be forwarded regularly to interested parties.

The H. E. Barton Tool Co., 106 South Jefferson St., Chicago, Ill., announces the publication of a 500-page catalog, $4\frac{1}{2}$ x 7 in. covering twist drills, taps, reamers, milling cutters, dies, hacksaw blades, chucks and other small tools.

High Grade Lathes and Shapers. The Springfield Machine Tool Co., Springfield, Ohio. Catalog No. 1. Pp. 64; 9 x 6 in. A general description of lathes and shapers, their parts and accessories as manufactured by this company is here given.

The $3\frac{1}{2}$-in. Lo-swing Lathe. Fitchburg Machine Works, Fitchburg, Mass. Booklet. Pp. 24; 6 x 9 in. This booklet illustrates and describes the Lo-swing lathe, and shows with a number of line drawings some typical tool set-ups covering a wide field of work.

The $3\frac{1}{2}$-in. Lo-swing Lathe. Fitchburg Machine Works, Fitchburg, Mass. Booklet. Pp. 26; 6 x 9 in. Giving a description and a number of illustrations of the 8-in. Lo-swing lathe. A number of line cuts are included, showing a few of the typical set-ups used on this machine.

The National Factory Systems. National Scale Co., Chicopee Falls, Mass. Catalog. Pp. 60; 9 x 12 in.; illustrating and describing the National counting and weighing machines, the National Chapman elevating trucks, National calling system and "Multi-Unit" sectional-steel shelving.

The Fortin 5-Spindle Drillhead. Spafford Tool Works, Hartford, Conn. Circular. Pp. 4; $6\frac{1}{2}$ x $9\frac{1}{2}$ in. An illustration of the Fortin 5-spindle turret drill head attachment, together with a description of the machine. The attachment is shown both separate and attached to the drilling-machine spindle.

H. P. M. Hydraulic Valves and Fittings. The Hydraulic Press Manufacturing Co., Mount Gilead, Ohio. Catalog 43. Pp. 60, 10 x $8\frac{1}{2}$ in. This new catalog of hydraulic valves and fittings has just been issued and presents the complete H. P. M. products. The four general classes of hydraulic valves, operating, check, knock-out and safety, are clearly illustrated and described. Standard types of hydraulic fittings are listed; also accumulator controls, pressure gages, hydraulic pipes, etc. Interested parties may obtain copies from the above address.

New Publications

Taylor System in Franklin Management— By Major George D. Babcock, in collaboration with Reginald Trautschold, with a foreword by Carl G. Barth. Two hundred and seventy pages; $5\frac{1}{2}$ x $7\frac{3}{4}$ in.; numerous illustrations and charts; cloth. Published by the Engineering Magazine Co., 6 East 39th St., New York City. Price \$3.

In 1908 the men in charge of the H. H. Franklin Manufacturing Co. decided on the adoption of the Taylor System of Scientific Management as a method of improving conditions in this plant, which was at that time considered to be up to date. The results obtained are truly remarkable, and at the present time the Franklin plant is considered by the leading exponents of the Taylor system to be one of the best examples of this form of management in existence. After taking up the company's reasons for deciding upon the system the author takes up Dr. Taylor's four underlying principles of management—development of a true science of management, scientific selection of workmen, scientific education and development of workmen, and intimate friendly coöperation between the management and the men—individually and collectively and shows their practical application to the problems at the Franklin plant. The control system, which is really an addition to the work of Dr. Taylor is described in detail. The author then devotes two chapters to the changes that have been brought about. These changes are many and varied and involve not only the work, methods labor problems and costs but many other equally important problems as well. Chapter X, which shows graphically the results attained, is of particular interest. Two appendixes have been added—the first taking up various problems relating to the determination of wages rates at the Franklin shops and the second taking up methods for applying scientific management to repair shops, factories manufacturing small parts and plants with uniform manufacture. This latter appendix is of particular interest.

The chapter headings are as follows: I, Factory Conditions in Nineteen Hundred and Eight; II, Investigation of the Taylor System; III, Classification and Standardization; IV, Establishing Control; V, The Schedule, Control Boards and Pnuematic Despatch Tubes; VI, Employment and Rate Fixing; VII, Organization Classification; VIII, Changes in Product and Method; IX, Changes Which Have Affected the Men; X, The Results Graphically Depicted. Appendix I, Wage Rates in the Franklin Shops; Appendix II Examples in Application of Scientific Management.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers. Spring meeting at Worcester, Mass., June 4, 5, 6 and 7, with headquarters at the Hotel Bancroft.

The American Society for Testing Materials will hold its twenty-first annual meeting at Atlantic City, N. J., June 25-28, with headquarters at the Hotel Traymore. The permanent headquarters of the secretary-treasurer are under the name of the society, Philadelphia, Penn.

Boston Branch National Metal Trades' Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The next convention and exhibit of the Georgia Retail Hardware Association will be held at Savannah, Ga., June 4, 5 and 6, 1918, with the Savannah Hotel as headquarters. Exhibits and convention sessions will be held in the new municipal auditorium on Barnard St. Walter Harlan, 44 Boulevard Circle, Atlanta, Ga., is secretary of the association.

The National Gas Engine Association will hold its eleventh annual meeting at the Hotel Sherman, Chicago, Ill., June 3 and 4. The headquarters of the association are at Lakemont, N. Y.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers, 29 West 39th St., New York. Summer meeting to be held at Dayton, Ohio, June 17-18. Complete war program, at least half of it being devoted to the actual demonstration of war apparatus. All meetings will be held at Triangle Park, a dinner being served Monday evening and luncheons each noon. Reservations may be secured at hotels Miami, Holden, Algonquin, Phillips and Bechel, or by writing the Dayton S. A. E. Committee, 137 North Ludlow St., Dayton, Ohio.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

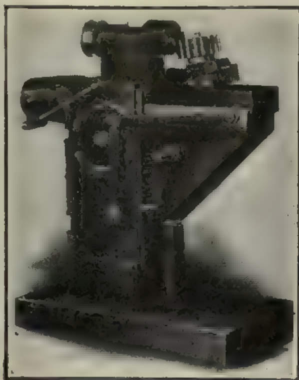
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Gear-Tooth Rounding Machine

Charles H. Walker Machinery Co., 42-44 East Larned St., Detroit, Mich.

"American Machinist," May 9, 1918

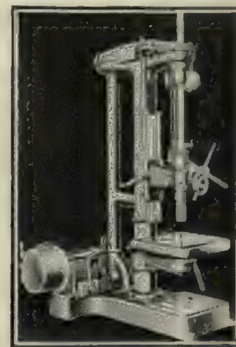


An improved form of the model previously described on page 439, vol. 46. A double-eccentric spindle bearing gives any degree of offset necessary for work with any pitch from 20 to $2\frac{1}{2}$. The spindle is mounted on ball bearings and the drive is through a Carlyle-Johnson friction clutch. The work-holding spindle may be tilted to 15 deg. Oiling is by the splash system and the capacities claimed are from four to twenty-six teeth per minute, depending upon the pitch.

Drilling Machine

Aurora Tool Works, Aurora, Ind.

"American Machinist," May 9, 1918



This machine is of the friction-back-geared type with speed-box drive, all moving parts except the spindle and feed rod being inclosed. Capacity, 28 in. All bearings and gears run submerged in oil and gage glasses are provided. All gears are of the spiral, stub-tooth form and 16 speeds are available. A lubricant reservoir is cast integral with the base. A friction-tapping attachment can be furnished if desired.

Toolholder, "Bull Dog"

The Green Bay Drive Calk Co., Green Bay, Wis.

"American Machinist," May 9, 1918

Made in five different sizes, either straight or with right-hand or left-hand offset, in sizes from $\frac{1}{2}$ x $1\frac{1}{8}$ x 6 in. accommodating a $\frac{5}{16}$-in. square cutter, up to 1 x 2 x 11 in. accommodating a $\frac{5}{8}$-in. square cutter. The feature of this device is the center piece, which is pivoted and has at one end a sharp point or tongue and on the other end a setscrew. When the tool bit is long it is held by both the tongue and setscrew and when short is held by the tongue only.

Filing Machine

Advance Engineering Co., 848 Massachusetts Ave., Indianapolis, Ind.

"American Machinist," May 16, 1918

Of compact construction with moving parts balanced and inclosed. All bearings and wearing surfaces are of bronze and are replaceable. The table may be tilted to an angle of 10 deg. on either side of the central or vertical position and may be turned around on the base so that the pulleys can be located on either side or at the rear. The spindle is provided with a special clamping device, by means of which a $\frac{1}{8}$ x $\frac{3}{8}$-in. flat file may be used on the machine, the files ordinarily used being of the $\frac{1}{8}$-in. round or $\frac{1}{4}$-in. square shank variety. Height, $11\frac{1}{2}$ in.; stroke, 1 in.; weight, 40 lb.; speed, 500 strokes per minute.

Sawing Machine, Cold-Metal

Swind Machinery Co., Widener Building, Philadelphia, Penn.

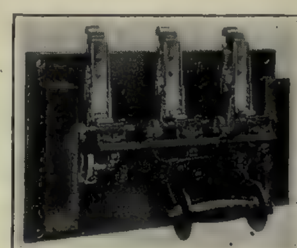
"American Machinist," May 16, 1918

This machine is automatic in action and is driven direct from the line shaft by means of a single pulley. The oscillatory, cylindrical carrier is mounted in the frame of the machine and is provided with an eccentrically mounted saw spindle, the carrier being rotated by means of a rack-and-pinion mechanism. A clutch is incorporated in the pulley. Floor space, 30 x 18 in.; capacity, up to $3\frac{1}{4}$ in. rounds; size of saw, 14 x $\frac{3}{16}$ in.; net weight, 1100 lb.; size of cylindrical carrier, $18\frac{1}{2}$ in. in diameter by 10 in. wide.

Circuit-Breakers, Self-Timing

The Roller Smith Co., 233 Broadway, New York City

"American Machinist," May 16, 1918

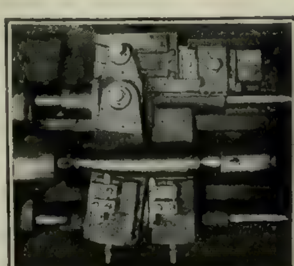


The illustration shows one of a line of self-timing circuit-breakers now being manufactured by this company. The particular one illustrated is of the 60-amp., 250-volt, three-pole type with rigid arm, plain overload circuit-breaker, two self-timing attachments and wall mounting. Two independent controls are used—one thermal, being operated by the expansion of a metal rod heated by the passage of the same current which drives the motor, the other being electromagnetic instantaneously operating in the case of a heavy overload. Both controls are adjustable. The circuit-breakers are made in a large variety of forms.

Shell-Turning Attachment for Lathes

Amalgamated Machinery Corporation, Chicago, Ill.

"American Machinist," May 16, 1918



This is a development of the shell-turning device shown on page 483, Vol. 46. The device has two cutting tools so arranged that one follows the curve at the nose end while the other turns the straight part of the shell body. It is claimed that the construction is such that the disadvantage of the ordinary method, wherein the angle presented to the work by the cutting edge of the tool is constantly changing, is overcome.

Shaping Machine, Wood

Oliver Machinery Co., Grand Rapids, Mich.

"American Machinist," May 23, 1918

Speed, 7000 r.p.m.; vertical adjustment, 6 in.; length of collars, $8\frac{1}{2}$ in.; diameter of spindle at collars, $1\frac{1}{2}$ in., at top bearing; $2\frac{1}{4}$ in., at bottom bearings $1\frac{1}{2}$ in.; length of top bearing, $7\frac{1}{2}$ in.; length of bottom bearing, $4\frac{1}{2}$ in.; width of driving belt, 4 in.; number of rings, 3; hole in smallest ring, 2 in.; size of table, 60 x 36 in.; distance from front and side edges to spindle, 18 in.; distance from center to center of spindles, 24 in.; height from floor to table, 36 in.; diameter of holes in table, 8 in.; floor space, 60 x 44 in.; horsepower recommended, $7\frac{1}{2}$.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No 2 Southern Foundry, Birmingham	$33.00	$33.00	$40.00
No. 2X, New York	34.25	......	44.00
No. 2 Northern Foundry, Chicago	33.00	37.00	45.00
*Bessemer, Pittsburgh	36.15	37.25	45.00
*Basic, Pittsburgh	32.00	33.95	42.00
No. 2X, Philadelphia	34.25	33.75	44.00
*No. 2, Valley	33.00	33.95	43.00
No. 2 Southern Cincinnati	35.90	35.90	42.90
Basic, Eastern Pennsylvania	32.75	33.75	42.00

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4.195	$4.195	$5.00	$4.20	$5.00	$4.20	$4.50
Soft steel bars	4.095	4.095	4.75	4.20	4.50	4.10	5.00
Soft steel bar shapes	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Plates, ¼ to 1 in. thick	4.445	4.445	7.00	4.20	7.00	4.45	6.50

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.00
Warehouse, New York	4.70	4.60
Warehouse, Cleveland	4.10	4.50
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
*No. 28 black	5.00	6.445	6.445	9.25	6.385	8.25	6.45	7.50
*No. 26 black	4.90	6.345	6.345	9.15	6.285	8.15	6.35	7.40
*Nos. 22 and 24 black	4.85	6.295	6.295	9.10	6.235	8.10	6.30	7.35
Nos. 18 and 20 black	4.80	6.245	6.245	9.05	6.185	8.05	6.25	7.30
No. 16 blue annealed	4.45	5.645	5.645	8.70	5.585	7.95	5.65	7.70
No. 14 blue annealed	4.35	5.545	5.545	8.60	5.485	7.85	5.55	7.60
No 10 blue annealed	4.25	5.445	5.445	8.50	5.385	7.75	5.45	7.50
*No. 28 galvanized	6.25	7.695	7.695	11.00	7.635	10.00	7.70	9.50
*No. 26 galvanized	5.95	7.395	7.395	10.70	7.335	9.70	7.40	9.20
No. 24 galvanized	5.80	7.245	7.245	10.55	7.185	9.55	7.40	9.05

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 10%	List plus 25%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Current	One Year Ago
New York	$15.00	$13.00
Cleveland	15.00	12.00
Chicago	17.00	11.50

In coils an advance of 50c. usually is charged.

Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

3/8, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel	7.50	8.00	7.50
Spring steel (crucible analysis)	11.00	11.25	11.00
Coppered bessemer rods	9.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel	9.00	8.25	8.50
Floor plates	6.19½	6.00	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			

LAP WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York Black	New York Galvanized	Cleveland Black	Cleveland Galvanized	Chicago Black	Chicago Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	41.9%	26.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	37.9%	23.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	29.50
Tin, in 5-ton lots	103.00	85.00	65.00
Lead	7.05	7.25	11.50
Spelter	7.50	7.50	9.50

*Government price.

ST. LOUIS

	Current	One Month Ago	One Year Ago
Lead	6.85	7.10	10.50
Spelter	7.25	7.25	10.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Copper sheets, base	32.50-33.00	32.00	42.00	34.00	42.00	32.50	43.00
Copper wire (carload lots)	31.00	32.00	39.50	34.00	41.00	32.00	40.00
Brass sheets	31.75	30.75	45.00	30.00	43.00	30.00	43.50
Brass pipe base	36.50	36.50	47.50	41.00	50.00	40.00	47.50
Solder ½ and ½ (case lots)	69.75	62.00	40.38	60.00	39.50	70.00	39.00

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	28.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks Current	In Casks One Year Ago	Broken Lots Current	Broken Lots One Year Ago
Cleveland	21.50	22.00	23.00	23.00
New York	17.00	23.00	17.50	23.25
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	12.50	29.00
Chicago	13.50	28.00
Cleveland	15.00	29.50

Hydraulically Operated Shell Production Machinery

BY I. WILLIAM CHUBB

THE employment of some women in making 9.2-in. shells is not uncommon, and a case or two might be discovered in Great Britain where women are doing a few operations even on 15-in. shells. But the plant under review, employing 92 per cent. of women, is, as far as I know, unique. It is hydraulically controlled, and apart from one pair of gear-wheels on each machine used for speed reduction, no gear-wheel or lead screw is used on any lathe or other tool. In most cases the main spindles of the machines are driven mechanically from shafting, four only having direct-motor drive; but the movement of the saddles and cross-slides carrying the tools is performed by hydraulic cylinders with suitable pistons and is under perfect control by means of valves which vary the water admission.

In the west of England a factory for the production of the British 9.2-in. shell is being run in a manner that as regards both personnel and machinery may be considered as extraordinary. Despite the weight of the forgings the whole of the plant is manipulated by women, no operation, whether in production or handling of the shell, being performed by men. Of the total number of employees the proportion of women is 92 per cent., leaving about 8 per cent. of men. The men are employed for tool setting, repairs, removing shells from railway trucks to factory, supervision and other similar work.

The heaviest parts (one slide weighing more than 4 tons) are moved to position at a speed which is not approached by ordinary mechanical methods, and they are adjusted with all the nicety called for by the work. As to accuracy the shells have to pass the ordinary inspection of the munition officials before being accepted, and on this point it is possible to say that the proportion of rejections is less than one-third of 1 per cent., the faults leading to these rejections arising mainly during the training of inexperienced girls.

No special type of labor is employed, as, apart from the daughters of one or two peers working during the ordinary shift and striving like the others for the highest bonus, there are farmers' daughters, daughters of well-to-do business men, dressmakers and domestic servants; in short, the ordinary population of the district provides the workers, all laboring together with energy and enthusiasm to hasten the successful end of the war. Three eight-hour shifts are worked, a half-hour being allowed in each for a meal. The operation is thus practically continuous. Work stops at 5 o'clock on Saturdays and none is done in the shop on Sundays. The rapid production of munitions is the first essential, and some figures on this point are given later in connection with the machines used. Almost as important is the financial aspect, and here a record can fairly be claimed. All these special hydraulically fed machines have been produced in the Melksham works, associated with conveying and similar machinery belonging to Spencer & Co., Ltd., and the machines were designed and patented by W. Littlejohn Philip, who is joint managing director of the firm. Having tried the hydraulic scheme on tools for manufacturing smaller shells Mr. Philip, on behalf of a company, took a seven-months' contract for 9.2-in. shell production in a new works at the ruling price per shell. But he also undertook so to reduce the cost of manufacture that the entire cost of the special plant, amounting to about £24,000, should be met out of the price in seven months, and as a guarantee agreed to hand the plant over to the government department concerned on the completion of the contract. This was done, and on a continuation contract the shell firm is now actually paying rent for the use of the tools. Indeed it is asserted that the cost of production by this plant has been reduced by about 40 per cent. and the amount of labor employed by about 30 per cent. The last is of considerable national importance because of the urgent man-power question.

The lathes, etc., have to be arranged and set up for the job, the tool in each instance simply being pushed up hydraulically to suitable stops at any required speed and wthdrawn in the same way. The water pressure is 700 lb. per square inch, the return being effected by a closed hydraulic circuit at about 170 lb. Up to a certain point the plant must be regarded as special and for the war, but the figures given will show that

even from this point of view the hydraulic machinery has justified its existence, for, assuming the general cost of the shells to be fairly constant, a seven-months' continuation of the war, or at any rate of shell production, would more than pay for any new plant. Necessarily, for the present, after-war conditions will have to be left out of account, but undoubtedly there will be a very large field for this class of tools on repetition work. Scrapping a few special machines that cannot readily be adapted to peace demands will not matter greatly one way or the other, provided they justify their war use.

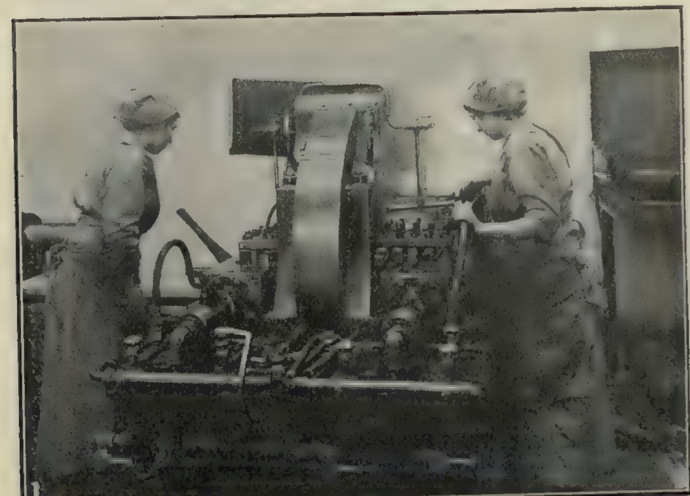


FIG. 1. CUTTING OFF END AND ROUGHING NOSE

FIG. 2. HYDRAULIC PRESS CUTTING DRIVING KEYWAYS

The chief processes in the production of the shells are noted in the following: No attempt is made to deal with the minutiæ of the machines, but the illustrations will afford almost all the information really necessary. In designing the separate shell factory the firm took advantage of its conveyor experience to insure that the manual handling of heavy weights should be avoided, so that women might be employed. The shell forgings, therefore, generally are deposited in a trough along which they naturally roll, the inclination being 1 in 144. From this trough hydraulic cranes lift the shells to the machine adjoining, and when the process is completed it returns them to the trough along which they roll until they reach the position for the next operation. In fact, as in other shell factories, during the process of manufacture each shell goes through at the level at which it is worked. It does not reach the floor unless it is specially placed there as a reserve or has been rejected by inspectors. Consequently no lifting by hand is necessary, and the machine being essentially valve controlled the physical effort called for is within the capacity of a woman.

For the production of the shell body itself five different machines (four hydraulic) are employed, each unless otherwise stated being under the control of two women, one to operate and the other to assist. The main work of the latter is to make sure that the cuttings are cleared away promptly. In the first machine, Fig. 1, the shell forging is placed by a hydraulic crane in a cradle and an expanding mandrel enters the bore, this mandrel being hydraulically operated. By this means the forging is pushed into a ring chuck, where it is clamped true with the bore, not the periphery. In this machine four slide rests are employed, a pair being back and front at each side of the central chuck. On one side the open end of the shell is parted off and chamfered, while at the other the profile of the nose is roughed out true (as far as the setting goes)

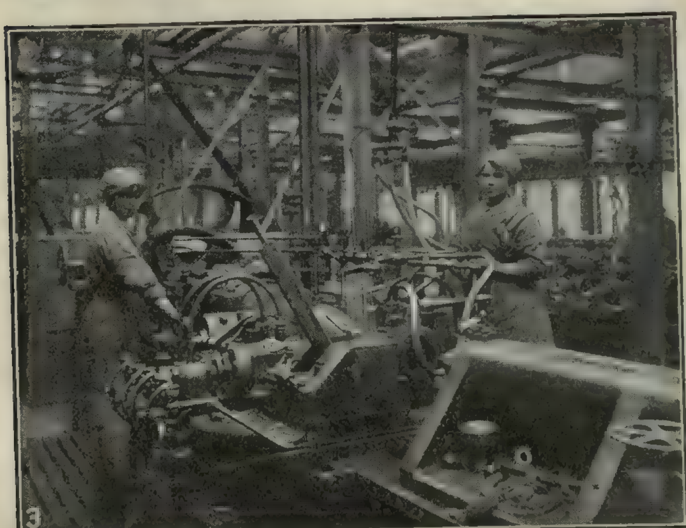


FIG. 3. BORING NOSE AND TURNING EXTERIOR

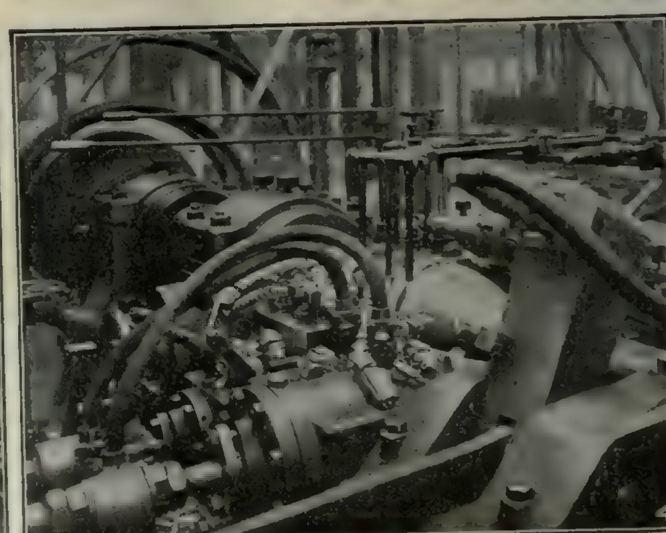


FIG. 4. THE ROUGHING CUT

to the hole. For this rough forming nine plain tools are employed, one slide carrying five and the other four, one tool breaking into the space left by the others. The nose-forming end is at the right-hand side of the illustration. With this machine two girls remove on an average about 60 lb. of metal from each shell.

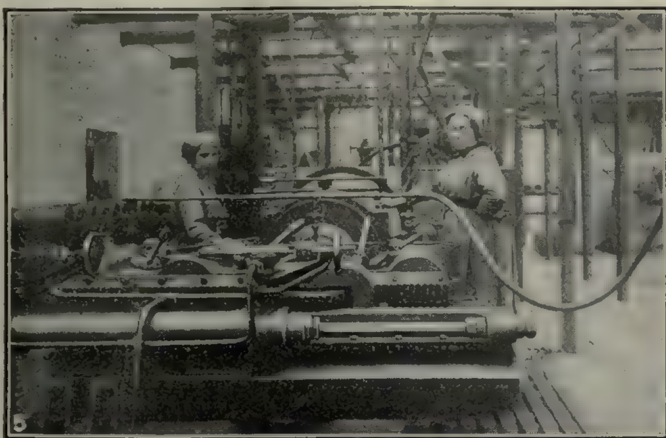


FIG. 5. ROUGH AND FINISH TURNING INTERIOR

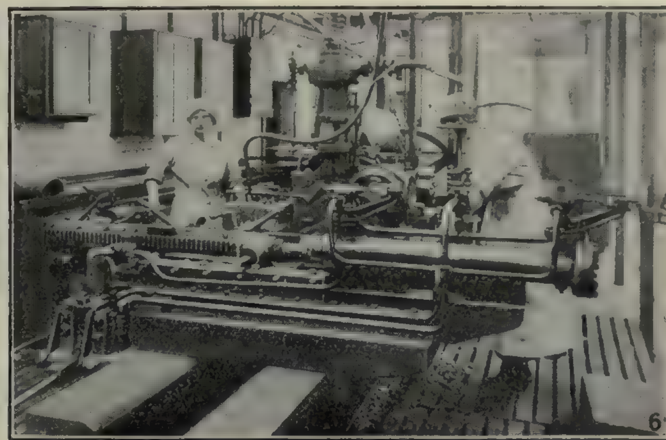


FIG. 6. FINISHING BASE, THREADING AND GROOVING

The best actual tooling time is about 8 min., and the best average time for a complete cycle of operations in a week of 45 hours is 16.14 min. (As these figures are here given for each machine it may be stated that in all cases the best operator's average time for the week includes lifting from conveyor, chucking, tooling, unchucking and returning to delivery conveyor.) Each machine of this type is driven by a 25-hp. motor, which affords perhaps some explanation of the rate at which the metal is removed. With this machine, and regarded as forming part of it, is a hydraulic press, Fig. 2, which grips the nose of the shell and the base, and

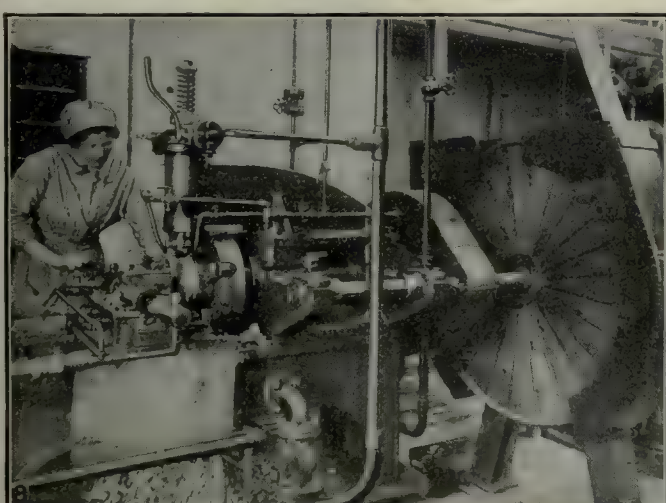


FIG. 8. FACING ADAPTER, FORMING AND RECESSING

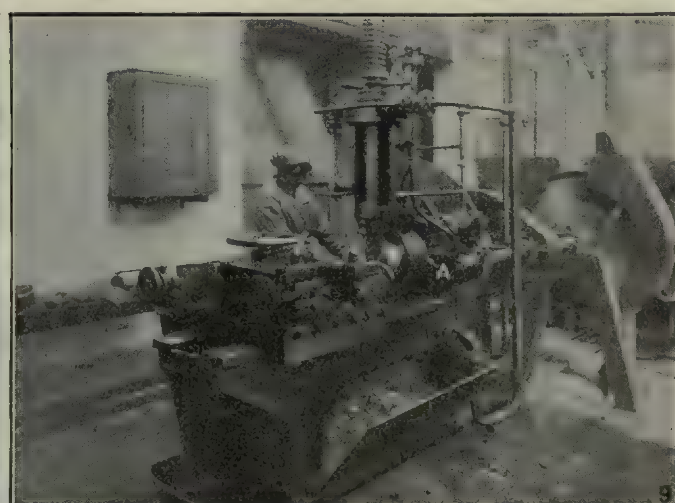


FIG. 9. FINISHING INNER FACE OF FLANGE

cuts three short driving keyways in the bore. The work is done by the same two girls.

An expanding mandrel, with sliding dogs to suit the driving keyways, next grips the shell body in the second machine, of which a general view is given in Fig. 3, the shell being pressed on by the hydraulically operated poppet spindle. First the nose is drilled and bored for the fuse and faced off, and when this operation is completed the hand lever shown is used to lift the tools out of the way, the shell end being plugged with a hardened bush to receive the poppet spindle center for the following operation. The body is then rough turned, two cross-slides carrying two tools at the back and three at the front being so employed that the actual sliding motion is but a fraction of the length of the shell. This roughing cut is shown in Fig. 4. A single tool with micrometer adjustment then finishes the parallel portion to size and another set of tools on another cross-slide turns the nose. Finally a single form cutter, about 13 in. wide, on the front of the nose, finishes it to radius. Here again, controlled by two girls, the machine removes an average of 77 lb. of metal from each shell and the capacity is about 200 shells a week. The best operator's time in actual tooling is 20 min., and the best average in a week of 45 hours is 27.07 minutes.

The third machine, Fig. 5, is especially substantial in design and is used for tooling the inside of the shell, both roughing and finishing. On a cross-slide are four boring bars, the slide itself being operated for cross position by its own hydraulic cylinder, and the exact position of the bars being determined by taper locating pins operated by levers. The nose end of the shell interior is finished by a single-sided spade cutter and the shell during the operation is held in a spring-collet chuck operated from the rear. The two girls

remove on an average 34 lb. of metal from each shell, and here again the capacity is about 200 shells a week, the best operating times being 24 min. for actual tooling or 29.8 min. as the best average for a 45-hour week.

On the fourth machine, Fig. 6, the operations at the base end are completed, the end being first faced

FIG. 7. FINISHING NOSE BORE, FORMING RECESS, CHAMFERING AND TAPPING FOR FUSE

off to correct weight and the diameter reduced behind the driving-band groove. After the rough grooving and recessing for the base adapter the undercut is formed in the groove, the wave is produced, and the thread milling is done for the adapter. For this a special electric-motor driven thread-milling cutter is mounted on the cross-slide, which carries all the tools except the undercutting equipment and is controlled by a push-button. During the process of milling the thread, the ordinary drive from the overhead shaft is locked in the off position, the whole machine being then controlled electrically and with slow spindle motion and reverse given by the motor. Here about 8 lb. of metal is removed per shell, and the capacity is about 250 shells a week, the best actual tooling time being 18½ min., while the average time in the 45-hour week is about 22.59 minutes.

The final machine for the bodies, Fig. 7, is simply a converted Herbert lathe with a special chuck; it is used for skimming out the bore in the nose for the thread, forming the recess, beveling the lip and tapping the thread for the fuse. Here one girl only is needed, and the best time for actual tooling is 9 min. and the best average for a 45-hour week 13.5 minutes.

As tending toward completion brief reference may be made to the production of the base adapters. Fig. 8 shows the first-operation lathe where the end of the forging is cut off, flange formed (bevel shaped) and the recess produced at the end of the screwed portion. The average weight removed is 9¾ lb. and the capacity of the machine is 500 a week. The actual tooling time is 7 min., and the best operating time average over the 45-hour week is 9.5 min. After two podger holes have been drilled and tapped in an ordinary machine the second lathe, Fig. 9, turns the body of the base plug, rough and finish faces and forms the reduced portion and chases the thread to fit that in the body of the shell. The weight removed averages 5¾ lb., the machine capacity is 250 a week, the operating time is 16 min., and the best operator's average time during the standard week is 22.13 min. A third lathe skims the inner face of the flange, etc. The machine capacity is about 1000 a week, and the actual machining time is 3 min., with an operator's weekly average of 6 minutes.

Objection may be raised to the hydraulically controlled feeds that screws cannot be cut, no lead screw being fitted. This is overcome in the case of the base adapters by the use directly on the main spindle of a large threaded ring to control the chasing tool, as will be seen at *A*, Fig. 9. For the waving operation a roller on the tool saddle is pressed against a cam placed on the faceplate of the lathe.

So far the shell has been machined in position with the axis horizontal, but when it reaches the vertical lathe, shown in Fig. 10, and thereafter it is held in a vertical position; the view shows the special end-facing lathe, which also carries a pneumatic riveting device, though the latter had been swung out of sight when the photograph was taken. The bands are turned in another special vertical lathe, Fig. 11, one slide carrying a roughing tool and the other tool passing across the job tangentially for finishing. The copper band is pressed on by a six-jaw hydraulic press, giving a load

FIG. 10. SPECIAL FACING LATHE

FIG. 11. TURNING COPPER BANDS

on the jaws of 1000 tons. The washing and varnishing section of the works is illustrated in Fig. 12, which shows the lifting and conveying devices used. Finally, after being officially passed, the shells travel to an adjacent loading bay and are transmitted by a motor lorry (a converted motor), in the head piece, to the warehouse and thence, if necessary, to the railroad. Here again the work is done solely by women.

Without stating the actual number of finished shells produced it may be said that the weekly output rate well exceeds four shells a person employed, counting in the latter the lorry driver and her assistant. Apart from the women engaged on the machines, girls are employed in assisting and in laboring generally in the machine shops, and a number are of course employed in fitting adapters, pressing on bands, varnishing, etc. Only two skilled men are employed on each of the shifts as foremen and tool setters. The best operator's total time for production of a shell body is 98 min., and for an adapter 33 min. The cutting speed is about 65 ft. a minute.

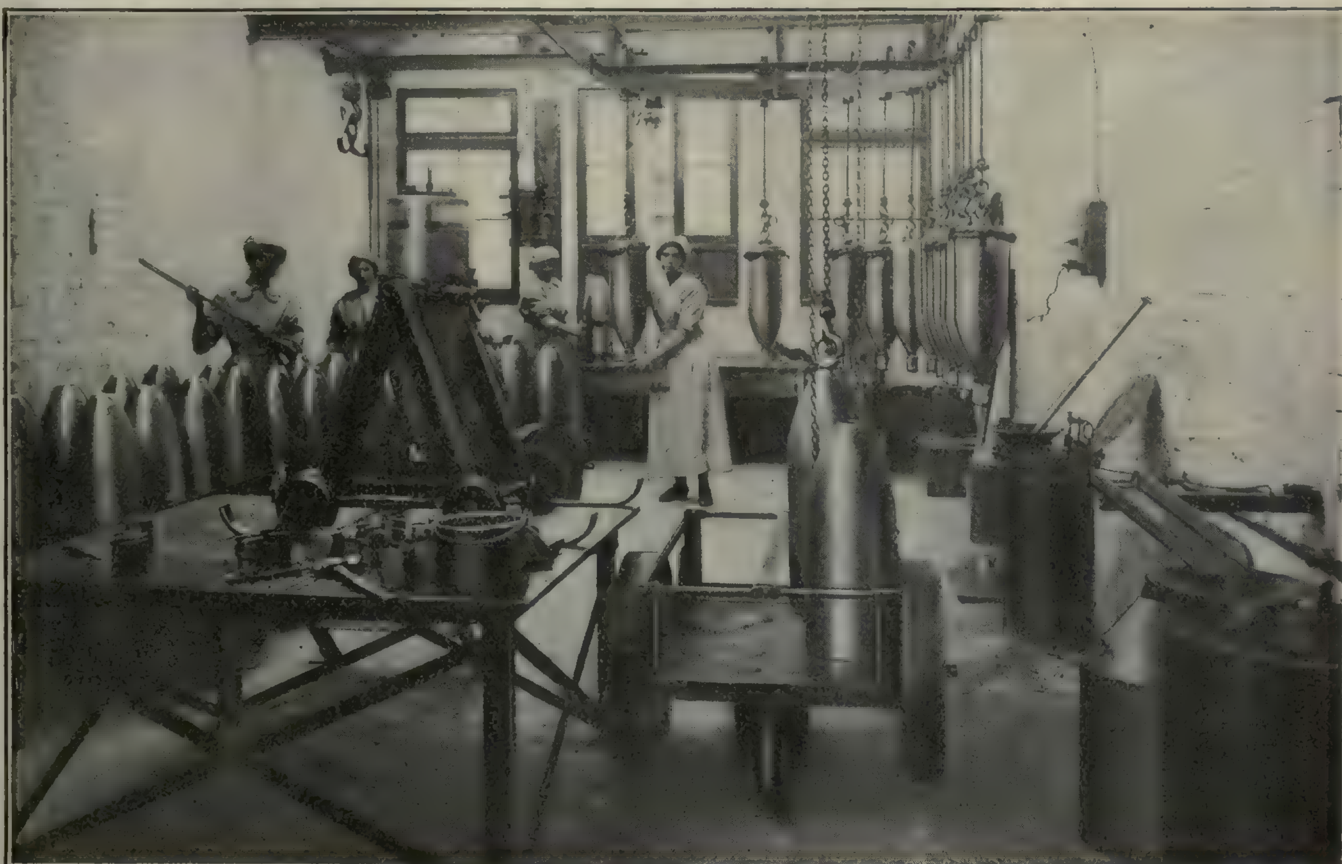


FIG. 12. WASHING AND VARNISHING

Concrete Planing Machines

By W. T. Sears

In the *American Machinist* of Apr. 11, 1918, there is a description of some heavy metal planing machines built largely of concrete. The article makes rather interesting reading, the planing-machine beds being 184 ft. long, the platens 90 ft. long and the width between housings 72 in. with fixed cross-rails.

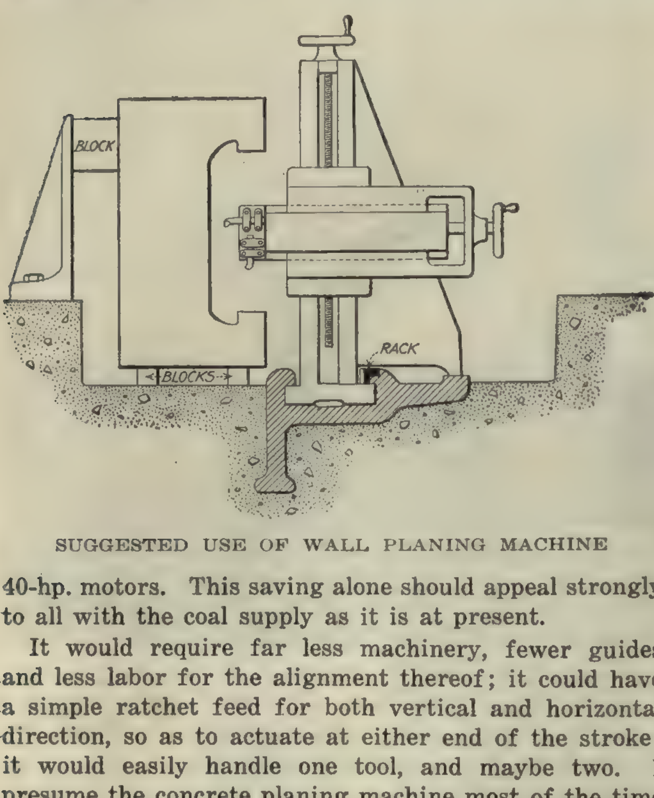
The question of building in a short time a large planing machine in shops having medium-sized machines seems to me to be best met by using cast-iron guides and structural-steel braces and parts. With almost any stiff rolled or built section and an intelligent use of rivets (electric welding, thermit and oxyacetylene) I think that a planing machine sufficiently good for the purpose could be built in less time than that needed for one of concrete design. The scarcity of structural steel at present, however, might make such construction prohibitive.

Now, what I am really coming to is contained in the statement "that the machines were built for the purpose of planing the bed of large gun-boring machines made for the Government." It seems to me that the problem originally was "how to finish the ways of long beds" and not "how to make large planing machines in a short time," and I think that it might have been quicker and simpler to approach the problem in a different manner. The building of a 72-in. standard-type planing machine is a big job, no matter how constructed. The pieces to be handled are large, the amount of machine work and fitting is enormous, and it might have been just as well before assuming that a standard type of planing machine was the best for the job to look over the field of machine tools for some other standard machine that could do the work sufficiently well and in an equal or shorter time.

The machining of the metal parts on the concrete machine must have required a considerable number of hours, and probably the same amount of time might have sufficed to make an all-metal machine that would do the work and be more flexible and easier to handle.

If such a machine could be found there would then be released for other work the engineering ability used on these machines, which was exceptional, and eliminate a great deal of expense to say nothing of the delay that would be caused by the appearance of new problems brought up by new conditions.

As a suggestion the illustration, which shows the simple type of the so-called wall planing machine, is submitted. A machine of this sort with a 7-ft. column would plane a bed 6 ft. wide and could be made to take any length. The sketch shows the column and traveling base as one, but the planing column itself completely fitted with a saddle could be obtained separately ready to bolt to a traveling base. Similar columns are frequently advertised in the *American Machinist.* The traveling base could be driven by a reversing motor carried on itself, and the necessary amount of power for driving the base with its column would be very slight compared with the amount needed for traveling a slab of concrete 13 in. deep, 60 in. wide and 90 ft. long with its load. It would certainly not require two



SUGGESTED USE OF WALL PLANING MACHINE

40-hp. motors. This saving alone should appeal strongly to all with the coal supply as it is at present.

It would require far less machinery, fewer guides and less labor for the alignment thereof; it could have a simple ratchet feed for both vertical and horizontal direction, so as to actuate at either end of the stroke; it would easily handle one tool, and maybe two. I presume the concrete planing machine most of the time will use two, but I believe the cost and time of construction of the wall planing machine would be much less than the concrete—in the ratio of three or four to one—and as many could have been built as necessary. Furthermore the length of the machine would be only slightly more than the length of the work, say roughly, 100 ft., and not 184 ft., which is the required length of the concrete planing-machine bed to handle work 90 ft. long.

There may be reasons why this type would not do, and it may have been given thorough consideration, but I can hardly believe it. Going back a little further in the problem it might be said that it was a problem of boring guns and not necessarily of making gun-boring lathes of a standard type, and I ask why, if for boring only, the lathes themselves could not have been constructed largely of concrete and still more time saved? Such a machine could be constructed along the following lines:

The lathe beds appear to have been about 90 ft., which would mean they are capable of boring a hole about 40 ft. deep. There would then be needed a geared head on a concrete base, three or four steadyrest bases and a boring-bar head and supports carried on guides set in concrete. These guides would have to be 50 or 60 ft. long; they would be set up high so that the iron work of the boring-bar supports would be reduced to a minimum and the bar fed in by a separate motor.

Such units could be made in numbers and set up for almost any combination of length and size of gun desired, and furthermore they could be so made that they might later be put on standard beds of iron.

The idea I had in mind was that the real attacking point of the problem might possibly have been overlooked and the start made at a point where the most economical results could not be obtained either in time or money, owing to the assumption that the job must be done on a planing machine of the usual type. This article is therefore not intended to be taken as wholly destructive criticism, but rather to discuss the solving of this or any problem by going as far back to the starting point as is necessary to get the final result in the best way. To begin at the beginning is a mighty good rule.

The British Metal Bank

As an indication of the way in which the business men of Great Britain are looking forward to doing business after the war, it is interesting to note there has been formed in London the National Metal and Chemical Bank, this organization having been registered on Mar. 23, 1918. The capital is £1,000,000, divided into 100,000 shares of £10 each, all subscribed privately by the promoters and those associated with them.

The articles of association conform to the new model laid down by the Board of Trade for adoption by companies engaged in vital industries. None but British subjects may become directors of the bank, and provision is made to prevent the control from passing into the hands of foreign interests. The articles give the bank very wide powers. It is authorized to undertake all forms of banking, but will devote its activities primarily to developing, as its name implies, the smelting and chemical industries of the empire. By reason of its connections it will be in a position to offer wider financial facilities to those engaged in the metal business than any ordinary bank, which, of course, does not keep a special staff of expert advisers capable of reporting on the technical merits of a mining or smelting proposition.

Considerable progress has already been made in erecting the necessary smelters and refineries in this country to treat the raw materials produced in the empire, which before the war were sent to Germany. A consolidation of allied interests has been effected, which should go a long way toward rendering this country independent of German supplies of certain metals. It is in order to make this consolidation of interests still more effective that the Metal bank has been formed.

Trade with Italy and Spain After the War

In the following article the Guaranty Trust Co. of New York studies the plans being laid by Italy and Spain to enlarge their respective shares of world business after the war. Both are Latin countries, both are producers of similar food products, both have experienced a great industrial expansion since the war.

THERE is every indication that industrial and commercial conditions in the United States after the war will be affected to a remarkable degree by the measures which Italy is developing to reëstablish herself when on a peace basis. The efforts which that country is making to extricate herself permanently from those Teutonic entanglements in which long-established and highly profitable economic relationships involved her deserve the closest attention of American business men. The success of those efforts depends in large part upon how American producers and traders receive the invitation that Italy extends to them.

It is not an invitation to the home of an utter stranger. While for many years before the war Germany and Austria dominated the foreign trade of Italy and by methods now fully exposed and understood contrived to extract from their operations a lucrative return, Italy has long been one of our best customers on the European continent. In 1913 Italy imported more raw materials and foodstuffs from America than from Germany and Austria together, but she procured her partly finished and finished products to a large extent from her Teutonic neighbors. Italian exports also went mostly to those countries. Exchanges with Germany in that year totalled $183,872,058; with Austria $93,424,457; with England $161,899,440; with France $96,740,416, and with America $152,041,111. The total of exchanges with all countries, including these, was $1,184,091,723. Italy's invitation to America therefore is not to enter a new field, but to extend and enrich one that has already been explored.

Ties That Became Fetters

To no country engaged in the present war did belligerency mean a greater disorganization of established enterprises and trade channels than to Italy. It was only when war snapped the ties that bound her to her northern neighbors that she realized how largely they had become fetters, and how far the Teuton had insinuated himself into the control of her important undertakings and into the lines of communication that made them effective in world competition. Whatever the war has cost, Italy's men of affairs feel today that it has been worth while in awakening the country to a realization of what may be done through new methods and new associations to place Italy in the foremost ranks of international traders. To develop new methods of production and distribution, to form new relations through which to give the largest measure of effectiveness and the most remunerative returns to the peculiar abilities of her people and the fertility of her soil is now the object to which Italy's statesmen and financiers are giving all the thought and energy that can be spared from the immediate task of holding back the invader and preserving her nationality.

Italy's devotion of her industrial machinery and transportation facilities to war purposes has been complete. Italy's preëminence in the production of certain articles of commerce marked her as the chief source of supply for similar products of a warlike nature. Her ordinary production of automobiles, airplanes, turbines and heavy oil engines has merely been intensified and modified in the direction of such a standardization as would permit quantity production. For example, it is well known that Italy excelled in the manufacture of automobiles designed for those able to satisfy luxurious tastes. Very few of such automobiles are being made now, and the large manufacturers have turned to the more useful, cheaper, standardized types. When the war ends they intend to continue the manufacture of the last mentioned types.

Insuring Industrial Expansion

The government is very much interested in the plans which manufacturers are making to turn their facilities to the output of peace products. Despite heavy taxes huge profits have been earned during the war. To foster preparations for international competition after the war the government makes an allowance to manufacturers who invest a certain portion of their profits in new plants or in extensions. Extensions had to be made as a war measure. In making them the Italians availed themselves of every suggestion that meant economy of labor and materials in turning out the finished product. Now the desire for modern methods has seized the industrial mind, and extensions of plant, intensive development of resources and quantity production are to be continued as peace policies.

These policies are especially significant to the United States because for many years we have looked to Italy for a large part of that increase in the labor supply which a new country must have. With the entry of Italy into the war the steady stream of sober and thrifty, but for the most part unskilled, labor from that country was cut off. Today more than 4,000,000 men and women who never worked in factories before are becoming skilled workers in plants from which the implements of war are being supplied. Many more are engaged in occupations connected with the care and feeding of the military forces. More than ever before Italy has become a nation of workers. In view of the plans being made for developing the resources of the country it seems likely that no problem will arise as to employing these men and women as well as the men now in the army when the war ends. In fact it is the belief of Italian leaders now in this country that Italy's future depends so much upon the use of every available unit of human energy that emigration will be restricted and that conditions will be so favorable in the homeland that no general objection to such restrictions will be raised there.

Italy looks to America as the chief source of supply for those raw materials and partly finished or finished

materials which she formerly obtained from Germany and Austria. This she does partly from the desire for economic independence of these countries and partly because she feels that these and other European nations will for some years be so busy with their own reconstruction programs as to have scant opportunity to fill the heavy demands of Italy. Coal, iron, lumber, machinery and railroad and shipbuilding materials will be needed in large quantities. She also hopes to obtain directly from this country many things that formerly found their way to farm and workshop through England and Germany. Cotton she will need in large quantities because of her aim to rebuild the cotton-manufacturing business that prior to the war was competing successfully with the English in the Near East.

Italian agriculturists are preparing to meet the competition of the Spaniards in France, and of both the Spaniards and the French in England and the United States. Spain sells large quantities of oranges and lemons in France, and in the belief that they can obtain a bigger share of this business the Sicilians now have a commission studying there the markets and seeking to acquaint the French with the advantages of using the Sicilian products. Italy also seeks to supplant Spain in the exportation to France of those heavy wines which the French mix with their own lighter varieties. Much study is being given to the improvement of marketing methods, and one of the first steps in this direction will be the cancellation of agreements giving sales monopolies in foreign countries. Restriction of agencies is now considered inimical to the best interest of the Italian producers.

Ships, Harbors and Railways

The opportunities to extend foreign trade have naturally turned attention to increasing the facilities for operating the proposed greatly increased merchant marine. New harbors on Italy's long coast line are planned and others are to be enlarged. The menace of the invaders to Venice has diverted trade to Genoa, and enlargement of this harbor is now under way. An engineering task of huge proportions has been undertaken in the conversion of lakes near the Adriatic coast into supplementary harbors. These lakes are at sea level and it is practicable to connect them with the sea by channels. Plans have been drawn to make these lakes the nuclei of great manufacturing districts from which products can be transported at a saving of time and motive power. Italy's lack of coal has brought forward the possibility of using her water power for the production of electrical energy to be applied not only to manufactures but also to the railways. These railways are to be extended, and the familiar single-track lines of the country are to be replaced by double-track lines as rapidly as possible.

Abroad there is planned an increase in the number of branch banks and in the investments of Italian capitalists in the financial institutions of other countries. There are no restrictions imposed by law upon the amounts which Italian bankers may invest in foreign banks and no restriction upon the establishment of foreign branches. This means that every facility will be placed at the disposal of those who are trying to develop the foreign trade of their country.

The present war has rejuvenated Spain. Like many another country younger than herself she has been forced to rely upon her own efforts to sustain her population, and through that experience she has come to be a producer for foreign markets on a scale such as has given her inspiration for the future. Her one thought now is to secure every advantage she can before the commercial struggle begins after the war.

Comprehensive Studies

In preparation for that struggle a commission of the Directorate General of Industry and Commerce is now making a study of economic conditions with the object of so directing agriculture, industry and trade in the future so as to insure maintenance of Spain's present favorable international position. The field to be covered by the commission is set forth as follows:

(1) The state of the foreign trade of Spain in 1913 and 1914, including information regarding the countries with which such trade was maintained; the articles it consisted of: the competition encountered, and the reason why Spanish manufacturers found it impossible to retain markets.

(2) The disturbance of or modifications in the world market occasioned by the war, including particulars in regard to nations that have suspended their exports; nations that have maintained their export trade, and to what extent and under what conditions; markets lost and won by Spain; Spanish industries that have increased their productive capacity by entering such markets, and inquiry as to the permanent or transitory character of new exports from Spain as well as the strenthening of former branches of the export trade.

(3) Analysis of the economic consequences of the war, including the possibility of economic wars being instituted, and of the formation of two great irreconcilable groups or the necessity in which these latter may find themselves of living together economically with no greater separation than that of certain differential tariffs among allies, or the forced submission of both parties to the economic laws of reciprocity and exchange; the consequences to Spain of one and the other forms of political economy, and the foundation on which the country may base the continuation of its economic relations with the various groups; an inquiry into the system of commercial treaties, including a consideration of the "most favored nation" clause; the system of a defensive customs tariff against any article artificially favored by an export bounty in the country of origin, as well as a tariff for encouraging and helping Spanish industries.

(4) Finally as it is considered neither conceivable nor desirable that the economic independence of any country should be so great as to isolate it completely from the rest of the world the commission is to include in its memorandum a classification, according to countries, markets and products, of the goods which Spain can contribute toward the trade of the world in such a manner as to allow of Spain obtaining the supplies that foreigners can supply, at the same time building up strong home industries by acquiring outlets abroad.

The tremendous boom in foreign trade brought to Spain by the war quickly demonstrated the necessity for improving the country's methods of production, conditions in the factories and transportation facilities. From all that can be learned there is still room

for great reforms in the treatment and payment of the laborers, whether in the field, vineyard, mine or shop, but considerable progress has been made.

Spanish railways had been deteriorating for years before the war, and the progress of the conflict imposed unusual burdens upon them at a time when it was least possible to get materials into the country for rebuilding and extensions. As a measure of relief coastwise shipping was forcibly increased. The movement of certain classes of traffic between seaports by rail was prohibited, and a Committee of Marine Transport was empowered to organize and distribute the service among these ships. These temporary measures of relief have been followed by plans for great improvements in the future. The Congress of National Economy has suggested many changes in the matter of ownership, gage, wage scales and unification of freight tariffs. Four of the largest companies have joined in the formation of a company to manufacture locomotives with the idea of overcoming the necessity of importing them from Belgium, Germany and the United States. Such preparations augur well for the future, indicating as they do an appreciation of the importance of transportation facilities in any program for the development of foreign trade. The Congress has recommended a careful revision of these plans by economic, technical, civil and military specialists so that the nation's highest interests may be conserved. The government has been asked to require the railroads to submit plans for improvements, and itself to float bond issues to cover costs.

The government has done much and indicated its purpose to do more to encourage the development of the country's resources by direct subventions and by the conclusion of favorable commercial understandings with other countries. More than $2,000,000 has been appropriated to assist in the cultivation of oranges, lemons and grapes for exportation in the provinces of Alicante, Almeria, Castellón, Murcia, and Valencia. Under an agreement with England minerals are to be exported in return for coal, and in addition England is to take enormous quantities of oranges, grapes, almonds, raisins, bananas and onions.

For the present the United States is mostly concerned with rebuilding Spanish railroads and furnishing supplies of cotton in exchange for foodstuffs for the American expeditionary forces. The renewal of mining, manufacturing and agriculture on a large scale in Spain, however, and that country's evident purpose to participate in the struggle for commercial preëminence means the creation of an excellent market for American machinery and raw materials. Spain has become wealthy beyond her fondest dreams in the last few years. She is ready to buy when the world's markets are again thrown open. There appears to be no good reason why the United States should not become her chief source of supply.

Multiple-Roll Gear Chuck and Formulas for Grinding Holes in Gears

By W. A. Ford

With reference to an article under the above title by C. H. Eastman, published on page 821, vol. 47, of the *American Machinist*, I would like to discuss several points which may interest your readers.

The illustration does not clearly show how far the collet described by Mr. Eastman is split, but assuming it to be only for the length of the gear teeth it will readily be seen that the three sections of the collet will not close parallel and grip the rolls over the whole length of the tooth. Also if the spaces between the teeth vary but a small amount it will be found that the diameter over the rolls will increase in much greater proportion. Thus if the variation in the tooth space is 0.001 in. the radius over the rolls will vary as much as 0.006 in., depending upon the gear being chucked. The collet must therefore be capable of holding gears whose diameters when measured over the rolls will vary as much as 0.012 in., therefore for the very accurate work demanded in grinding gears the spring collet, because of this variation, seems to fail.

For example: Assume a perfect gear that with correctly ground rollers has a diameter over the rollers of 4 in. To hold this gear the collet should be ground in position in the chuck body to 4 in. diameter, taking care that the outside cone of the collet fits accurately into the chuck body. A collet thus made should hold a perfect gear accurately.

Distortion in Casehardening

When gears are casehardened, however, they are distorted, and consequently the spaces between the teeth vary. Let us take a gear that owing to this distortion no longer measures 4 in. over the rolls, but whose apparent diameter is now 4.012 in. If this gear be put into the collet the latter cannot be drawn back into the chuck body so that the external cone of the collet will fit the internal cone of the former, for, because of the springing of the collet to accommodate the increased diameter, the contour of the cone is no longer a true circle, but takes rather the shape shown at *A*, Fig. 1, which is exaggerated for the purpose of illustration. Further, the bore of the collet also assumes a somewhat similar shape. If a number of rollers are used upon a distorted gear they will bear at different points on the bore of the collet, tending to rock each section about point *A* until opposing forces are in equilibrium. It is therefore quite possible for the sections of the collet to come to rest in positions similar to those shown in the outer circle of Fig. 1 at *B*. In the writer's experience it has been impossible by this method to grind the bore true with the pitch circle when there is distortion.

When testing by the following methods variations up to 0.008 in. have been found. The gear to be tested is swung up on a faceplate and the bore indicated. A roll is then placed in each tooth space successively and tested with an indicator as the gear is turned round, the variation of the readings showing the amount the pitch circle is eccentric with the bore.

Now with regard to the bearings of the collet along the length of the roll, the collet could be constructed, as shown in Fig. 2, so that the long portion of the collet can assume a double bend, allowing the front portion to close parallel with the axis and thus bear upon the rolls throughout the whole length of the gear teeth or preferably on the narrow band at the end of the teeth, as shown. This is necessary if the teeth are long in comparison with the diameter, as it

is necessary for the pitch cylinder of the gear to run true; and if the gear is of small diameter it could not be located from one end for the reason that a small amount of scale on the face would throw the gear very much out of true.

Of course the same applies to gears in which the length of teeth is small compared with the diameter of the gear; but in this case it is much better to locate from one face, even though it be slightly distorted, than to try to obtain good results by locating from the short length of the teeth.

I would also like to point out a better way of holding the rolls in the retaining ring than the one suggested by Mr. Eastman. In the first place the rolls must be hard so as to resist wear, and if the small hole in the end of the roll is drilled before hardening it will be impossible to upset the end of the roll after hardening because it will simply crack and break off. To prevent this the roll could be made with a groove turned at one end, as shown in Fig. 3, and the retaining ring be made of sheet brass with holes drilled and cut through as shown at *A*. The roll is then inserted by bending the brass aside, slipping the narrow portion of the roll between the ends and then bending the ends of the ring back again.

One other point to which I would like to call attention is the method of securing the chuck to the spindle nose of the machine. Where accuracy is required this seems a most unsatisfactory way, for unless the bore of the collet be ground with the chuck in position on the machine spindle it is almost impossible to make the chuck run true or to set it true after it is once removed, for the reason that the shoulder, where the chuck bears, has a small surface and the least bit of dirt or grit will throw the chuck out of true.

A more satisfactory way would be to have a flange on the chuck, bolting it to a faceplate screwed on to the spindle nose of the machine, which faceplate should be ground in position and not removed after once grinding true. The flange should be ground truly concentric with the bore of the collet; then the chuck can be set up to run quite true, testing by means of an indicator on the outside diameter of the flange. Perhaps other interested readers could give details of their experiences and the degree of accuracy to which hardened gears can be ground in fixtures by locating from the pitch line.

Mr. Eastman refers to the grinding of soft gears by the same method. It is my opinion that a much more satisfactory gear can be produced by grinding the bore first and locating from the accurately ground bore for cutting the teeth.

Regarding the formula given by Mr. Eastman, I am submitting one which I believe to be better. Mr. Eastman's formula is in error in assuming the pressure angle of all gears to be 14½ degrees.

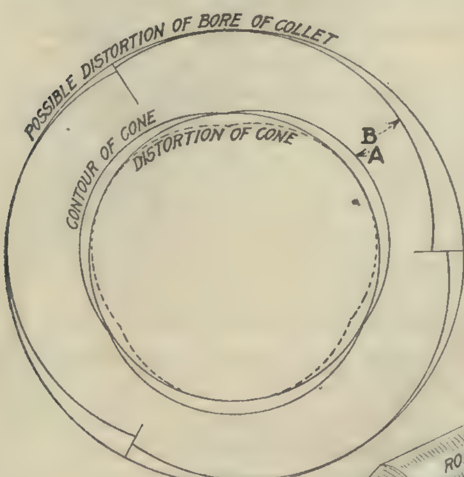


FIG. 1

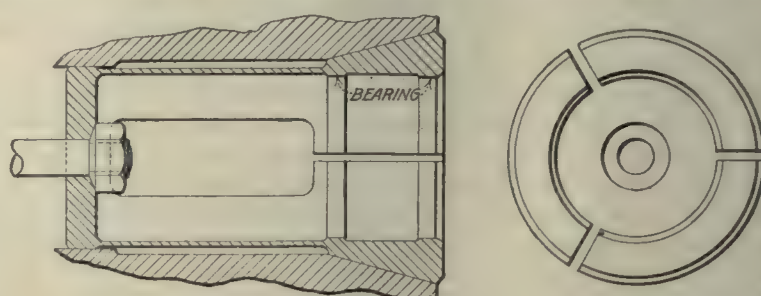


FIG. 2

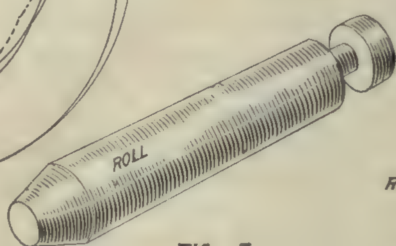
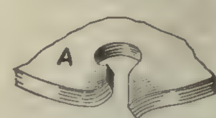


FIG. 3

RETAINING RING



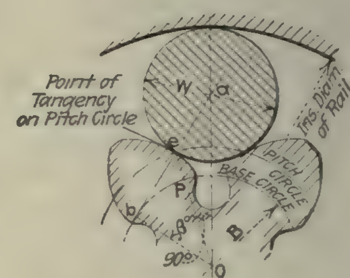


FIG. 4

FIGS. 1 TO 4. MULTIPLE ROLL CHUCK AND FORMULA
Fig. 1—Showing distortion due to holding varying diameters. Fig. 2—Better form of collet for holding gears for grinding. Fig. 3—Rolls and method of holding them. Fig. 4—Calculating roll diameters

Referring to Fig. 4. Let N = number of teeth; P = pitch circle; β = pressure angle; B = base circle and W = diameter of roll.

From Fig. 4. $B = P \cos \beta$.

$$\frac{ab}{bo} = \tan\left(\beta + \frac{90}{N}\right)$$

$$\frac{eb}{bo} = \tan \beta$$

$$ae = ab - eb$$

Therefore

$$\frac{W}{2} = \frac{B}{2} \times \left(\tan\left(\beta + \frac{90}{N}\right) - \tan \beta\right)$$

Diameter of roll =

$$W = B \times \left(\tan\left(\beta + \frac{90}{N}\right) - \tan \beta\right)$$

also

$$ao = ob \times \text{secant}\left(\beta + \frac{90}{N}\right)$$

$$ox = oa + ax = \frac{D}{2}$$

Therefore

$$D = \left(B \times \text{secant}\left(\beta + \frac{90}{N}\right)\right) + W$$

IX. Feed Cover—II

This section of the feed-cover article shows a few of the operations in profiling the locking lugs, profiling the cartridge-spring clearance opening, profiling the pawl-clearance slot, machining the sight lug, etc. The illustrations cover a number of important gaging devices which are essential in holding the parts to exact dimensions.

THERE are many other examples of important fixtures and gaging tools used in connection with feed-cover operations, but only a few more will be shown in this article. One of these, Fig. 76, is a fixture for profiling the locking lug on the right and left sides, the operation being No. 18 in the schedule. This fixture makes use of the same method for locating the feed cover by the $\frac{3}{8}$-in. hubs as described in connection with other tools, the bushings in the top of the fixture for receiving the hubs being clearly shown in the drawing. An eccentric shaft and a T-slotted clamping head are utilized, as in previous examples, for drawing the work down snugly to the fixture face. The eccentric shaft, it will be noticed, operates in a hardened and ground bushing fitted in the side of the fixture. An additional clamping device in this tool for steadying the front end of the work consists of a hook-shaped bolt which is drawn in from the right-hand side of the fixture by means of a large wing nut at the opposite side, the end of the work thus being gripped between the bolt head and a stop plug at the left to resist side thrust due to the action of the cutter.

The bolt is prevented from turning by a short cross-pin which enters a slot in the fixture and is released from the work by spring pressure when the nut is unscrewed.

A type of fixture in which the work is held at an angle for a profiling cut is shown in Fig. 77. The operation performed in this tool is No. 23, profiling the cartridge-spring guide clearance slot. This angular position is indicated in the drawing, which gives all important details of fixture construction. It will be noted that the method of locating and securing the work is the same as employed with the fixture last described. The chief points of difference as compared with preceding fixtures are to be found in the angular block which carries the work and in the shape of the slot of the form plate which receives the guide pin on the profiler head. Another profiling operation of interest is the milling out of the pawl-clearance slot, roughing and finishing cuts being required as in many other operations of similar character. The roughing of this cut is performed in operation No. 31. After the pocket or clearance has been roughed out two hubs of $\frac{1}{4}$ in. in diameter are formed in the bottom of the clearance cut by a hollow-milling operation, these hubs serving as pivots upon which are mounted later the stop pawl and rebound pawl for the magazine feed. The finishing of the pawl-clearance cut is attended to after these two small hubs for the pawls have been hollow milled to size and depth.

The fixture for both roughing and finishing the profiling cuts in the pawl-clearance seat is illustrated in Figs. 78 and 79. In the former illustration the work is shown undergoing the profiling operation, the auxiliary form plate for the guide pin for the other cut being shown swung up and out of the way of the lower form plate. The shape of the guide opening in the lower plate is best seen in the illustration, Fig. 79, where in the plan view the upper plate is shown removed.

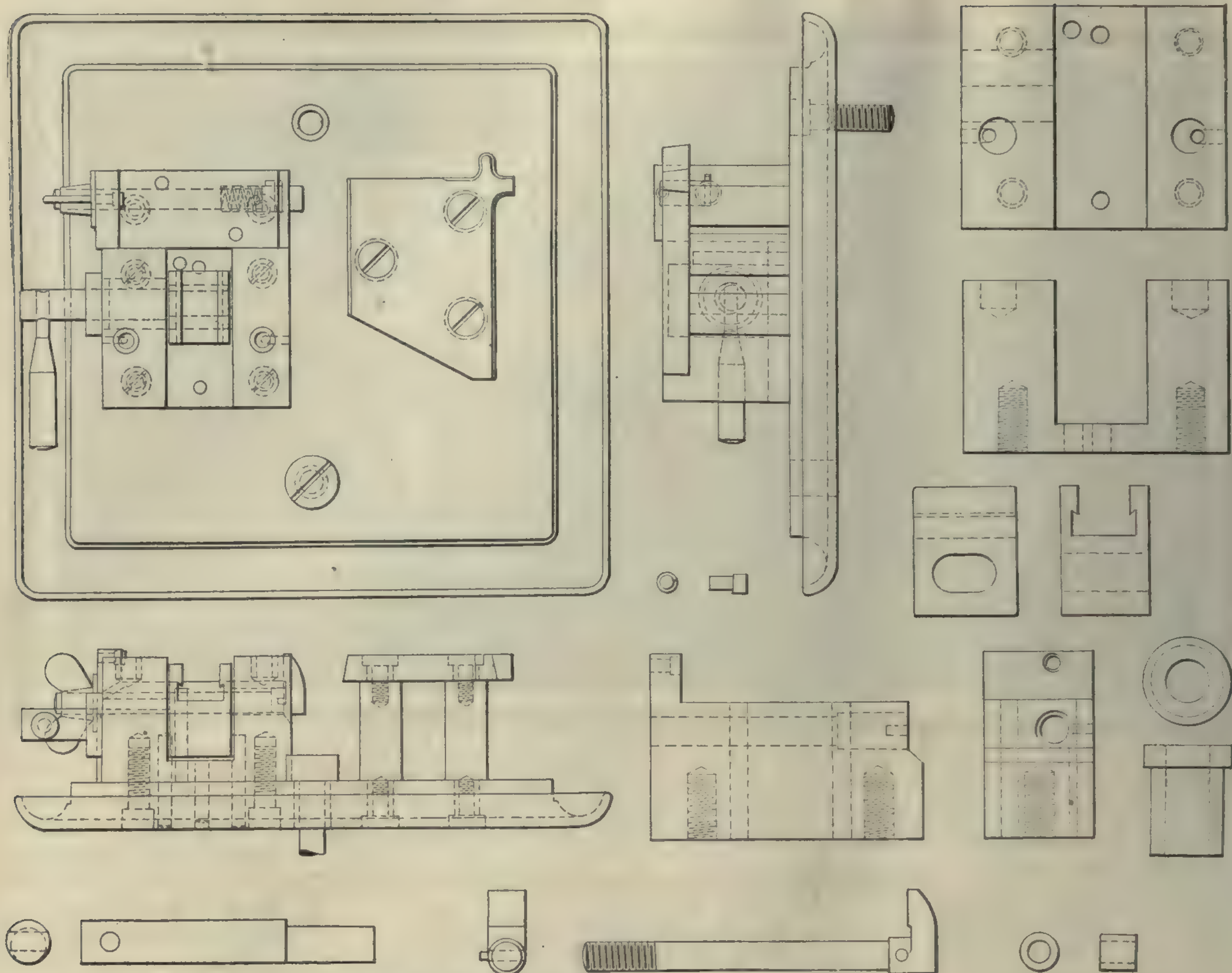


FIG. 76. FIXTURE FOR PROFILING LOCKING LUG

The shoulders C in the form plate B prevent the profiling cutter from working into the corners of the rectangular opening where are located the pawl-carrying hubs which are formed in the hollow-milling operation. The other plate A, having a rectangular opening without shoulders in the corners, allows the work to be operated upon around the entire edge of the rectangular seat. When the upper plate B is in service, it is held in correct alignment with the lower plate A by a stud, or pin, which is fitted in that plate and projects upward to engage the slot in rear end of the swinging plate B.

The method of holding the feed cover in this profiling fixture is similar to the one employed in connection with other fixtures that have already been described somewhat in detail.

The gaging of the work as it comes from this profiling fixture is accomplished with the device illustrated by Fig. 80 and the templet Fig. 81. The latter tool is made of $\frac{1}{16}$-in. flat stock fitted to a knurled handle and applied to the pawl-clearance opening to test its contour.

The gaging tool, Fig. 80, is in the form of a fixture whose base carries two $\frac{3}{8}$-in. bushings for holding the feed cover by the two hubs at the rear end or in the same manner as the work is located in the other fixtures illustrated. At the other end of the fixture base is a bracket with a long head, which is bored out vertically to receive four $\frac{1}{2}$-in. plugs, the lower ends of which are finished suitably to form contact-gaging surfaces while the upper ends are drilled to receive small operating handles. The lower part of each plug is ground at E to $\frac{1}{4}$-in.

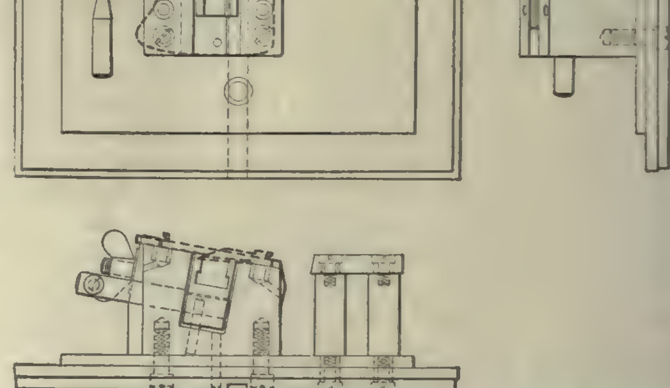


FIG. 77. PROFILING FIXTURE FOR CLEARANCE SLOT

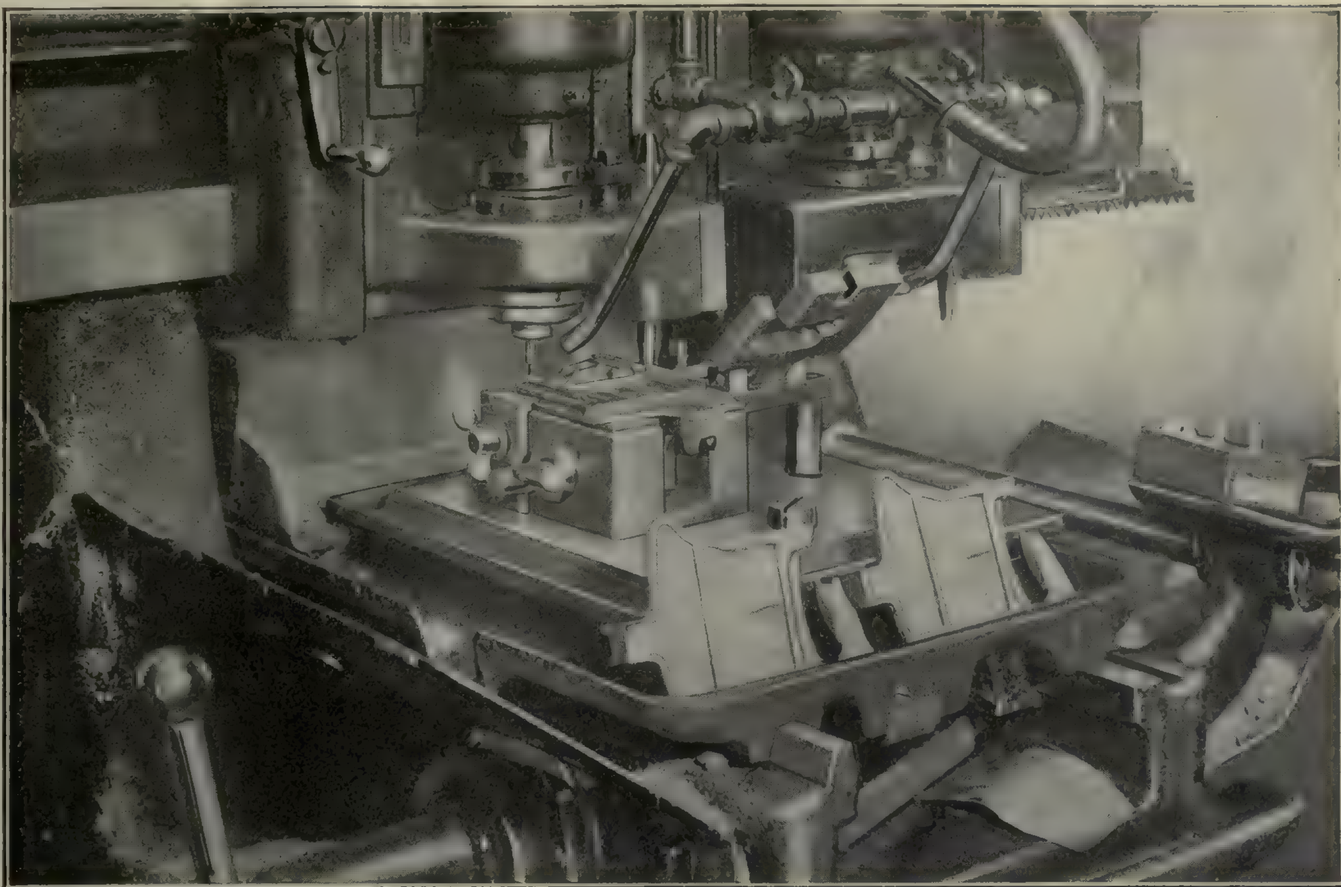
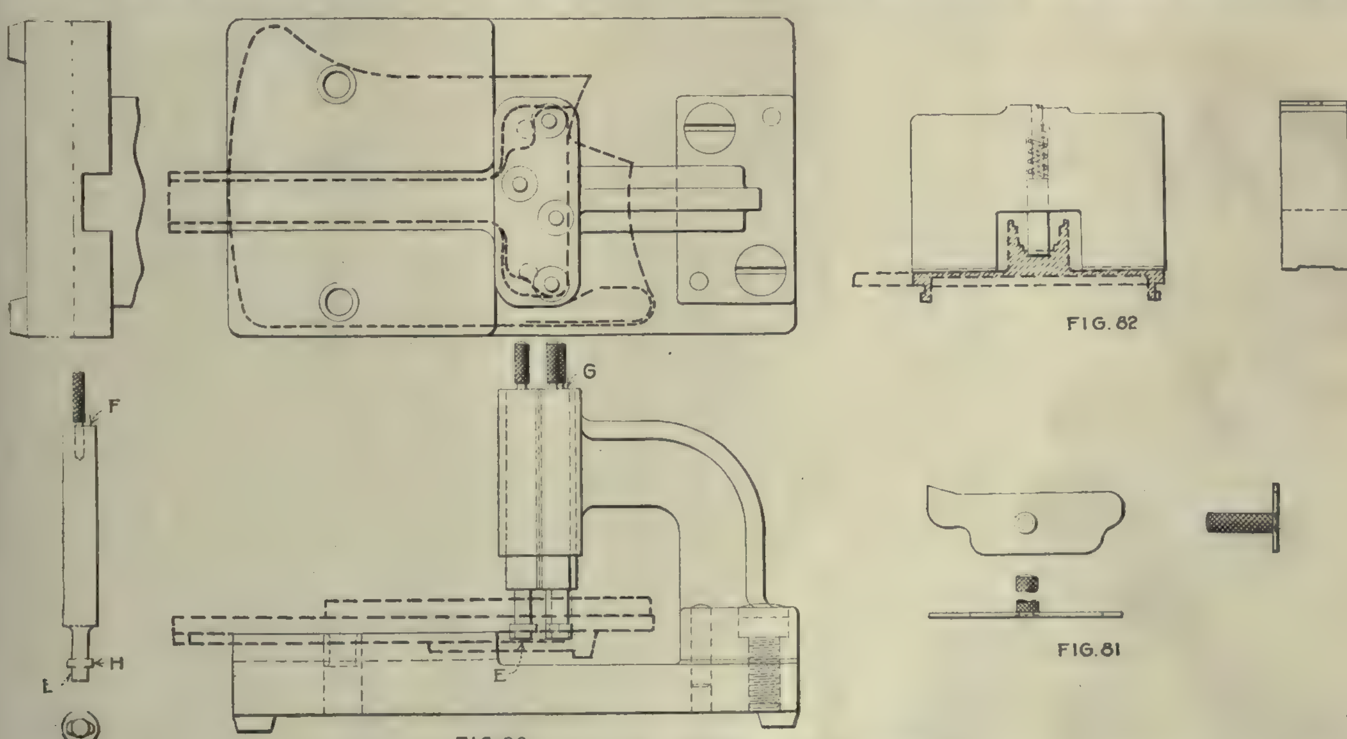


FIG. 78. A PROFILING FIXTURE FOR TWO DIFFERENT CUTS IN THE PAWL-CLEARANCE SEAT

diameter, and with this small end pushed down into contact with the pawl-clearance seat the upper end of the plug at *F* comes flush with the top surface *G* of the bracket head, so that the four plugs constitute a set of flush-pin depth gages for the bottom of the opening.

For gaging the sides of the opening for correct position each of the four plugs has a winged portion at *H* formed by flatting the sides of an enlarged shoulder, and when the plug is turned the ends of the wings provide a contact test for the profiled edges of the opening.



FIGS. 80, 81 AND 82. GAGES AND TEMPLETS

Fig. 80—Gages for the pawl-clearance opening. Fig. 81—Templet for contour of pawl-clearance opening. Fig. 82—Gage for seat cut in sight lug

Two of these plugs, it will be observed, are so located as to gage the ends of the cut, the other two the sides.

Following a number of operations on the sight lug and bed on the top of the feed cover the gage, Fig. 82, is applied to the work to test the spring-locking seat at the front end. This gage has a body which straddles the lug and carries at the middle a flush pin, the lower end of which contacts with the surface of the profiled seat.

One more operation is included in this article; this is operation No. 45; for profiling clearance for the sight-elevating screw. The fixture for this work and the method of holding the piece will be understood from Fig. 83. Here the feed cover is again located by its $\frac{5}{8}$-in. hubs which enter bushings *H* in the overhanging brackets on the fixture. It is held up against the hardened and ground stop plugs in these brackets by the supporting plate *J* and the long wedge *K*. The supporting plate *J* is guided by three pins or posts *L* fixed in the base of the fixture, and it carries in its upper face hardened plugs which bear against the under side of the feed cover to be profiled. The profiling cutter itself is indicated at *M*. After certain other operations are accomplished the locating lugs (which up to this point have formed the means by which the feed cover has been properly positioned in the various tools) are cut off; then a number of hand operations, such as filing to gage and the like, are taken care of. The feed cover is then ready for hardening, sandblasting and browning.

The hardening is done as in the case of the receiver, only such spots as require hardening being heated.

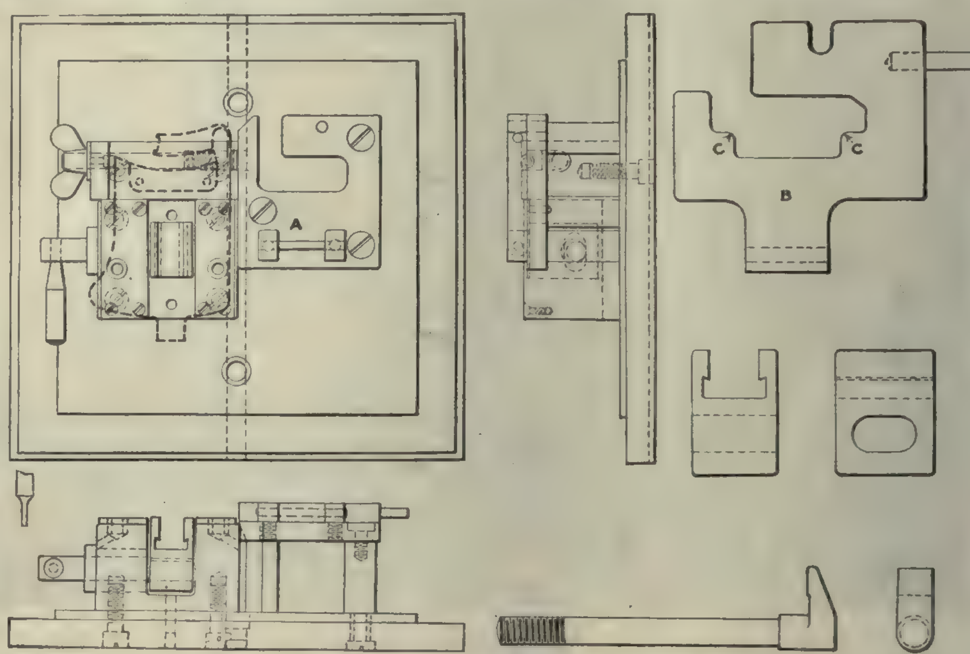


FIG. 79. DETAILS OF FIXTURE IN FIG. 78.

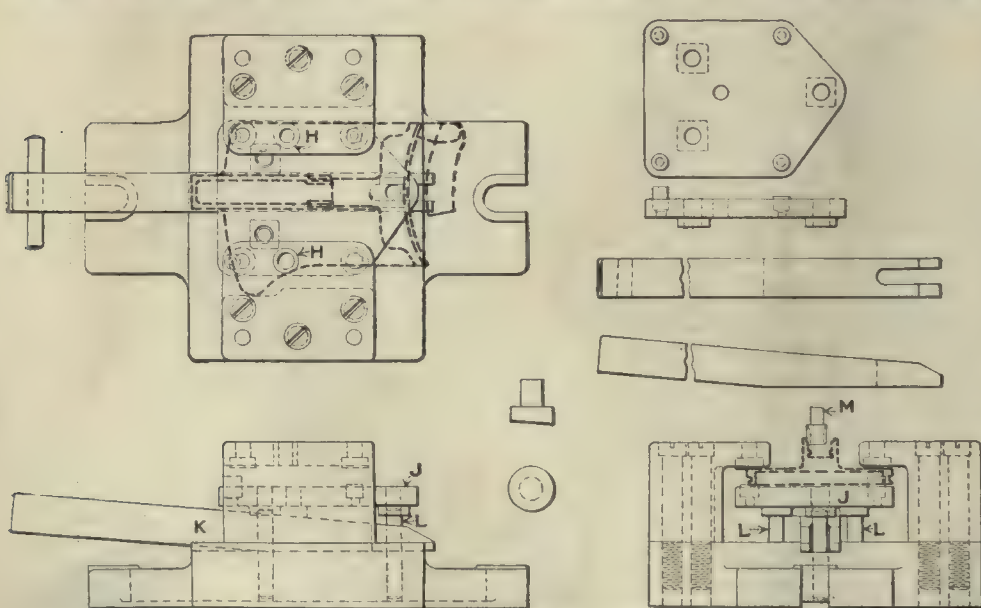


FIG. 83. PROFILING FIXTURE FOR SIGHT-ELEVATING SIDE CLEARANCE

Some Industrial Problems

By Entropy

In these days when the word democracy is on everyone's tongue, it is easy to be carried away by the word without thinking what it really means.

Real democratization of business would mean that every business enterprise would be a corporation the members of which had equal investments and all of whom would work in the business. These stockholders would elect their own board of directors, who in turn would elect representatives to conduct the business, and they would share equally in the profits or losses. The only thing that would make desirable the position of general manager of such a concern would be, if we leave out the chance for graft, the innate desire to stand in high places. Suppose a man wants the job, he will go about getting it in exactly the same way that a man endeavors to become mayor of a city. He will have the same proletariat to appeal to and they can be won in the same way. When he gets it his next problem is not production, but how to hold the job. In democracies the man who promises the most reforms and who caters to the crowd having the most votes stays on the job. Carrying out preëlection promises does not seem to count for much. The natural result of such methods of mismanagement would be the same as in municipal affairs; that is, the cost of doing anything would be practically doubled. Applied to business as a whole this

would mean that we could have about half as much for our money as we have now.

That is democratization of business. Who wants it? Only a few students of sociology and a few people who see in it a chance to loaf at the expense of the crowd. What the rank and file of us want is an opportunity to sell the only thing we have to sell—our efforts—where we can get a square deal. We want an open market without favors or privileges. Collective bargaining appeals to men only when they cannot see their way clear to get a square deal without it or when they expect to get something for nothing. When any man receives an income which he apparently does not earn we resent it, and this resentment is directed as much toward men who are drawing large sums from the Government shipyards for doing but a fraction of their duty as to the man who rolls by in his limousine. But it is not that the accumulation of wealth is resented by the rank and file so much as it is the manner of its acquirement. Most of us know that if we want to pay the price we can become at least moderately wealthy. If we are content to live singly, on the barest amount of food that will keep us alive, the least clothing that will protect us, and invest all our savings, even though at low rates of interest, by the time we are so old that we cannot enjoy anything we will have something to enjoy. Few of us envy wealthy people who have made their wealth by honest efforts. The ones to whom we object are those who have made it by sitting still and letting it rain on them. We cannot see why John Jones, who buys a vacant lot, should profit because Tom Brown builds a block on the next lot, and we cannot see why a lazy son should inherit the fortune his father acquired by sweating for it. The redeeming feature of this last case is that we know he will dissipate it very shortly.

What We Really Want

If we do not want to become rich by the only method we recognize as legitimate, and if we do not want to take the responsibility of jointly conducting a business enterprise, what do we want?

We want to be certain that we can draw the market price of our ware without having to bargain for it. We want the one-price system. Would any of us go back to the old store system where the prices were not stated in plain figures and where we knew that every price would be set by the clerk according to his estimate of our ability to pay? Not a bit of it. Then why not make our jobs one price? Not one price for everybody, but one price for every job. If I drive 2000 rivets in Boston and then move to Detroit why should I not get the same price there for the same job, barring differences in cost of living? We know that in four shops out of five there are different prices for the same work, as the matter of rate setting is left to foremen who are not in harmony with each other nor always consistent themselves. This refers to day rates, piece rates being usually set by men higher up; but even then they are a hopeless jumble of fat and lean, with the fat jobs handed to personal friends or dependents of the foremen.

What we need is better foremen, or better supervision of foremen so far as their relation to us is concerned. Whoever heard of a foreman being given any instructions as to how to be a foreman? or, for that matter, who could give such instruction? The superintendent is only a foreman promoted, with all the foreman's faults and some added abilities. The man to instruct foremen must not only have had a mechanical training but also experience in other parts of the organization, as the sales department, for example, where success depends on one's ability to meet other people on their own ground.

Our production departments are just beginning to find themselves in a position which is not new to the sales department. There constant shifting from a buyer's to a seller's market takes place. Salesmen have discovered that it is not wise to take their last ounce of flesh when things are coming their way, because the market always has changed in the past and probably will do so again. Foremen, however, cannot remember when there was an employees' market for labor, and they find it hard to realize the changed conditions. To be sure, in many instances their subordinates have become drunk with power and have done things almost as bad as the foremen themselves did before the balance of power swung away from them, but that is inevitable.

The Other Fellow's Position

The best way by which a foreman may know whether or not he is giving the workman a square deal is by putting himself in the other fellow's position. No man wants to work or should work where the conditions or the pace may shorten his working life or leave him to suffer after his working life is over. Steam power is so much cheaper than man power that there seems to be little excuse for using the muscles to anything like the tiring point, yet in many shops machines are placed away from cranes that might easily do the lifting and men waste their time doing it. Peace of mind is even more important than peace of body. Any man who is wondering when the boss will jump on him without provocation, or who is kept in fear that a slight slump in business will bring a layoff, will not be able to do his work as he should. Assurance of steady work and uniform treatment will solve many of the cases of high labor turnover which are so prevalent today.

Another thing which is not within the foreman's control but which is just beginning to come to the surface again is the fact that the best employees are those who have families. From the earliest days of factories it has been necessary to provide housing. Textile mills were obliged to go where there was water power, and it was necessary for them to build villages near their sites for their employees. The houses of this earlier day would not prove attractive now, for times have changed, and it is necessary not merely to provide a shelter, but there must be pleasant surroundings—schools, places of amusement and possibly churches, though the demand for the last mentioned does not seem to be so urgent as formerly. A company store where the operatives can procure their supplies is also necessary.

Taken altogether, it would seem as though much of the industrial unrest is due to lack of understanding as to what is taking place. We are fighting a great war, but right in our own shops we are passing through a tremendous revolution, and for the most part meeting it only by throwing out a bone now and then in the form of an increase in wages, thoughtlessly granted, too late to "beat them to it," and without due consideration of the true state of the labor market.

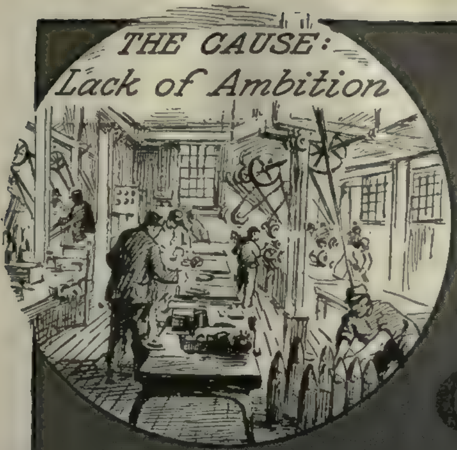
Fill Up the Gaps

By Berton Braley

There are no hours to a soldier's job;
He can't "lay off" when he wants a rest;
He must fight on where the cannon throb
And hold the line when it meets the test.
And we who labor to crush the foe
Must mend our ranks in the shop or mine;
Make this the slogan for high and low—
"Fill up the gaps in the working line!"

The idle lathe and the idle drill
Are spots that weaken the line of war—
Dangerous breaks in the ranks of skill
Imperiling all that we're fighting for.
We've each enlisted to see it through;
We mustn't slack and we mustn't pine;
Let's do our duty as soldiers do—
"Fill up the gaps in the working line!"

For every moment the workers lose
The fighters suffer; and we must strive
To back them up with our brains and thews
And do our part in the mighty drive.
Let's see that never a task's delayed;
Let's stick on the job—your job and mine—
The man who loafs is the Kaiser's aid—
"Fill up the gaps in the working line!"

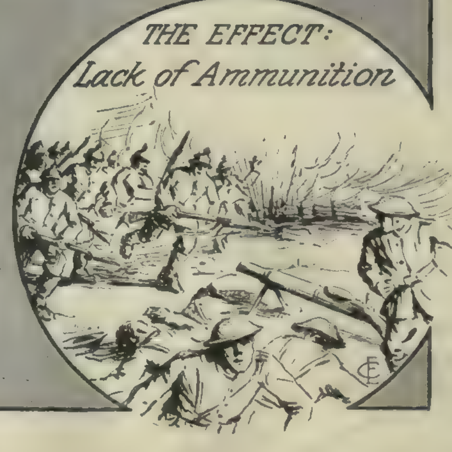


Gaps in the shop line Are as dangerous as Gaps in the battle line.

Let's keep the ranks closed.
Let's keep on our job.
Let's not lose time by being absent or late.

A minute late in the battle line may mean an army lost—*A MINUTE LOST IN THE SHOP MAY BE* the cause.

STAND BY OUR BROTHERS AND PALS. KEEP THE RANKS CLOSED.



This article describes the methods and tools used in making the Comptometer. On account of the exacting service required of the machines, extreme care is used from the selection and testing of the raw stock, through all of the machining operations, to the final inspection of the finished product.

IT IS unnecessary to describe the Comptometer made by the Felt & Tarrant Manufacturing Co., Chicago, Ill., as it is well known and widely used in the business world where speed and accuracy of accounting or mathematical calculations are required. A history of the little machine, from the time of its first inception and invention by Mr. Felt many years ago, and the many vicissitudes through which they both have passed, to the time when success crowned the never-tiring efforts of the inventor and a corps of assistants—many of whom have been associated with him for over 20 years—would make a long and interesting story, but its place is not here. It would, however, teach a lesson that all young mechanics should remember. A thorough mastering of the practical end of the machinist's and toolmaker's trades, as learned by Mr. Felt when young, coupled with inventive ability and an unconquerable perseverence and determination to succeed, will in the end bring success. Before the detailed description of the manufacturing departments a general outline of the shops will not be amiss.

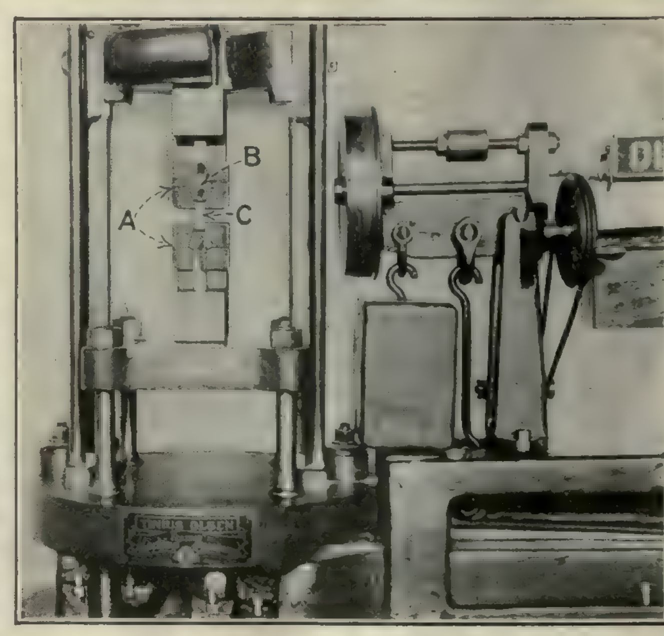


FIG. 1. MACHINE FOR TESTING FLAT STOCK

The shops of the Felt & Tarrant Manufacturing Co. comprise two five-story buildings of brick and reinforced-concrete construction. The new building which is just being completed will be used to some extent for stock storage, and will carry a safe floor load of 2000 lb. per sq.ft. This and the older building are connected by a tunnel of ample size for moving trucks of material from one building to the other. A complete power, lighting, heating and compressed-air plant makes the shops independent of outside concerns.

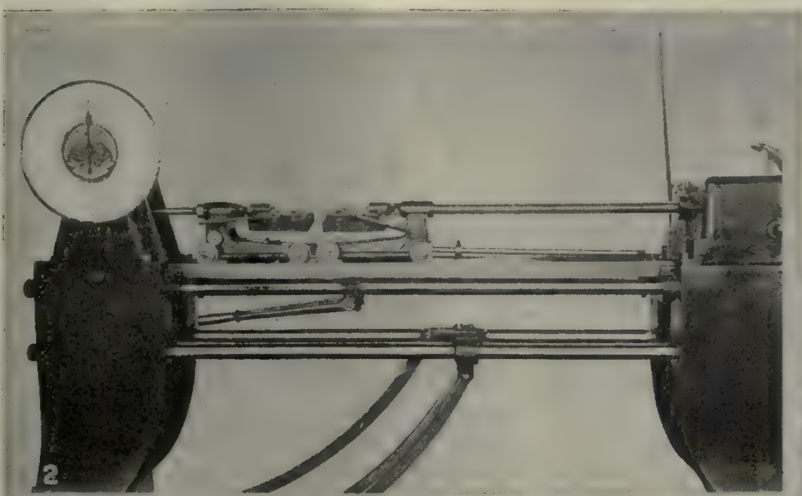
Besides the regular passenger and freight elevators, there are installed at various places throughout the shops, automatic elevators for the movement of stock from one floor to another. These are electrically operated by suitable switchboards and signal systems on each floor, and are inclosed in steel-lined shafts provided with steel doors, so that they cannot be considered a fire risk. The shipping department is two floors below the final testing and inspection room, and is connected with it by an inclined roller way and a spiral chute.

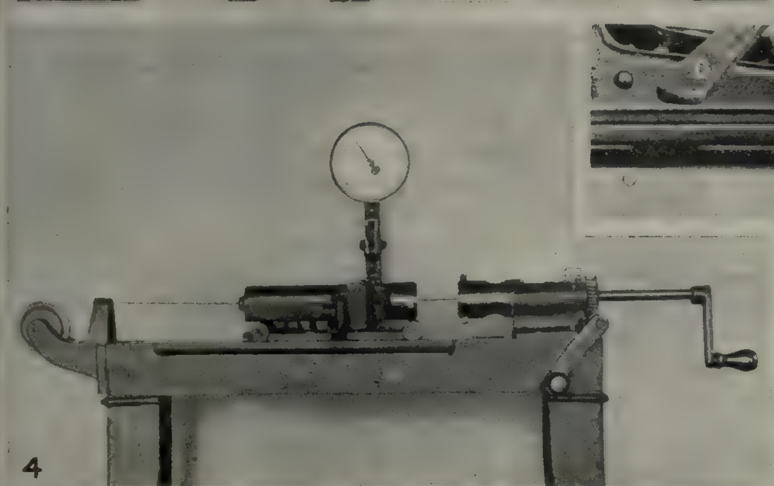
When a Comptometer is ready for the shipping department it is placed in a wooden box well padded on the inside and started down the roller incline, whence it goes through the spiral chute directly to the shipping department. Large fireproof vaults on

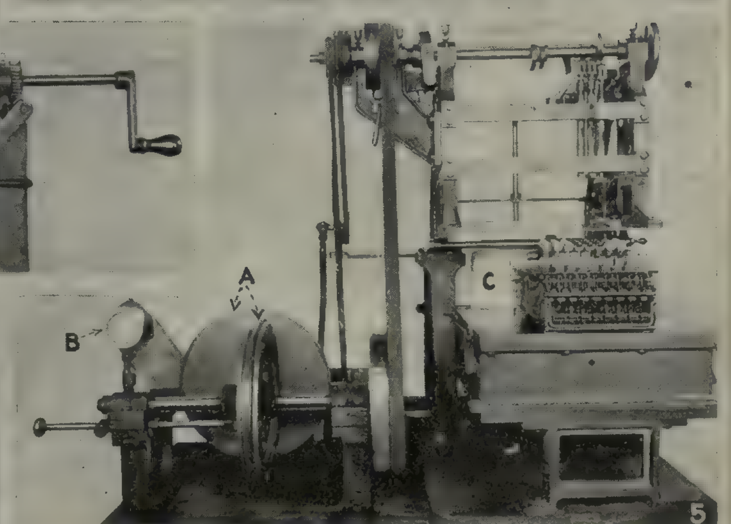
each floor provide ample storage for stock, tools, dies, gages and combustible materials.

A very complete photographic department is provided, and is in charge of a capable photographer. Photographs for advertising and catalog work are all made here, as well as photographs of all the parts which enter into the Comptometer itself. The photographs of parts are used in connection with shop operation sheets and blueprints; this is done because the intricate shapes of many of the parts render the blueprints rather difficult for the ordinary machine operator to read.

Photographs are also used to illustrate to the employees how accidents happen and how they may be avoided. The photographic studio itself, besides being provided with excellent natural lighting, is equipped with a 3000-candlepower flaming-arc light with reflector and adjustable stand, and a 1000-candlepower, nitrogen-tungsten lamp and reflector. This latter is mounted on a portable stand so that it can be easily moved from place to place in the factory if pictures of machines are wanted. The dark room is provided with all the accessories of an up-to-date commercial establishment and large sinks with running water and with ventilating hoods and fans for removing chemical fumes which sometimes prove injurious to the operator. Under the supervision of J. A. V. Turck is a very complete physical laboratory for the testing of materials. In this laboratory alone Mr. Turck has secured enough interesting and valuable data to fill a good-sized book.







FIGS. 2 TO 6. SOME OF THE MACHINES AND DEVICES USED

Fig. 2—Machine for testing music wire. Fig. 3—Gripping device for wire. Fig. 4—Torsion-testing machine. Fig. 5—Testing and recording machine. Fig. 6—End view of recording machine

A very large part of the material used in the Comptometer is crucible-steel stock, low in sulphur and phosphorus, and with the carbon content varying from 0.60 or 0.70 per cent. to 1.50 per cent., and the manganese content varying with the amount of carbon.

Very exhaustive practical tests are made on all stock when received, both in its natural condition and when heat treated. All steel that is heat treated is placed in an electric furnace fitted with thermocouple and hydrometer in order to secure exact results.

A number of standard machines for the testing of materials are in use, but in most cases they have been remodeled to better meet the particular requirements of these shops.

Gripping Devices for Wire

In Fig. 1, is shown an Olsen machine modified for testing the tensile strength of flat stock. Two hardened steel blocks *A* are provided with triangular recesses to receive the test pieces *B* which are punched to exact size in order to secure uniform results. The cross-section is figured on the area at the point *C*, which is of known size. For these tests the stock samples are heat treated in the same manner as are the finished pieces.

A machine equipped to test music wire is shown in Fig. 2. As supplied by the manufacturers this machine was not equipped with gripping devices suitable for testing wire, and it has been fitted with special devices as shown. In Fig. 3 is an enlarged view of the wire-gripping devices.

The wire to be tested is gripped at one end by the clamp *A*, which is operated by the lever *B*. It is then passed twice around the pulley *C* and clamped in a similar manner at the other end of the machine. As power is applied, the strain on the wire does not come at the points where it is gripped but comes between the two pulleys *C*, and it is here that the break always occurs. The readings are taken from the indicating dial shown in Fig. 2.

After very exhaustive tests, Mr. Turck has determined certain standards which must be met in tests of music wire used for springs. It might be interesting to note that there are but two manufacurers of music wire in the United States, and one in Europe, whose product meets Mr. Turck's specifications.

Testing Wire

Besides passing tensile and torsional tests, all spring wire must be of uniform size throughout the entire length of the roll, and a drill made from the wire, without hardening, must drill through a piece of crucible-steel stock of certain thickness. The wire must wind on a mandrel of its own diameter, without signs of breaking or splitting; and stock springs made from it must pass a stretching and vibrating test without undue elongation or loss of strength. Even after these exhaustive tests, a certain number of test springs are taken from each lot, as will be described later. Aside from this each and every spring is weighed and tested separately.

The machine shown in Fig. 4 is a torsional testing machine of standard manufacture.

The machine shown in Fig. 5 was designed and built for charting or diagraming the action of various levers in the Comptometer when operated both mechanically and by hand, and has given some very valuable information that could not have been obtained otherwise.

The machine is power driven, various speeds being obtained by the sliding friction drive at *A*. The speedometer at *B* shows the speed. The various tests are charted on the recording drum *C*. An end view of this machine is shown in Fig. 6. In this view the plunger *D* depresses one of the machine keys. As this plunger operates, pencil points at *E* press against the paper on the drum and produce the record.

Government Wants Business Diplomats

The Government is looking for big-caliber men with foreign-trade experience to serve as commercial attachés for the Bureau of Foreign and Domestic Commerce, Department of Commerce, and announces that appointees will be accredited to American embassies or legations abroad and will be expected to meet in a creditable manner the most important Government officials and business men in such countries and make trade reports.

The appointments will be made in pursuance of the department's plan to prepare now for the competition in foreign trade that will come as soon as the war is over, and because the work is so vitally important to the future of American trade only men of undoubted qualifications will be considered.

A written examination will be held on June 6, and those interested are urged to write at once to the Bureau of Foreign and Domestic Commerce, Washington.

Applicants admitted to the examination will be required to write a thesis on some given foreign-trade subject and answer difficult and searching questions on economic and commercial geography and transportation, current events in foreign countries, the industrial development of the United States in its relation to export, and to know well at least one foreign language. Education and foreign-trade experience will be important factors, and those most successful in passing the written examination will later be given an oral test before a board in Washington.

The salary of commercial attachés ranges from $4000 upward and there are transportation and other allowances. The Department of Commerce is also planning to appoint trade commissioners to Europe, South Africa and the Far East in the near future, and appointments may be made from those who successfully pass the attaché examination without receiving assignments.

Small Motor-Driven Drilling Machine Used for Tapping

By F. S. Kingston

I have been using a bench drilling machine for some time for the purpose of tapping small motor parts, such as rotors, journal boxes, frames, etc., driving by means of a d.-c. motor of ½ hp. running 950 r.p.m. The reversal of the tap is accomplished by reversing the motor with a small switch operated by a treadle, a spring closing the circuit and running the motor forward, while pressure on the treadle reverses the motor and allows the tap to back out.

The field circuit in the motor is left closed to prevent sparking when the armature is reversed. To reduce tap breakage to the minimum the amount of torque is controlled by loosening or tightening the belt.

This idea, so far as I know, is original and I hope it may be of value to others.

Meeting of the National Machine Tool Builders' Association

SPECIAL CORRESPONDENCE

THE semiannual convention of the National Machine Tool Builders' Association was held at the Marlborough-Blenheim Hotel, Atlantic City, N. J., May 16 and 17. The whole atmosphere of the convention was an endeavor to discover by what means the machine-tool builders of this country could render the greatest service, and with this end in view speakers were secured who had a distinct message on the all-important subject of winning the war.

The main address of the first session was that by Isaac F. Marcosson, war correspondent, whose subject was "The Business of War." As Mr. Marcosson has been on all the fronts and has studied practically every phase of the situation from various angles he was in position to give just the kind of information needed, especially by those who are apt to be too optimistic in viewing the whole situation. His keynote was to beware of prophecy and over-optimism, as will be seen in the extract from his address in another part of the paper.

Maurice T. Fleisher of Philadelphia spoke on "Trade Acceptances," and H. W. Dunbar of the Norton Grinding Co. on "Safety Devices for Machine Tools."

The afternoon session was opened by Admiral R. S. Griffin, engineer-in-chief of the United States Navy, who told of some of the advances which had been made in engineering and other departments of the navy. Francis H. Sisson, vice president of the Guaranty Trust Co. of New York, spoke on "The Business Survey," while H. E. Miles, chairman of the Section of Industrial Training for the War Emergency Council of National Defense, gave his illustrated talk on "Women in Industry."

Lieut.-Col. H. W. Reed told how the machine-tool builders could best help at this time, and gave out a list of heavy machine tools which are going to be needed in the near future for the manufacture of heavy guns. This was reproduced in our last issue.

Address of President J. B. Doan

It is hoped that this convention will be of some practical value to all present. It has seemed to me that there is almost no reason for a convention of business men during these times unless practically their entire time is given over to an understanding of the present war conditions, to the Governmental program pertaining thereto and to its advancement. Every speaker on our program today will in some way touch upon conditions affecting the war, and I hope will cause everyone present to more thoroughly bear in mind the needs of our country at this time, and to advance the cause of the United States of America and its noble allies.

It has been stated a great many times that the machine-tool industry is a fundamental industry, and this is especially true during war. Therefore it should be clearly and fully drawn to the attention of every member here that he should do his utmost to increase production of a kind required by the Government and, with this in view, to overcome all of the many known obstacles in the way. These obstacles might be enumerated as a shortage of skilled labor for the machine shop, the moving about from one community to another of labor, both skilled and unskilled, and the difficulty in securing certain materials.

We have just become aware through many articles in the press that something has slipped in the manufacture of airplanes, which are so badly needed at the present time. It is stated that large sums of money have been spent without the proper return in completed machines. However, I am convinced that this failure has not been caused by graft and incompetence, as has been charged. The members of this association know that such terms could not apply to those well-known and competent men who have been chosen from Detroit, Dayton, Indianapolis and other cities to carry on the manufacture. The delay in our airplane program, which amounts to a calamity at this time, has come through the failure of those not accustomed to working in metals and in the development of mechanical apparatus to take full cognizance of the fact that it takes time to design and make patterns, jigs, fixtures, templets and the necessary producing machinery. In short, we cannot in any program begin late and finish early. Along this line I especially wish to call attention to the fact that in the building of the larger sizes of machine tools, which apparently will be urgently required, it is not possible for them to be produced overnight and that a program should be laid out as far in advance as possible, so that when production is demanded the proper machinery will be in readiness.

Small Machine Tools Plentiful

I desire to attract the attention of our members to the fact that the smaller sizes of machine tools seem plentiful, and very likely the supply of these is greater than the demand. There is, however, a scarcity of the larger sizes, most of which are wanted quickly.

The very size of the United States and its manufacturing facilities is in a sense a handicap. In the consciousness of our nation's vast resources we are apt to forget that great bodies move slowly, and though the need may be most urgent it cannot be supplied properly unless we plan in advance and then see to it that there is no failure in the work of our own hands.

We must consider wisely and make plans to meet the labor shortage. First, we must stop the wild bidding for men, which causes them to move from one community to another. To the time lost in transporting these men may be added that consumed in teaching them new occupations, which later are abandoned as the men become dissatisfied with their new surroundings. The mechanical trades have developed so very much during the last few years that there is naturally a shortage of skilled help, and we must look the facts in the face and start to make skilled labor out of unskilled labor, both male and female. This is one of the very important things for this association to consider, because there could be no greater catastrophe than to find the machine-tool building shops of this country so undermanned that they could not produce the necessary machine tools for the building of aircraft, machine guns, cannon and ships—in fact everything for which machine tools are used.

The creation of a vast army and of the many accessories that go with it has been a tremendous job. When it is considered that within one year this nation has been transformed from a nonmilitary nation into one that is fast becoming a great military power it is no wonder that there have been some disappointments and much criticism, both among our allies and in this country; but it seems to me that it is time for all thoughtful men to take this in hand and stop all criticism which is either malicious or made without good reason. Big men, as a rule, can stand honest and just criticism, and perhaps that kind of criticism, particularly if it is constructive, is good for any of us; but we should be careful that it is constructive and proper, else it may do more harm than good. None of us know the exact point of view of the men in full charge of the man-

agement of this great struggle, but we do know from our own personal experience that words of encouragement do more toward creating efficiency than bitter criticism and denunciation. Therefore, I suggest that this convention be one in which we turn the light upon our own efforts for the purpose of preparing ourselves for more efficient accomplishment, so that every bit we are able to do is added to the strength of our national Government in its efforts.

We are today familiar with the advanced cost of almost every commodity, principally because most of us have had to go down in our pockets and pay the advanced cost of labor, of cast iron, of steel, of bronze, in fact of all materials which enter into the cost of construction. We also know of the greatly increased overhead burden brought about largely by the necessity of manufacturing with greater speed than before, and of the necessity of training operatives who had no previous knowledge of the trade, but who had to be paid while they were being taught. This naturally has made it necessary for every machine-tool builder to increase his selling prices. When I look about at the increased cost of almost every article which we purchase I believe there can be no criticism at the modest advance in prices in the machine-tool industry. This, I believe, is particularly true of the older builders of machine tools who have reputations to maintain and who expect to remain in the machine-tool business in the future; but it is my earnest hope that every member of this association will consider the necessities of his country at war and therefore advance his prices only as it becomes necessary. There is, of course, such a wonderful variety of machine tools, both in design and with respect to workmanship, accuracy and productive capacity, that machine tools are difficult to compare; but may I further urge that every member of this association feel it his duty to keep his selling price well within the bounds of common sense as well as good business practice?

Liberty Bonds

I have sometimes wondered at the efforts of some speakers to demonstrate that Liberty bonds are a good investment. It goes without saying that they are a good investment—they are this and infinitely more, because the Liberty bond and every Government bond is a first mortgage on every industry represented here today, whether or not the managers of that industry have subscribed to their limit. A Government bond, especially at this time, is a first mortgage on the wealth hidden in the ground as well as everything in sight. It is a mortgage on the machine shop, on the offices, on the lathe, the milling machine, the planing machine, in fact on everything we possess, and over and above that it is a first mortgage on our most loyal coöperation.

All industry must of course have profits if we are to buy Liberty bonds; if we are to pay income taxes necessary to meet the tremendous Government expenses; if we are to contribute to that magnificent organization of mercy, the Red Cross, and if, moreover, we are to extend our industry to meet the coming war requirements for machine tools, especially when we all know full well that today plant extension is more costly than ever before.

What we owe to our own Government we also owe to our allies, especially to Great Britain, to France, to Belgium and to Italy and the others who are aiding us in this great struggle. We have advanced them moneys and credit, but they have given largely of those things which no man can replace, namely, their limbs, their eyes, their blood and, many of them, their lives. We have sent them machinery and equipment which they have carried, through their own personal effort and great sacrifice, to the very front line, where they have laid down everything that is worth while in the stupendous struggle for world freedom. Our entrance into this struggle after a long delay makes our responsibility even greater than it would have been had we plunged into it earlier; therefore we should exert ourselves the more to make up for this lost time, and all of us should pause and determine in our own minds what might have happened had not our European allies held back the Hun. However, we are all now working, giving, fighting, bleeding and dying together for a great cause, and I beg to express the hope and the belief that when this great struggle ends in a tremendous victory for the Allies the love and coöperation born of this enormous sacrifice will be evidenced in the peaceful pursuit of both business and pleasure, and that as we visit the countries of each other as friends do we shall all feel ourselves a part of the great allied family forevermore. [Great applause.]

The Business of War

Address by Isaac F. Marcosson

War Correspondent, Saturday Evening Post

I sometimes wonder if you men making machine tools realize the important part that you are playing in the great drama of this war. It may interest you to know and to hear something that Lloyd George said to me in 1915—that fateful year in the history of this war. That marvelous little man without doubt is the most interesting, fascinating and extraordinary human being in this war that I have seen, and I have seen them all, you know. He is a little man with long, white hair and keen, blue eyes, and he had just taken up the job of being shell master in England. He was going down by railway to make a speech to the British trade-union congress, and I was making the trip with him when he suddenly turned to me and said: "Do you realize that this is a war of machinery? that this is a war between the British and the French workmen on the one hand and the German workmen on the other?" Of course he was speaking of shell output; but what was true of shell output then between Britain and France and the Central Powers is now true of Britain, France and America; and you men back here behind the firing line who are making possible those great engines to wage this war—for as you all know the war is developing into a test of machinery—ought to have the thanks and the gratitude of the whole country.

The men who are selling machinery abroad are fighting a battle as important as the battle waged by those who carry guns. I have come across those salesmen of yours, and I regard it as a very great privilege to stand before you and pay my respects and my compliments to the men whom I have seen in action in three different countries—France, Italy and Spain.

Before I take you on this little trip of mine up and down the battle fronts, but more especially up and down the line of European business and manufacture, I want to say a few simple words to you as one citizen of this country to another. As some of you know, I have had a commutation ticket on two or three transatlantic lines. I bought it in 1914 and it has been punched pretty regularly since.

The Danger of Over-Optimism

I have seen a great deal of this war, and there are two words—whether you are in business or whether you are out of it—that have no place in the shifting vocabulary of this war. One is "prophecy," and the other is "optimism." No man who has ever seen this war will venture to make a prophecy about anything because the hopes of today is the very ruin of the next.

In a conversation with Sir Edward Carson, whose name you all know, I asked him: "How is it that a certain famous Englishman, young, brilliant, with a great gift of oratory, who had always stood at the frontiers of the great things, looked into the valleys of success and failed? How is it that this man, young, gifted with an eloquent tongue, and with the heritage of great statesmanship has failed?" He answered: "The reason is, my boy, he is a dangerous optimist." My friends, the curse of this country today and the curse of the war in Europe has been optimism. The curse of the war has been the assumption that because things seem to be right they are all right. It is a dangerous optimism in this country to believe today that everything is right when everything is wrong. At this second, while I am standing here, there never has been in the whole tragic, immortal story of the Allies a time when their position was as precarious as it is now.

The trouble in life is in love. We like to believe what we want to believe. The trouble in life is we want to follow the line of least resistance, and that has been true of

this war. "Too late!" Those words "Too late!" have been the tragedy of Europe. The Allies were too late to save Serbia, Roumania and Russia. I have been in every one of these countries. And they were almost too late to save Italy. The great hope of today is that this great country of ours and that flag will not be too late to save this cause which means our own happiness and our own future, your industry, as well as mine.

Now there is one other thing that I wish to impress upon you, and it is this, that if this war is not won in Europe—I use the word advisedly—that if this war is not won in Europe it must be fought out on these shores—perhaps on this very shore out here—and that is why it is essential that this country should pool its patriotism, and syndicate its energies, and mobilize its man and woman power, because there never was a time in the history of the world when a proposition was put as squarely up to a country as the proposition of winning this war has been put up to this country of ours

The Danger of Propaganda

We do not realize that there is a danger in our own participation in this war far greater than the submarine, the Zeppelin and the airplane; and I mean by that the hideous danger and menace of the German propaganda. I do not mean sabotage, which as you all know has destroyed $60,000,000 of wealth in this country in the last six months; but I mean that sinister, silent, subtle German agent who has opposed our Red Cross, who has studiously and surreptitiously but effectively fought the sale of Liberty loans; who is in our midst and on our thresholds, and sometimes in our very houses. I have studied the German propaganda, and I can tell you more about it from experience in all the various countries. I have studied the German propagandist in eight different countries. I have had the honor of being followed by some of the most distinguished and stupid German spies in the world; but wherever I have been the method and system of the German interests and agents are precisely the same. They aim at two things. One is to end the war now while Germany has all the chips on her side of the table; the other is to build up German trade after the war is over. And I have long maintained throughout this country that if we would shoot the German spies in this country and conduct a publicity campaign of what we have done it would be worth years of agitation and conversation.

Now that we have got these controversial subjects out of our system, I want to talk to you, as I had originally thought today, of the "Business of the War." But I am going to try to talk to you about something that has just come into my mind—not the business of war, but the war of business.

The Root of the War

You men know as well as I that this war was rooted in Germany's overmastering desire to control the trade and the business of the world. In the three or four years before the war it was my good fortune to study German efficiency and German commercial organization. Wherever the sun shone, wherever you found a German diplomatic agent, wherever you found a German consular agent, there also you found the outposts of German trade. That great phrase "To find its place in the sun" was more than a phrase. I wonder if you realize that as recently as July, 1914, the German Reichstag passed the famous (or infamous) Delbrück bill. Under the stipulations of that law a German subject can, and could, retain his citizenship in Germany no matter what oath of allegiance to any country he might take. Of course, like the violation of "the scrap of paper," otherwise known as the Belgian treaty, it was a violation of all international law; but a little thing like a violation of international law has no force or terror to the German autocrat out to get the business of the world. That Delbrück law which is on the statutes of Germany today made any German who took allegiance to any country after July, 1914, a perjurer and a criminal. But little things like perjury and crime are small things between German aspiration for world trade and its consummation.

The operation of the Delbrück law proved beyond doubt, and it is merely incidental, that Germany was determined to force the world into this war in order to cement and rivet her hold upon the economic mastery of the world.

In Berlin, as some of you may know, on the Unter den Linden there is a big white building that flies the imperial flag of the German empire, with a little black eagle. That is the Foreign Office—the Wilhelmstrasse. But what most of us have not realized until a few months ago was that the German Foreign Office was the head and front of the selling system of German business the world over. There was a school of salesmanship. It was the dynamo of German trade. Wherever a German went he carried it. I have seen this with my own eyes—wherever the sun shines, east and west—the credentials of that German Foreign Office.

That is why when the war began it was not so much the idea of territorial conquest as it was, as you all know, to get business. And today, in the midst of the war which is threatening her very imperial existence, Germany is preparing to launch a trade offensive more important to you and to me than this great battle that is going on today on the fields of Picardy and Flanders.

I was in Petrograd a year ago today. I came back by way of Norway and Sweden. In Stockholm, in Christiania and in Copenhagen I saw German business men selling goods. In Italy and in Spain and in Holland I saw the same thing. So, you see, it is a great illusion, it is a part of the costly optimism of this country, which says Germany is down and out.

Germany Still Very Strong

Germany is far from being down and out. That is the great fact that I want to urge upon you. An empire that can put six million armed men in the field and at the same time get a corner in Spain, as I will describe to you after a while, is far from being out—certainly is very remote from ceasing to be a factor in this great world game.

The great object of Germany today—as she is doing with her propaganda in this country, as she is doing in Italy and Spain and Holland and in Switzerland—is to get up a great industrial machine that will enable her to have a flying start when the war is over. What is more important the day this war is over Germany will not only be a big commercial factor, but she will have something to sell, as I will now describe to you.

But first of all I want to tell you what I saw a year ago in Petrograd. I had the honor of being the first countryman of yours to get there after that great upheaval which dethroned the czar. Lloyd George sent me across the North Sea on a British destroyer, and on that trip I saw a sight that with one exception was the most striking and unforgettable of any I have seen in this war. There was a storm that day and at the end the great sun came out in the west and suddenly there broke through the mist of the Scottish coast, with a majesty and with a power unspeakable, the whole British Grand Fleet in battle order. And as I saw that fleet—those acres and acres and square miles of battleships, and cruisers, and mine-sweepers and destroyers—I realized for the first time what the word "empire" meant; and I also realized when I saw those citadels, mile after mile, that so long as that fleet rode the seas that the thing known as the "freedom of the seas" was safe.

I also realized, my friends, that but for that British Grand Fleet you would not now be sitting here upon the shores of this ocean in peace and comfort. And the world is some day going to know its obligation to the incredible heroism and eternal vigilance, the incomparable courage, of that British Grand Fleet!

One day, I had a long talk with Kerensky, whose name you know, and he said to me: "So long as I am alive there never will be a separate peace with the kaiser." The next day after I saw Kerensky I was in our embassy talking with our ambassador, Mr. Francis. We heard a noise in the street. We went to the window. We saw a tall, lean man with a beard and high-cheek bones and glaring eyes, which seemed to be like balls of living fire, leading a mob of three thousand highbinders down the street. That man was making a demonstration against

the American embassy. He was making a demonstration against the United States. That man with high Slavic cheekbones and living fire in his eyes was Lenine, who is today the dictator of Russia. I tell you that, so that you may know the effects of German propaganda. Lenine came to Petrograd when I was there. He came in a box-car from Berne (Switzerland) through Germany. Now if the kaiser had any other idea than that Lenine's entrance into Russia meant anything but service to Germany he would not have given him a Cook's tour and joyride through Germany. From the moment Lenine got to Petrograd the undermining of Russia began, and that human garbage known as the Bolsheviki, which made the most obscene peace in the history of the world, was the result.

The reason I speak of this is the effect upon industry in this country of the Russian peace—that peace made with Germany, which is a greater blow to the Allies than the destruction of two of Haig's armies. It has added from one to two years to the length of the war which, by the grace of God, might now have been ended.

A War of Raw Materials

You men know as well as I that this is a war of raw material; that Germany can only continue it so long as she continues to get the raw material with which to wage it. The nation that is going to have raw material and coal when this war is over is going to be the nation that is going to rule the world.

Russia has turned herself inside out today. Her great stores of wheat; her great stores of copper and all, 65 per cent. of the munition factories of Russia are in Petrograd in enormous stores. I have seen them with my own eyes, and, what is more important, a million and three-quarters of German prisoners in Russia to boss the job of reconstruction and the conversion of that country into an economic asset and an economic vassal of the German empire. These are the facts that I want you to take home with you, and when you read about the German peace with Russia you will understand that Germany has built herself a prop which not only gives her a new lease of enthusiasm, but also a fresh lease of that most important thing in the world, and certainly after the war—which is, for a nation to become self-sufficient.

I went to Italy last September. Wherever you go, as I take you with me on this little trip, you will find the same thing happening—always the German propaganda; always the German desire to build up a great trade after the war.

I was on the Italian front with General Cadorna three weeks before the great German assault, and when I saw those Italian troops I said to myself that with the exception of Haig's incomparable army there are no finer fighters in the world. One day I stood on a hill on the Italian front, which is the most marvelous of all—and I have been in Flanders, and Picardy, and in the Caucasus, and have seen all the armies fighting. In those places it is a war of trenches, and men stick in them months and years at a time, and the enemies seldom see each other, except when they "go over the top." But in Italy it is as if a god who made the world had built a great stage, a great granite theater hundreds of square miles, and placed around it, as it were, the galleries and the boxes—these great mountain Alps. You can stand on those Alps and look down on this titanic stage and see this great epic being enacted by thousands of men. Well, I stood one day with Cadorna's chief of staff on one of these mountains, and there sixteen miles across the valley of death I saw these thousands of Italian troops—little gray dabs on the mountainside, without a stick or a tree or a stone, or without a trench—under the frightful Austrian shell fire, and in the sunlight, always going up and being hurled back, and I said: "Surely those are wonderful fighters." And three weeks later in London I read that this army, with its banners, had been swept back and had lost in six days what it had taken eighteen months of some of the most brilliant fighting of the war to win.

What was the reason? I can tell you the reason in a sentence. The German propagandists undermined the Italian army—in Italy there are one hundred and twenty thousand Germans of that type of German, "once a German always a German;" they speak Italian as well as you and I speak English. In Italy before the war, and some of you who have been there will confirm these facts, you know you could not do business without the approval or consent or knowledge of that great bank in Berlin. In Milan there was this great bank, the Commercial Italiano—this great marble palace that was the dynamo and center of German trade in Italy.

A young man in Turin told me this story: He and a friend got a water-right privilege in Sicily. They wanted to build an electric-light plant. They had a good business proposition. They went to this Italian bank, laid down their plans and asked if the bank would advance capital for it. "Why, certainly," said the bank; "it is a splendid proposition." Before the deal was consummated the vice president of the bank said: "Of course you have arranged to get your equipment?" "Yes," said the young man; "we have got a very excellent arrangement with a French house." "Well, I am extremely sorry," said the banker; "unless you get the machinery from the Allgemeine Electrische Gesellschaft," which you all know, "we cannot advance you the funds." These men had to sign a contract and make arrangements to get this equipment from the Allgemeine Electrische Gesellschaft, which had a great plant in Italy, and the head of which was the head of the bank. That is the way the German financial system operated in Italy, and that is why I say that when this war began Italy faced the proposition of breaking off with Germany and committing business suicide or waiting until she could extract some of the fangs of this German financial reptile.

These one hundred and twenty thousand Germans in Italy were, as I say, as much a part and parcel of the Italian national life as you are of ours, with this distinction—that they never forgot that they were German spies. They never forgot that their first interests were for that white building with the flag and black eagle on it in the Wilhelmstrasse. And it came about that these forty thousand Germans in the Italian army, by some curious circumstance, got into the second army, and by still greater circumstance they were all in the army that was in these mountain passes. One day one of the great soldiers said to me: "This is the pass Italy can hold against the world. A handful of men can hold it." I have seen those mountain passes scarcely wider than this room. Some more of that optimism that I have been talking about! But the Germans got through that pass. How? When the Germans made that attack these Germans in the Italian army were there, and they gave the signal to retreat. It is an easy thing to start a retreat in a battle, but it is an almost impossible thing to stop it. Those Germans in the Italian army—those propagandists who had scattered through the army that "end-the-war" propaganda that we have in this country—were the men who were the undoing of this great Italian army when that retreat began, and which was stimulated and inspired by this German propaganda, and as you all know they lost in six days what it had taken sixteen months to win.

Italy Stronger Than Before

But do not forget that Italy is far from being down and out. I went, as some of you may also have gone, to the great Ansalda factory in Italy. It is the Krupp of Italy. I saw this plant, three times bigger than the Bethlehem steel plant, on the shores of one of the most famous seas in the world, and I saw battleships and cruisers being launched in a steady stream, and here Italy has achieved an industrial supremacy such as it had never achieved before. When you see those Ansaldo works, when you see the Fiat automobile factory in Turin, and when you see all the great shell factories going up in Italy you begin to realize that Italy is far from being down and out. I always like to say a word about Italy. We seem to forget in this country that an Italian, Christopher Columbus, discovered America.

Again when I was on the Italian front, a young man, a private, came up to me and said: "I am awfully glad to see you. I was a section hand on the Pennsylvania. I helped to build the Hudson tubes." We often forget the racial link between Italy and this country.

Their great statesmen have told me that unless America helps Italy she will be out of the war, because, as I have been urging upon you, this is a war of raw materials, and the nation at war that cannot get coal and steel is out of it. And when anybody comes along and asks you to help Italy, just remember that this reverse has given her a rebirth of spirituality and courage, and that under this rebirth she is more resolute than ever before.

Now, I used to think that the last German colonies were Cincinnati—with all due respect to Mr. Doan [laughter]—Milwaukee and St. Louis.

President Doan—You are partly mistaken.

Mr. Marcosson—I know I am now, because what I am going to say shows it. But when I went to Spain last summer I realized I was wrong. Spain today is the last outpost of Germanic power. If you walk along the streets in Barcelona, or Madrid, or San Sebastian, where I went to see the King, and ask anybody who is winning the war, without the slightest hesitation they say the Kaiser. If you ask anybody in any of the smart clubs in Spain who is the greatest man in the universe, not even excepting God, they instantly say, "The Kaiser."

How has that happened? Simply because Germany has got out and, as you men would say when you are selling machine tools, sold. The German propagandists have carried on a campaign on the proposition of the Kaiser. It has been the finest selling campaign that I have ever seen. They have organized it. Each man had his territory, his selling territory; each man has his line of samples, and that line of samples was the finest lot of German gold and German hot air that any propaganda has ever produced.

Getting a Foothold in Spain

The Germans have sold Spain on the proposition of German trade and German good-will, because they are giving the Spaniard, as they did in business before the war, what the Spaniard had in mind. You know perfectly well, those of you who sell goods, that if a Spaniard or an Italian wanted anything, no matter how ridiculous, the German salesman would say: "That is a splendid idea; I congratulate you upon your good taste, and it will be an honor to sell it to you." In England they would say: "That man is a silly ass, and I refuse to have a damn thing to do with it." That is the plain truth, and that is the secret, as you all know, of the great German trade.

Germany went into Spain to fill the Spaniard with hot air, and to tell him he was the finest aristocrat in the world. And he got it over. And if you had gone, as I have, from one end of Spain to the other and looked into these great warehouses you would have found hundreds of them jammed and packed with copper and oil and cotton, and all the material with which to reëstablish a great industry. And today, whenever there is a water right for sale; whenever there is stock for sale, or whenever anything can be leased, or a factory can be bought, who buys it? The Germans.

They have got the finest industrial secret service in Spain that I have seen in my life. And to what end? All to the great end that when the war is over, in Spain, as in Holland and in Switzerland, the wheels of German output will be going, and that little mark, "Made in Germany," which for some years after the war will be the commercial brand of Cain—I don't know how long, because I have my doubts as to how much patriotism there is in the average pocket book—but at least for a few years after the war that little brand will be possibly a hissing and a byword, and to meet that boycott, Germany will put on the goods, as I have seen with my own eyes, "Made in Spain," "Made in Switzerland," and "Made in Holland." Your own goods, machine tools, are going out in the markets of the world now and forevermore in competition with German-made stuff, made by German hands, made by German capital, part of this new German trade offensive, in competition with stuff that is marked as I have said it would be marked.

That is one of the things that I warn you and every man who has seen this war and who has studied the business of war, as I have—they will tell you the same thing, and that is why today there ought to be such an embargo on the exportation of raw materials and finished machinery to those neutral countries as will prevent them from ultimately falling into the hands of our enemies. This country could do no bigger job than to put such a drastic mark on all the machinery that goes out of it, and more especially to Spain, and it would be a great service to every man that comes to this hall and takes part in the discussions here, because Germany is seeking by every secret, sinister, subtle way, as she has done with her propaganda, to get machinery into her own country by way of Switzerland and Holland.

France, the Spartan Mother

I want to say a word to you about France, first, because it is a country bound to us by the unspeakable ties of a common sacrifice. France, to me, has ceased to be a country. It has become a human being, a sort of Spartan mother who holds to her breast the child of freedom. That breast is sucked dry; but the soul in the war-worn and racked body is alive with faith. It is the heart in that ravaged body which beats with pain and faith.

I want to tell you two little stories, which have nothing to do with this great clash of world commerce, or the war after the war, or the great trade autocracy of the Teuton; but two stories that come to my mind now that seem to me you ought to hear. They may illustrate to you what this war is costing France, and how, up to this time, we have escaped it.

I was coming back once from the French front, going through that area which you all know, for the want of something better, is called the "devastated regions." I was making my way through miles of ruined cities, blackened forests, all that wanton waste the German leaves in his path. I suddenly heard the sound of hammering. I stopped my car and looked across the fields all churned up with shell holes and I saw a solitary house, wabbly walls, and a crazy chimney, and out of that chimney there came a wisp of smoke. I walked across this field, stumbling through those shell holes, and came to the door of the little house, and this is what I saw. A woman stood at a forge beating out a horseshoe. Her husband, as I learned, had been a soldier, and had been killed in the battle. She had on a uniform, and a little child four years old played on the ground at her feet, while the sparks blew upward. Everything that this woman had had in the world had been swept away by the war, except the wabbly roof over her head, the little child at her feet, and the anvil to which she still clung. Between the beat of the woman's hammer I could hear the sound of guns three miles away on the horizon. Never in this war has the sound of cannon been to me so ominous, so full of fate, as on that day, when those great iron-throated guns boomed in sympathy and in chorus with this woman's hammer. They seemed to me to be making a protest against her agony and her sacrifice. That woman standing at her forge in the zone of fire was the symbol of woman in this war; and I wished, that afternoon, thrilled and stirred as I was by that sight, that some great artist had been with me to have seen that scene as I saw it, because he would have painted it into a canvas that would be a companion picture to that great painting that hangs in the Metropolitan Gallery of New York, which shows Joan of Arc walking with her vision in the little churchyard at Domremy.

The Mother Who Gave All

At another time I was coming back from Verdun. I was on the frontier of the fighting; I was very thirsty, and I stopped at the only little farmhouse I could see. The only sign of life I could notice was an old woman, who I suppose was about eighty-five—wan, yellow and parchment faced. She was working with a hoe in a little garden, and I stopped and began to talk to her while she got me a drink. She asked me, "Where did you come from?" Those old French people, as you all know, are very talkative, and it was most interesting, and it is worth emphasizing—that old woman, eighty years old, the only sign of life on the horizon. When you wander about in France, especially now, you discover that the only people you see are the very old and the very young. You do not see

young men and women going out. You do not see those signs of tenderness and happiness. Then it dawns upon you what this war has meant; that it has stripped the world of its flowers, and it has left on the shores of safety only the old and very young.

This old woman, when she found out where I came from, said: "Come into my house and I will show you what this war has brought to me." She took me inside a simple French farmhouse. In the middle of it was the little eating room, in one corner of which was a combination fireplace and stove, and in another was an iron single couch, a little camp bed, and over the bed a French flag. On the flag were pinned four Croix de Guerres, which, as you all know, is the Cross of War that France bestows upon her heroic soldiers, just as Britain bestows the Victoria Cross—there were four crosses of war. Each one of those crosses was won by this old woman's sons, and the four of them had been killed. One by one, as these boys were killed, the medal was taken off their breasts and sent back to this fine old heroine as a symbol that her sons had not died in vain.

One by one the old lady pinned them upon the flag as her "Victoria Cross." When the last boy was killed, he had a small watch on his wrist, and it was going when he was killed. One of his comrades wound it up and sent it back next day with his medal, and the old lady hung it up on the wall under the flag with the four crosses, and every night she wound it up, and every morning when she wakes up she hears the ticking of this watch, and to that great old woman it is like the beat of a human heart. It is a loving link with her heroic dead.

I have stood in the great sanctuaries of the world. I have stood in St. Peter's in Rome when the Pope came down in stately procession. I have stood in Westminster Abbey, amid all the great traditions of the Anglo-Saxon race, and once in the sun I stood in Petrograd before the great cathedral, while two hundred thousand people paraded and the priests went about and scattered incense, and the Easter chimes rang out, but never in my life have I been so moved and stirred as I was that day in France when I stood with that old woman alongside her flag with the four crosses and heard the tick of that watch. As I heard its tick and the beat of that other woman's hammer on the anvil—the tick of that watch and the beat of that hammer on the anvil were one and the same thing—they were simply echoes, echoing the imperishable heart-throbs of France.

France to be Reborn

But everything in France is not to be sacrificed, as I have tried to tell you. France is going to come out of this war industrially reborn. I want to tell you the story of a man of whom some of you may have heard, and about whom I wrote an article which some of you may have seen. I refer to André Citroën.

In this country we have a monopoly of the business of being selfmade; but I want to tell you that this war has proved to me that in Italy and in France, and even in Spain, there are in the making many selfmade men and that henceforth America will have no monopoly of that description. In 1914, when the war began, André Citroën was an obscure manufacturer of gears. He told me afterward that at that time his capital was less than fifteen thousand francs. He fought in the battle of the Marne. He realized then as now that France's great need was shells. He knew that we could not get over adequate shells in time. He got three days' leave and went to the War Office and said: "If you will give me a contract for fifty thousand shells I will guarantee that you will have fifty thousand shells within a year or in a much shorter time." As often happened in this war, as you know, he was given the contract and he took it. He is a great salesman, and he was then only thirty-three. He went to the bank and borrowed on the contract in order to start a factory. He sent the best shop man in France to this country to buy every automatic machine he could get his hands on, and his instruction to him were: "If you cannot get those machines from Cincinnati and Chicago and elsewhere to New York by freight send them by express." And he got them to New York, and he got them to France. He leased a great area of land within sight of the Eiffel Tower. When I first met Citroën in the early part of 1915, he had built three factories, and he was making twenty-three thousand shells a day. Today he employs fourteen thousand people and is making 65,000 shells a day. That is a selfmade man of France!

It may interest you to know that the things that made possible this combination of Charles Schwab, Henry Ford and Westinghouse in France was the fact that we had the stuff on hand and got it over, and it was United States machinery that did the job, and we were the only people in the world, as some of you sold him the stuff know, who had it.

I tell you the story of André Citroën, not because it is a thrilling story of selfmade success, but because behind it, behind this heroism, this sacrifice and devotion to France, there is some live wire which means that France is going to come back, and France is going to have a hard journey when this war is over. France and England, as I will tell you, are going to try, as Italy will try, to make themselves as self-sufficient as possible.

The Competition to Come

Do you know that when this war is over sentiment is going in the "discard." It is going to be a struggle for existence; and competition between countries, which was once merely a part of the orderly development of the country, is going to be a fierce struggle to live; and no man can go to England today without feeling the thrill of the imperial heartbeat, of getting the effect of a galvanic something that proclaims a nation aroused.

This war has made of England a great crucible, and out of that melting pot has come an empire bound together by hooks of industrial ties as great as the bonds of courage and sacrifice and service that distinguished the Anzacs and the Scot on the battlefield of France.

England will be the great country to whom we must look for great competition when this war is over, and wherever and whatever England gets when this war is over she is honestly and justly entitled to.

I have been with Haig's armies again and again, and when I speak of them—perhaps you would like to hear a word about Haig, as I have often seen him, that incomparable soldier—it will be an interesting thing for you to know that as long as there is a line of British khaki left that line is going to hold. While we are on the subject of England, I have studied, as some of you know—I have been the envoy of Wall Street for many years—I have studied the science of business organization in every country; but the British army today represents a scientific business efficiency, a standardization of effect, a cohesion of energy, that would represent one thousand steel corporations and Standard Oil companies and Henry Ford factories rolled into one.

I have seen that army in action a month at a time. Those men have been my comrades. I have lived and almost died with those men, and when I tell you, knowing Haig as I know him, having lived with Haig and seen him in every condition of modern warfare, my own feeling is that the Germans, no matter what they may not see, at last have come to the unconquerable will of opposition which spells for them, as the doom note in the opera, the end of their aspirations in the field.

There are in England today, as some of you know, two great organizations which are of interest to every man who makes machine tools in this country. One of them is the Federation of British Industries, which, I believe, you know, and the other is the Empire Producers' Association, a federation of British interests today, which has got a membership of five thousand firms. The original initiation fee of that association was £1000—think of it, five thousand dollars!—and it has built up a great campaign fund which has been extended to explore the world for trade opportunities for England and Scotland and Ireland after this war is over, and the Empire Producers' Association is doing for trade and resources what that great British army has done in fighting. In that British army you see the New Zealander, and the Australian, and the South African, and the Scot, and the Welshman, and the Irishman, side by side. Those men

fight. And in this British Empire Producers' Association you find Australia and Canada, and the other British colonies, in every place where the British flag flies, linked together in a coördination of effort which will not only develop every resource in those colonies, but standardize them and segregate them for the use of Britain after the war.

Britain has learned at great cost, as we learned to a small degree, her dependence upon Germany when this war began. Britain then solemnly registered the vow that never again would she depend, if it were humanly possible, upon another country for the wherewithal with which to live and to manufacture. That is why I say the great lesson for you, born of England's awakening, born of a great industrial rival, born of that colossal speeding up, which to see is to give you a thrill, is that Great Britain is going to unfurl her flag of great industrial effort when this war is over, which is going to startle the world.

I want to leave in your minds one final picture. One afternoon not very long ago I got out of a train in northern France. I had left the Italian battlefields behind, and I had made my way through German-ridden Spain, and I was back in the domain of death, the empire of fighting men. I noticed as I got off the train groups of good-looking, smooth-faced, loungy chaps who were chewing gum with both jaws, and who rolled cigarettes with one hand, and then I began to hear such bits of conversation as "Can that bull," "Let us beat it back to camp," and I suddenly realized that after years of wandering, with strange troops and fighting men, with strange flags, that at last I had come upon my own.

I would like to say that I have heard operas in all of the great opera houses in this world, but never in my life has music been so sweet to me as the sound of that Middle West or Southern slang that I heard that afternoon in France. I got in a car and started up the road. You know in this war every day things happen that if you read of in a book or saw on the stage of a theater, or on the screen of a cinematograph you would say they could not happen in real life. But great deeds of service and heroism become so commonplace in this war that they cease to have any other interest for you except they are part of the day's work.

In my three years' experience in this war so many thrilling and wonderful things have happened that it takes a great outstanding, overwhelming experience to really excite me, and I say there came one of those experiences which if you had read it in a book or saw it on a film you would say it was a great ending of the third act.

Seeing the First American Flag

I was going down the road in my car on an October afternoon; the hills were all red and brown, and there came over that part of northern France a curious stillness and quietness, and it seemed in curious contrast with all the rest of the country that I had been through. It was just at that very haunting and searching hour of the day when things seem to be more elusive when they are in twilight, when I came to a turn in the road and I looked on my right and there in the last rays of the setting sun, just as if the great Stage Manager of the world had set this scene for me, I saw that flag—the American flag! That was the first time I had seen it in the war.

As I told you, I have seen some thrilling things. I saw, as I tried to tell you, the British Grand Fleet break through the haze of the Scottish coast, an enthralling and unforgettable picture of imperial power. I have stood with the Belgian army hip deep in the reddened Yser Canal, where that gallant little army was defending the final fringe of Flanders. I saw the last great charge of the Crown Prince's army at Verdun; and across that line that stretched across Italy, which is known as the Carso, I saw one of the great hand-to-hand battles. I have stood shoulder to shoulder with Haig's incomparable army, all the way from Ypres down to the valleys of the Somme. Yet in all that experience I had not seen anything—not even the old French woman, that showed me the flag and the medals—that exalted me so much as the sight of the Stars and Stripes whipped out by the winds of France raised over the soil of that great redemption.

I went on, as the night was coming on, and finally I came to a little town that you now see will be forever famous in history. I stopped before a great, white, square building that flew the American flag on one side and the French flag on the other, and almost before I knew it I had gone up the steps and was shaking the hand of a great, big, bronzed man, who had some of the atmosphere of Haig. He had large, deep, fine, tender eyes and deep lines in his face; he wore two stars and an eagle on his shoulder, and he gave you, as Haig does, and especially as Foch does, the impression of power and authority—and that is the way I met General Pershing.

We talked a long time that night—rather he did—and when the time came for me to go, it was night. Night had come down over this little French town, and it was the time to change the guard. You could hear the march of our troops down the French street; the tramp of good Massachusetts shoes on the French cobblestones. You could hear the sharp note of young Massachusetts voices, young Massachusetts or Middle West officers giving the note of command. You could hear the rattle of Springfield guns on the French flagging. Through the trees I could see the American campfires, and across the night air there came the sound of our troops singing, and just in the faint light of the dim gaslight I got the end of the headquarters flag as it waved in the breeze, and then there came over it, over that French night, that most wistful, that most mournful and most exquisite music in war—the sound of taps.

No More Aloofness

General Pershing had got up and was standing at the casement, and I was standing alongside of him, and we were both thinking. He was hearing what I had been hearing, and we were both thinking the same thing—this big, bronzed man, with those lines in his face, who at that moment was the hope of one hundred and ten million souls, and the goal of the American forces. He was thinking that in this one thing, that in the sound of that marching of American troops, in the beat of their shoes upon the French cobblestones, in the sound of their guns on that French sidewalk, and in the benediction of that bugle call that floated out over that French night, it meant one thing, and only one great thing—that at last America was up and doing, and that old aloofness of ours from world entanglements and world obligations was ended, and that a new glory had come to Old Glory.

There was a time when I felt that a soaring optimism and a proud dependence upon our national resources would impair our participation in the war. Since we were the greatest advertisers in the world I felt that our people would take the publicity of what we were doing in the war instead of the actual performance; that we would accept the promise for fulfillment. All the while I knew, as many of my colleagues knew, the almost tragic dependence the Allies were feeling upon us; the yearning of the Allied heart that for three and a half years had been torn and rent. I knew, too, as only people who have seen this war can know, how absolutely essential it is for America, not only to fulfill her contract, but to do it now, because the next three months will be the most crucial and critical of the war. In that next three months will be determined how long Germany can last, and just what America can do, if there must and will be a limit to that heroic endurance of the Allies that has stood the grim test these last soul-racking years.

But I have lately traveled and talked much in this great country of ours. I have been out among our people and seen them under varying conditions, and under the stress of what is now a vast resentment. It is only when a nation is angered that it is aroused, and that moment, I believe, has come to us. I have clasped the hand of this country, and with that handclasp I have felt its heart. I have seen everywhere the sign of a great awakening, and in that awakening is a portent of the things that are to be, and the greatest of these is the wrath of a patient people, slow to anger, but swift, terrible and irresistible in retribution.

Out of all that I have seen and felt these past few months emerges a vision. I see this country in the terms

of a nationwide service flag that floats from sea to sea. Its crimson border symbolizes the rich blood of a resolute Americanism, even now mingling with the richer hue of a heroic sacrifice on the battle line of freedom. In its pure-white field I behold the shining symbol of our high and unselfish purpose in the war, while the millions of blue stars gleam as the eyes of the soul of this Republic—alert, unafraid and unconquered.

Priorities on Machine Tools

By Charles T. Foster

Assistant Commissioner Priorities Committee, War Industries Board, Washington.

You can congratulate yourselves on being in a business which however hard it is to pull off at this particular moment still is a going business and a requisite business in all the operations of the Government. Those of us who have been engaged as manufacturers for a great many years in industries which we thought were quite necessary to the community at large find ourselves at the present moment, a good many of us—and we hate to use the term—that we are in a sort of nonessential business.

The functions of various committees are little understood—I think too little understood—by the business men of our nation as to what we are trying to do, and we are *you*—it is *your* Government—the Priority Committee is your committee, and this war is our war. So I am going to take a few minutes of your valuable time simply to talk on the origin and the changes that have come in the matter of priorities. We are a committee that was not formed—just haphazard. We are a committee with functions given us by the President of the United States to give priority in precedence on commodities of raw material and manufactured products.

The first circular issued by the Priority Committee was very short and sweet, and as we look back at it it is rather amusing, because the only shortages that were known at the time were iron and steel. The circular that was issued to the business men of America read this way:

"During the war in which the United States is now engaged, all individuals, firms, associations and corporations engaged in the production of iron and steel and in the manufacture of products thereof are requested to observe the following regulations respecting priority . . . ."

As we progressed further into the war it was found necessary to obtain other materials than iron and steel, and it was found advisable to issue priorities on a list of materials which was known in the parlance of Washington as the "Shortage List." This list grew by leaps and bounds as we came into the further prosecution of the war.

There was also the question of power to be taken into consideration, as in many sections of the country the war work was of such a magnitude that the generating capacity of the public-service corporations was limited. It was overtaxed and it was found necessary and advisable to do what we could to apportion that power to the industries that were engaged solely in war work, both direct and indirect. In addition to our many troubles there came last winter a shortage of fuel, which naturally produced a further shortage of power.

The Function of the Priority Committee

If every department of the United States Government and every department of the purchasing end of our Allies should come into your factory or into your office and demand they should be served first you would have more trouble, I think, than you have now to satisfy them and to satisfy yourself in the order of precedence as to which should come first, second and third.

That is the function, as we take it, of the Priority Committee. Instead of having to do business with one hundred customers on priority we ask you to do business with one customer—the Priority Committee. It is up to us, not because we want it, but because it is the function of the committee. It is up to us to be the arbiter, if I may use that expression, between all the contracting arms of the Government and the Allies, and to say which machine shall have precedence over that of the other.

If I may take just a moment of your time I would like to quote from the remarks of Judge Parker, the Priority Commissioner, before the War Service Committee of the various industries as to what the purpose of priority is. He said: "The paramount purpose of priority is the selected mobilization of the products of the soil, mines and factories for direct and indirect war needs in such a way as will most effectively contribute toward winning the war. This necessarily involves the relegation to the bottom of the waiting list of all products and undertakings which do not directly or indirectly so contribute. This means not only that the supply and distribution of the direct war needs must be regulated, through giving precedence to priority according to the emergency demand, but that priority assistance must be extended where necessary to those institutions which produce war needs directly or remotely, so that they may where necessary increase their production.

"It also means that through the process of evolution the production of all nonessentials or less essentials shall be curtailed or, if need be, eliminated, to the end that plants now utilized in their production, the material now consumed in their production and the labor now employed in their production may all be utilized to the fullest possible extent toward increasing the production of the more essentials in cases where the demand exceeds the supply. This is only another way of saying that all labor, all capital, all the industrial organizations, all the agricultural, mining and transportation activities of this nation shall be drafted and mobilized for war."

The Priorities Committee does not want to run your factories. We hope we appreciate that you who have established an industry and brought it up are certainly more capable than we could possibly be of continuing that enterprise in these very acute times. I do not doubt you may have had a lot of troubles in order to satisfy various departments of the Government, as perhaps somebody gets a hunch and sends out something pretty quickly, without mature thought, perhaps. But underlying the whole proposition there is no thought on the part of the committee at least, which I have the privilege to represent, of endeavoring in any way whatsoever to stop any one of your industries that you can do better than anyone else.

Don't Form Your Own Committee

We only ask that you do not form in your own organization a priority committee. We ask that you put your cards, as you have done, right on the table.

We extend to you a cordial invitation to come down to Washington and tell your troubles, give us your suggestions, and when it comes to your own industry we shall be wide open. We won't pass the buck, gentlemen. You can come in, and we shall be glad to see you, and if you tell us of anything we are doing in the way of priorities regarding the machine-tool industry that does not fit in with the right operations and which may hurt what we all want—the grandest production possible out of you gentlemen in this industry—it will be remedied if possible.

It should be remembered right here that the army and the navy and the emergency fleet have the right to commandeer. But through coöperation with the Priority Committee, as suggested by the Secretary of War, the Secretary of the Navy and the general manager of the emergency fleet, they have said that they would not commandeer until they came to the Priority Committee and gave us a chance to get what they wanted, and when they wanted, on priority.

We ask and we seek coöperation with you and ask you to coöperate with us, so that if there are any troubles which we have forced upon you, unwittingly perhaps—and we make mistakes, and plenty of them—that you will come down and talk it over with us before going to your customer. If you will come down and talk to your one big customer, and get the priority proposition straightened out there we will get along in excellent shape, and there will be no trouble, I am sure, with either you or with us.

It may be of interest to you to know—probably you all know it by this time—that a preference list is being

established. The press has given some notice of it and it relates to certain classes of industry which shall have preference in obtaining coal and the transportation thereof into their factories.

The machine-tool industry, as an industry, has been listed on that preference list; so we hope, gentlemen, that during next winter, if perchance there should not be coal enough to go around, we can say to you now that the machine-tool industry will be supplied with fuel.

There has been recently formed in the War Industries Board a Requirement Division. Mr. Baruch has given a great deal of time and consideration to getting practical ideas installed in the War Industries Board. The Requirement Division meets every morning. It is trying to get in advance of the date of delivery the requirements of the different functions of the Government, whether it be for machine tools, hospitals, warehouses, electrical propositions, or what not.

In other words, we won't get in all of us on the tail-board of the wagon. We want to get ahead of the game, if possible, and to have the requirements discussed in detail. "Do we want that hospital? Do we want that nitrate plant, and where do we want it? And if we get that nitrate plant, can we get the electrical proposition that goes with it running? And can we get the contract for the nitrate plant, and perhaps put it somewhere where there is no power, and knowing perhaps that you cannot get a turbine for so long a time to go in there?" and the rest of the things.

That, we believe, is going to help out for the contracting ends of our Government and for the manufacturers at large who have to serve the Government, so that we cannot allocate, but we can find where these things can be got orderly and quickly, and keep everybody, if we can, supplied in business.

Question of Nonessentials

You will notice perhaps that up to date the question of nonessentials has been approached and backed away from, and sometimes little said. Then perhaps you do know that we realize that we are in war, and we realize that the industries of this country must be subservient to war needs. In the last two weeks the edict has gone out that not a pound of steel or an order for a pound of steel can be entered with any steel mill unless a priority certificate is obtained.

We always before passed on the priority after the order was placed. We always insisted on knowing that the order had been placed, and with whom, as you can readily see; but today no steel mill—I presume some of you know this now—will take an order for steel until you have a priority, which means, gentlemen, that we are down to the point where the war needs, the direct and indirect war needs, are the only ones that shall have precedence, and to whom material and transportation will be given.

Again, I say you can congratulate yourselves, and the Government can congratulate itself when I look at the number of gentlemen here, that the machine-tool section shall be supplied, and we are to be congratulated that there are so many of you to make that supply.

My personal knowledge of the machine-tool business is extremely limited, as you are well aware; but I am satisfied that the patriotism of American business men is the same in whatever vocation they may be, and through that tune I am sure we are able to speak the same language.

Exports During February

Exports of merchandise for February totaled $412,000,000, compared with $505,000,000 a month before and $468,000,000 a year ago. Imports for February were valued at $208,000,000, compared with $235,000,000 the month before and $199,000,000 a year ago, leaving a favorable "balance of trade" for the month of $204,000,000, compared with $270,000,000 the month before and $268,000,000,000 a year ago.

Revised Export List Requiring Licenses

The attention of shippers and others concerned is directed to the Revised Export Conservation List, known as Appendix to Circular C. S. 2-A, issued by the War Trade Board. The commodities on the Export Conservation List are in many cases being strictly conserved on account of the limited supply and the needs of the United States and Allies for the successful prosecution of the war. Before making purchases or sales for export or engaging freight space or tonnage for these commodities shippers are advised to obtain licenses for their exportation.

These modifications became effective on Apr. 15, 1918. Export license is required for the following items which are of particular interest to the machine trade:

A

Aeronautical instruments.
Aeronautical machines, their parts and accessories.
Alloy steel.
Alloys containing tin.
Alloys, nickel.
Alloys, steel.
Aluminum and all articles containing 10 per cent. or more (in weight) of aluminum. (Individual licenses not required to Canada and Newfoundland.)
Ammunition.
Antiaircraft instruments, apparatus and accessories.
Antifriction metal.
Antimony.
Arms.
Asbestos.

B

Babbitt metal.
Balata.
Band-saw blades.
Bars, steel, sheet.
Beans, castor.
Belting leather.
Belting, leather.
Billets, steel.
Blades, saw (circular, hack and band).
Blast furnaces, open-hearth.
Block tin.
Blooms, steel.
Bluestone (copper sulphate).
Blue vitriol.
Boiler plates and all other classes of iron and steel plates ⅛ in. thick and heavier and wider than 6 in. and circles over 6 in. in diameter, whether plain or fabricated. This includes No. 11 U. S. gage, but not No. 11 B. W. gage.
Boilers, marine.
Boilers, ship.
Boiler tubes.
Bone flour.
Bone, ground.
Bone meal.
Boring machines, horizontal and vertical.
Boring mills (vertical, all sizes).
Boring tubes (oil-well casing).
Brass and all articles containing 10 per cent. or more (in weight) of brass. (Individual licenses not required to Canada and Newfoundland, except for brass commodities listed below.)
Brass pipes.
Brass plates.
Brass sheets.
Brass tubes.

C

Cable (iron and steel), consisting of six wires or more.
Cable, stud-link chain.
Calipers.
Carbon electrodes.
Cast-iron pipe.
Castor beans.
Castor oil.
Castor oil, sulphonated.
Caustic soda.
Charcoal.
Chucks, lathe.
Circular-saw blades.
Coal. (Individual licenses not required to Canada and Newfoundland.)
Cobalt, chemical compounds thereof.
Cobalt, ore and any metal or ferroalloy thereof.
Coke. (Individual licenses not required to Canada and Newfoundland.)
Collapsible tubes, tin.
Compasses, ships.
Composition foil containing tin.
Condensers.
Copper as follows:
  Ingots.
  Rods.
  Scrap.
  Tools.
  Wire.
  All articles containing 10 per cent. or more (in weight) of copper. Individual licenses not required to Canada and Newfoundland, except for copper commodities listed below:
Copper, chemical compounds thereof.
Copper pipes.
Copper plates.
Copper sheets.
Copper tubes.
Copper sulphate (bluestone).
Crucibles, graphite.
Crucibles, plantinum.
Cyanides (all).
Cylinder oil.

D

Dental instruments.
Dental platinum.
Dental supplies.
Drilling machines, radial.
Drills (carbon and high-speed twist).
Drills, twist.

E

Electrodes, carbon.
Electrodes, graphite.
Engine oil.
Engines, marine.
Explosives.

F

Ferrocyanide of potash.
Files (abrasive).
Fireroom parts, marine.
Foil and composition foil containing tin.
Fuel oils.
Furnaces, open-hearth blast.
Furnaces, steel.

G

Gas oil.
Gasoline.
Generators suitable for searchlights.
Grease as follows:
Axle and other mineral oil greases.
Grinders, internal, plain and universal.
Ground bone.

H

Hack-saw blades.
High-speed steel.
Hydraulic presses.

I

Ingots, copper. (Individual licenses not required to Canada and Newfoundland.)
Ingots, steel.
Instruments, as follows:
Aeronautical.
Antiaircraft.
Dental.
Oil-well drilling and accessories.
Optical.
Surgical.
Iron, pig.
Iron pipe, cast.
Iron plates, including ship, boiler, tank, and all other classes of iron plates ⅛ in. thick and heavier and wider than 6 in. and circles over 6 in. diameter, whether plain or fabricated. This includes No. 11 U. S. gage but not No. 11 B. W. gage.
Iron, scrap.

L

Lathes, all sizes.
Lathe chucks.
Belting leather.
Locomotives and parts thereof.
Lubricating oils.

M

Machines, as follows:
Aeronautical, their parts and accessories.
Boring (horizontal and vertical).
Drilling (radial).
Milling, plain and universal (except hand milling machines).
Oil-well drilling and accessories.
Machine tools, as follows:
Grinding machines, internal, plain and universal.
Horizontal and vertical boring machines.
Lathes, all sizes.
Milling machines, plain and universal (except hand millers).
Planing machines.
Radial drilling machines.
Slotting machines.
Vertical boring mills, all sizes.
Manganese, chemical compounds thereof.
Manganese ore and any metal or ferroalloy thereof.
Marine boilers.
Marine engines.
Marine-fireroom parts.
Metallic potassium.
Metallic tin.
Mills, plate-rolling.
Mineral grease.
Mineral oils.
Mirror iron (frequently described as "specular iron" and "spiegeleisen").

N

Nickel and all articles containing 10 per cent. or more (in weight) of nickel. (Individual license not required to Canada and Newfoundland, except for nickel commodities listed below:)
Nickel alloys.
Nickel, chemical compounds thereof.

O

Benzine.
Castor.
Castor, sulphonated.
Cylinder.
Engine.
Fuel.
Gas.
Gasoline.
Kerosene.
Lubricating.
Naphtha.
Petroleum.
Open-hearth blast furnaces.
Open-link chain.

P

Petroleum.
Pig iron.
Pig tin.
Pipe, cast-iron.
Pipe, brass.
Pipe, copper.
Planing machines.
Plate, terne.
Plate, tin.
Plate rolling.
Plates, brass.
Plates, copper.
Plates, iron and steel, including ship, boiler, tank and all other classes of iron and steel plates ⅛ in. thick and heavier and wider than 6 in. and circles over 6 in. diameter whether plain or fabricated. This includes No. 11 U. S. gage, but not No. 11 B. W. gage.
Presses, hydraulic.

R

Radial drilling machines.
Radio and wireless apparatus and all accessories.
Railway cars completely assembled and unassembled and parts thereof.
Reamers.

S

Sal soda.
Saw blades, circular, hack and band.
Scrap, copper. (Individual licenses not required to Canada and Newfoundland.)
Scrap iron and steel.
Scrap tin.
Searchlights and parts thereof and generators thereof.
Sheet bars, steel.
Sheets, brass.
Sheets, copper.
Shellac.
Ship boilers.
Ship plates, iron and steel, and all other classes of iron and steel plates ⅛ in. thick and heavier and wider than 6 in. and circles over 6 in. diameter whether plain or fabricated. (This includes No. 11 U. S. gage, but not No. 11 B. W. gage.)
Ships' compasses.
Slabs, steel.
Slotters.
Solder.
Spiegeleisen (frequently described as "specular iron" and "mirror iron").
Steel as follows:
Alloy.
Billets.
Blooms.
Boiler tubes.
Files, abrasive.
High speed.
Ingots.
Oil-well casings (frequently described as "boring tubes").
Plates, including ship, boiler, tank, and all other classes of steel plates ⅛ in. thick and heavier and wider than 6 in. and circles over 6 inches diameter whether plain or fabricated. This includes No. 11 U. S. gage, but not No. 11 B. W. gage.
Scrap.
Sheet bars.
Slabs.
Wire rope, cable or strand consisting of six wires or more.
Steel furnaces.
Strand (iron and steel), consisting of 6 wires or more.
Stud-link chain.
Stud-link chain cable.
Sulphonated castor oil.

T

Tank plates, iron and steel and all other classes of iron and steel plate ⅛ in. thick and heavier and wider than 6 in. and circles over 6 in. diameter, whether plain or fabricated. This includes No. 11 U. S. gage, but not No. 11 B. W. gage.
Terne plate.
Tin, as follows:
Any metallic alloy containing tin.
Block.
Bottle caps.
Chloride of.
Collapsible tubes.
Compounds of.
Empty container.
Foil and composition foil containing tin.
Metallic.
Ore.
Phosphorized.
Pig.
Plate.
Scrap.
Tetrachloride.
Tools, copper. (Individual license not required to Canada and Newfoundland.)
Tubes, boiler.
Tubes, brass.
Tubes, copper.
Turbines.
Twist drills.

V

Vanadium.
Vertical boring mills (all sizes).

W

White metal.
White zinc.
Wire, copper. (Individual licenses not required to Canada and Newfoundland.)
Wire rope, cable or strand (iron and steel), consisting of 6 wires or more.
Wireless and radio apparatus and all accessories.
Wolframite.

Z

Zinc and its compounds.

Jack on the Foreman's Job

By James H. Follen

Dixie's treatise on "O'Neilling" die blocks, page 611, *American Machinist*, reminds me, because of its being so different, of an incident in a shop in a near-by city.

This shop built small pumps that sometimes would pump and sometimes wouldn't, and the foreman was one of those "pesky fellers" who could not be pinned down to anything. Most of the work was made to verbal instructions, and the men were constantly reminded to "Make her a little full; that reamer cuts large," or "Make her a little scant," etc.; then if you made "her" a little too scant there would be the devil to pay.

A big Irishman, whose name strangely enough was Mike, had got in bad this way a couple of times, and on his next job, which was a lot of plugs that were to drive in, the boss sprung a new one. Walking up to Mike, who was rouging down one of the plugs in the lathe, he said: "That reamer cuts over size; make these plugs a little plump." With a smile Mike handed his calipers to the boss, saying, "Wud ye mind setting me calipers?" The boss replied, "You hired out for a first-class man; can't you set your own calipers?" Mike with a sly wink to several interested listeners said, "Whoy, yis, as a gineral thing Oi can, but just now there don't happen to be any plumps on me scale."

SIDELIGHTS

EDITED BY E. C. PORTER

American 14-in. guns weigh nearly 95 tons and are 58½ ft. long and cost $118,000.

* * *

Since the outbreak of the war 52 declarations of war have been made. In addition 21 documents have been issued severing diplomatic relations.

* * *

The 247,795 employees of the Pennsylvania Railroad System subscribed $12,061,900 in the Third Liberty Loan campaign. Besides native-born Americans over 30 nationalities are represented among the purchasers.

* * *

New airplane companies formed during March had a capitalization of $6,250,000 compared with $3,850,000 a month and $2,825,000 a year ago. The total capital of all airplane and munitions companies formed since the European war began now totals $262,000,000.

* * *

Three and a half per cent. bonds of the first Liberty loan, 4 per cent. bonds of the first Liberty loan converted, and 4 per cent. bonds of the second Liberty loan may be converted into 4¼ per cent. bonds during the six months' period which began May 9 and which will end Nov. 9, 1918.

* * *

Engineers of the United States Navy have beaten Germany at her own game by producing gun steel of unparalleled excellence, Hudson Maxim, inventor of high explosives, told the American Institute of Mining Engineers at its meeting in New York recently. This new metal, when shells are fired, resists erosion to a degree which doubles a gun's value.

* * *

The original microphones employed by the Allies for the detection of the submarine depended upon the hum of the engines and motors and operated quite satisfactorily until the Germans saw fit to mount their motors on sound-absorbing bases. However, the later systems employed have reached a high state of perfection, and not only detect the presence of the submarine, if it is in motion, but also find its exact position.

* * *

The campaign for the Third Liberty Loan was closed with some 17,000,000 Americans purchasing about $4,000,000,000 of bonds. Hundreds of thousands of individual citizens, thousands of corporations and associations, and practically every newspaper and bank in the country gave liberally of their time, space, effort and money to make the loan a success. The response of the people of the country was commensurate with the appeal made to them.

* * *

The production of graphite in Madagascar during 1917 was 35,000 tons as compared with 25,480 in 1916. The exports, however, only increased about 1000 tons, and it is said that on Jan. 1, 1918, there were 10,000 tons of graphite in stock in Madagascar. Thus, according to Consul J. G. Carter, stationed in Tananarivo, the local market has experienced during the last few months a considerable slump in prices. First-quality material is said to have dropped from $144.75 a ton to $96.50.

* * *

One of the biggest difficulties connected with the quantity production of ships is the question of rivet driving. An idea of the task may be obtained when it is said that if a concern were to build one ship a week, a weekly number of 650,000 rivets must be driven. When we consider that the best rivet drive is by a company which drives 250,000 a week, and the next best is by the three largest shipyards on the Atlantic coast, the magnitude of the task involved in driving 650,000 rivets in one week may well be imagined.

* * *

It is estimated that Americans of foreign birth or extraction purchased $350,000,000 of the Third Liberty Loan; the number of such bond buyers is estimated at over 5,000,000. A consular telegram from Shanghai, China, states that subscriptions to the Third Liberty Loan in Shanghai amounted to over $600,000. The American Embassy in Mexico City states that the subscriptions in that city are more than $384,400, more than double the quota set for the Americans living there. The Shah of Persia purchased a $100,000 Liberty bond.

* * *

Female skilled laborers in the employ of the United States over 21 years of age may be put on night work on an eight-hour shift. The laws of the state in which they are so employed limiting the classes of persons who may be employed by the Government or prescribing the hours of labor or the compensation which may be paid them are not applicable, since the operations of the federal government in the exercise of its powers are entirely beyond the field of regulation by state authority. This is equally true whether such women are employed in an arsenal or on property not owned by the Government.

* * *

According to figures compiled by J. M. Hill of the United States Geological Survey only 605 oz. of crude platinum was sold by placer mines in 1917. This is less than the sales in 1916 by about 100 oz. The imports of crude platinum amounted to 31,921 oz., not counting the 21,000 oz. of Russian crude platinum, which was received by the Government late in December. During 1917 refiners made about 33,000 oz. of platinum, 4800 oz. of palladium, 833 oz. of osmiridium and 210 oz. of iridium, which can be called new metals. Of this amount about 7400 oz. probably originated from domestic materials. The saving of scrap platinum of all classes resulted in much larger recoveries of secondary platinum metals than in previous years, a total of 72,000 oz. being recovered as compared with 48,000 oz. in 1916.

The War Trade Board announces that in consequence of the conclusion of a general commercial agreement with Norway exports to that country of commodities are about to be resumed. Exports from the United States will be licensed subject to the general policy of conservation and to the general rules and regulations of the War Trade Board. The War Trade Board further announces that no purchases for export nor arrangements for the manufacture for export of any article should be made before an export license has been secured. Some of the commodities which Norway is entitled to import, as laid down in the agreement, are as follows: Metal-working machinery of all kinds, fixtures, motor cars, motor trucks, bicycles, writing machines, cash registers, accounting machines, hardware and tools, chemicals, dyes, colors, drugs, medicines, agricultural implements and agricultural machinery, tin (raw), tin plates, lead, iron and steel (pig-iron ingots, bars, hoops, angles, plates, pipes, fittings, wire, etc.), and copper (plates, bars, pipes, wire, cable).

* * *

At a meeting of the War Trade Board recently it was voted to place a restriction on the imports of crude rubber so as to create tonnage for military needs. For the purpose of determining the adequacy of the amount (fixed tentatively at the rate of 100,000 tons a year, or 25,000 tons a quarter) a practical test will be made during the next three months, after which the experts of the board will be in a position to know whether this amount will suffice for the indispensable needs of the rubber industry and so make necessary adjustments. Based on the figures of consumption now in the possession of the War Trade Board proper notice of the amount of rubber allocated to the manufacturer for domestic use for the three months' period will be sent each manufacturer. Manufacturers having Government orders shall immediately forward to the War Trade Board a sworn statement of the amount of rubber required by them during the ensuing three months to be consumed in Government work. Using such statements as a basis, the board will be prepared to issue to these manufacturers certificates entitling them to import from overseas an amount of rubber sufficient to meet Government requirements.

* * *

The damage done in Paris by the long-range gun, writes L. K. Tomlin, Jr., correspondent at the front for the *American Machinist* and the other McGraw-Hill papers, is much less than that which results from the dropping of a bomb by an airplane. Many of the buildings hit by the long-range shells are injured only in the two upper stories, while airplane bombs sometimes wreck them to as many as four stories. It often happens that when a shell strikes, the panes of glass on the opposite side of the street are shattered while those on the same side remain intact. Detonations are such regular events that the storekeepers are going to great trouble to protect their windows. The favorite means seem to be to paste long strips of paper across the glass. The city authorities of Paris are busy providing shelters, or *abris*, for the people during air raids. These are generally cellars of buildings not less than four stories in height. On the entrances to buildings containing cellars, which have been officially designated as *abris*, are big paper placards indicating the capacity of the shelter. These placards display the words "150 places," "80 places," etc. Some of the *abris* had window gratings fronting on the streets, but at present all of them are blocked up with plaster to intercept shell splinters.

* * *

The United States Civil Service Commission is calling for women for Government work of not less than sixty kinds. More and more as the war program progresses is the Government depending upon women to perform the tremendously increased volume of work in the civil branches. The forces of civilian employees in Washington increased from 30,000 to approximately 70,000 during the first year of our participation in the war. Of this increase of 40,000 more than 25,000 are women. The commission urges women to offer their services to the Government at this time of great need. As men are called to the colors women must take their places and keep the machinery behind the armed forces moving at the maximum of efficiency. Women are not available for employment in trade positions to any great extent, but their services are being utilized in every practical way. The following are some of the positions open to them in the Civil Service: Stenographers, typists, bookkeepers, clerks of a score or more classifications which require training in some special or mechanical line, statisticians, operators of various kinds of calculating, addressing and duplicating machines, proofreaders, law clerks, welfare executive secretaries, draftsmen of a dozen kinds, telegraph and telephone operators, trained nurses, chemists, physicists, library assistants, fingerprint classifiers and many others.

* * *

In order to provide military instruction for the college students of the country during the present emergency a comprehensive plan will be put in effect by the War Department, beginning with the next college year, in September, 1918. The details remain to be worked out, but in general the plan will be as follows: Military instruction under officers and noncommissioned officers of the army will be provided in every institution of college grade which enrolls for instruction 100 or more able-bodied students over the age of 18. The necessary military equipment will, so far as possible, be provided by the Government. There will be created a military training unit in each institution. Enlistment will be purely voluntary, but all students over the age of 18 will be encouraged to enlist. The enlistment will constitute the student a member of the army of the United States liable to active duty at the call of the President. It will, however, be the policy of the Government not to call the members of the training units to active duty until they have reached the age of 21, unless urgent military necessity compels an earlier call. Students under 18, and therefore not legally eligible for enlistment, will be encouraged to enroll in the training units. Provision will be made for coördinating the Reserve Officers' Training Corps system, which exists in about one-third of the collegiate institutions, with this broader plan. This new policy aims to accomplish a twofold object: first to develop as a great military asset the large body of young men in the colleges, and second, to prevent unnecessary and wasteful depletion of the colleges through indiscriminate volunteering by offering to the students a definite and immediate military status.

The President's Readjustment and Reconstruction Commission—I

BY WINGROVE BATHON
Washington Representative McGraw-Hill Co., Inc.

While the winning of the war must be our first thought, the conditions which must be confronted when it is over must also be considered. These articles will give the thought along this line as it crystallizes in Washington.

PEACE will come some day.

In the meanwhile American industry is doing nothing whatever in an organized way to prepare for the necessary readjustment.

On the other hand England and her colonies, France, Italy, the Teutonic empires, the Far Eastern countries, and the Latin-American countries have begun to prepare for readjustment and reconstruction.

What must we do?

This article and the articles to follow are for the purpose of suggesting the immediate creation of an agency to deal with the situation which will confront American industry at the end of the war—to gather facts now, to make plans now, to educate now, and to lead the industries of the country in the victories of peace when the right time comes.

In detail this is to suggest that a great service would be done the American people, and perhaps all of the free peoples of the world, in view of the resources of the United States which must be drawn upon for a long period by the whole world after the war, if the President of the United States would appoint forthwith a commission, to be the President's own commission, to prepare for after-the-war problems—such a commission to be one not hampered by legislative enactments of Congress as to powers upon which it might be difficult for Congress to agree; not curbed and controlled by Government appropriations or the fear of lack of them; which nevertheless should certainly be established under the Government sanction of an executive order, and which should be assisted by the creation of an advisory council of Government officials and possibly the chairman of some committee of Congress. Many executive officials and legislators are themselves too busy with the work of the war to lay aside their burdens of today to deal with after-the-war problems. Their assistants and associates should be used.

As to the main commission it should include not only leaders in industry of all forms taken from the ranks of private endeavor, but it should include leaders in labor, leaders in education and leaders in all endeavors which enter into industrial effort. Such a commission should report only to the President and should take as much of its inspiration from his leadership as he had time to give from the conduct of the war with which he is charged by the Constitution. Such a commission might very well include in its appointees the following:

E. H. Gary, president of the American Iron and Steel Institute; Samuel Gompers, president of the American Federation of Labor; Arthur N. Talbot, president of the American Society of Civil Engineers; C. P. Main, president of the American Society of Mechanical Engineers; E. W. Rice, president of the American Institute of Electrical Engineers; Sidney J. Jennings, president of the American Institute of Mining Engineers; William H. Nicholls, president of the American Chemical Society; F. J. Tone, president of the American Electro-Chemical Society; J. B. Doan, president of the American Machine Tool Builders' Association; H. A. Wheeler, president of the Chamber of Commerce of the United States; P. H. Gadsden, secretary of the American Electric Railway Association and resident Washington member of the Electric Railway War Board, and S. G. Williams, president of the Highway Industries Association.

The presidents of some of the various national organizations occupied with production and manufacture in the lumber, leather, rubber, textile, glass and other great industries of the country should be included, as well as perhaps the president of the Farmers' Grange, the president of a great railroad, the president of a great shipping company, the president of a great educational institution, the president of a great insurance institution, and perhaps the president of the American Bar Association and the President of the American Medical Association.

In any case, and by all means, even if only to assure reports from abroad, the following representatives of American business in other countries: A. V. Edwards, secretary of the American Commercial Club of Argentina, Buenos Aires; Charles E. Lydecker, secretary of the American Chamber of Commerce for Brazil, Rio de Janeiro; James R. Morse, secretary of the American Chamber of Commerce in China, Shanghai; George M. Cassatt, secretary of the American Chamber of Commerce in England, London; Charles H. Sherrill, secretary of the American Chamber of Commerce in Paris, France; J. B. Stetson, Jr., secretary of the American Chamber of Commerce for Italy, Milan; C. B. Parker, secretary of the American Chamber of Commerce for Mexico, Mexico City; Preston M. Smith, secretary of the American Chamber of Commerce for Spain, Barcelona; and Theodore R. Yangco, secretary of the Chamber of Commerce of the Philippine Islands, Manila.

Organized Preparation Needed

In Washington the peace-time industries of the country are now being placed upon a war basis in a gradual manner. There has been time for a gradual "turning over" in the further organization of the war which has been proceeding steadily month by month. But when the industries of the country have been fully placed upon a war-time basis, when supplies of labor, sources of material, reserves of capital and the markets for production have all been altered to meet war needs, it will be impossible to place industry back upon a peace basis gradually without danger of disaster second only in importance perhaps to the actual loss of the war.

To meet that danger there must be organized preparation, such as is now proceeding in all of the countries at war except the United States, and these suggestions are being made to set forth a working plan as a nucleus for discussion and action.

The facts and the prospects for the future are being discussed and acted upon in almost every country of the world except this. Literally thousands of books, pamphlets and other writings have been produced in foreign countries to educate the people along these lines. More than two years ago there was created in Great Britain a Reconstruction Committee, which has since become an agency of the British Government, the work now being in charge of Dr. Christopher Addison, a Minister in the British Cabinet without portfolio, and more than two hundred subcommittees plentifully supplied with experts are now engaged in solving British after-the-war problems.

The detail of what has been done in Great Britain and the other countries previously mentioned, some suggestions as to what should be done toward readjustment in this country, and suggestions for the personnel of an advisory council, also to be created by executive order, under the chairmanship, perhaps, of Frank Lyon Polk, counselor for the Department of State, and second in command of that department, will be offered in following articles. The personnel of a suggested advisory council will be dealt with in the next article as of prime importance, because this personnel will include many of the detailed legislative and executive war-organization contracts of the United States, which must be continued at work long after the war in all likelihood, to use a homely phrase, to assist in "unscrambling the eggs."

To Answer Vital Questions

There is need at once for a responsible high officer of the Government, occupying a position such as that of the counselor of the State Department, and for him to have important associates, on such an Advisory Council, to answer fully, freely, and day by day, now, the questions that a President's Commission on Readjustment and Reconstruction might put to the Government and to help solve the problems of such a Commission.

After the war, because of accelerated thinking, we can secure the adoption of ideas that otherwise would not be acceptable or would be acceptable only after a very lengthy educational process. Therefore we have an opportunity now; for, in addition to such obvious readjustment and reconstruction work as the orderly reintroduction to industry of returned soldiers, the development of export trade and the use of our productive capacity for our industries expanded by war needs, we can use, now, the opportunity to secure the adoption by the people generally of economic theories, such as the husbanding of our exhaustible natural resources, such as coal and other fuels, iron, timber, etc., and we can also bring about now the adoption of policies which will insure the perpetual renewal of even the so-called inexhaustible natural resources, such as the soil and its products.

The tendency in any civilization after the struggle to subdue new lands is passed and life becomes less harsh is to seek ease and pleasure and not to put forth such great energy in production. The result is that the demand tends to become greater than the supply, that is, we consume more than we produce. This leads to social dissatisfaction and the moral influences which lead to decay.

A readjustment and reconstruction commission must be set to work in this country at once.

Government Jobs for Technical Men

As a result of the war thousands of technical positions paying good salaries under the War and Navy Departments are now open to competent men. The United States Civil Service Commission, whose duty is to recruit the civilian force, is urging qualified persons to offer their services to the Government at this time of great need. A war cannot be won simply with an army and a navy; a host of specialists behind the fighting forces is quite as important.

Among the positions to be filled are the following:

	Usual Entrance Salary
Automotive engineer	$2,400 to $7,200 a year
Automotive designer	1,800 to 3,000 a year
Automotive draftsman	1,400 to 2,000 a year
Automotive tracer	1,000 to 1,400 a year
Expert in motor-vehicle standardization	1,600 to 3,000 a year
Gage designer	2,000 to 3,000 a year
Automobile draftsman	800 to 1,800 a year
Engineering draftsman	3.04 to 7.04 a day
Mechanical draftsman	4.00 to 8.00 a day
Metal-furniture draftsman	4.00 to 6.00 a day
Aeronautic draftsman	4.00 to 5.04 a day
Aeronautical mechanical draftsman	1,200 to 1,400 a year
Apprentice draftsman	480 a year
Assistant superintendent of artillery ammunition	2,500 to 3,000 a year
Engineer of tests of ordnance material	1,600 to 2,400 a year
Assistant engineer of tests of ordnance material	1,000 to 1,600 a year
Mechanical engineer	3,500 a year
Junior mechanical engineer on high-pressure apparatus	1,600 to 2,400 a year
Mechanic experienced on high-pressure apparatus	3.00 to 5.00 a day
Subinspector of ordnance	4.48 to 5.92 a day
Inspector of mechanical equipment	2,700 a year
Inspector of structural steel	2,400 a year
Inspector of laundry machinery	1,800 a year
Special mechanic qualified in submarine construction	5.04 a day
Ordnance foreman	5.52 a day

Besides the foregoing a number of technical positions in the War, Navy and other departments are to be filled. For the positions named applicants are not required to report at any place for examination, but are rated upon their education, training and experience, and in some cases on work submitted with the application. Physical ability is also considered in some instances. Ratings are determined by information contained in the application blank and by corroborative evidence.

The Civil Service Commission calls particular attention to the fact that all necessary information concerning civil-service positions and application blanks therefor may be obtained free of cost by applying to the commission's representative at the post office in any important city or by addressing the United States Civil Service Commission, Washington, D. C. Many of the drafting positions are open to women.

Navy Needs 1000 Gas-Engine Men

The Naval Reserve Force must enroll at once 1000 men experienced in the operation and maintenance of gasoline engines. This is an urgent call. The men are required for immediate duty. They will be rated as machinists' mates. The age limits are 18 to 35 years inclusive, and applicants must be American citizens. Draft registrants with letters from their local boards will be accepted. Apply at Naval Reserve Enrolling Office, 51 Chambers St., New York, or any navy recruiting station.

Bullard "Maxi-Mill" Boring Mill

SPECIAL CORRESPONDENCE

The new boring mill described is believed to have features that have never before been applied to a machine of this type, and is therefore of unusual interest.

THE Bullard Machine Tool Co., Broad St. and Railroad Ave., Bridgeport, Conn., has recently designed a new boring mill. This machine is of the 61-in. size and is known by the trade name of Maxi-Mill." In designing this machine the company has made use of many of the standardized units which have been developed for their vertical turret lathe in the last 12 years. In building the new boring and turning mill such standardized and complete units as the drive, feed works, spindle construction, rail construction and lubrication systems have been embodied with only such changes as are necessarily entailed in a new combination. It will thus be seen that while the machine is in itself new numerous essential features of it are really old and have had their value proved. Fig. 1 is a general view of the machine, showing the speed-control levers at the right, the power traverse for the head, the hammer handwheels for fine adjustments in tool setting and the power arrangement for raising and lowering cross-rail. Heat-treated chrome nickel steel is used for all gears and shafts throughout the machine, and a continuous-flow system of lubrication for all gears, bearings and spindles is incorporated. An integral filter is used to insure cleanliness of the oil used. The only gear used in the machine which is not heat-treated is the table drive gear, which is, of course, of such size as to render this method of treatment undesirable. All other gears are treated to give a scleroscope hardness test of 70.

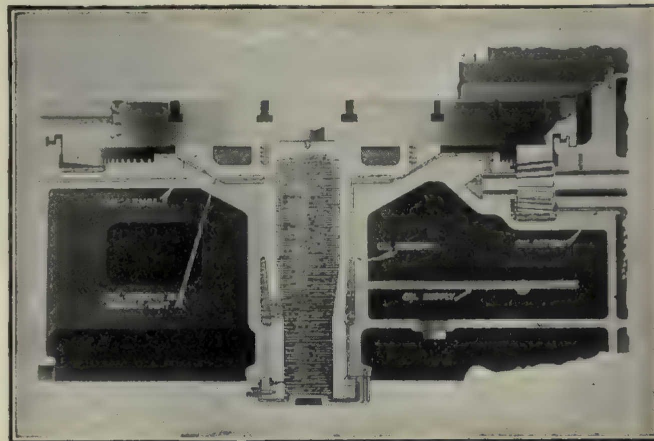


FIG. 2. CROSS-SECTION OF THE BED

Fig. 2, which is a cross-section of the bed, shows clearly the type of construction used in this part of the machine and also the method of insuring lubrication. It will be noticed that the gears and bearings are flooded with oil at all times. The form of centralized control used is claimed to be another item which adds largely to the productiveness of the machine. The control of the brake and clutch for starting and stopping the table is conveniently arranged for the operator, whether he be at the right or the left side of the machine. The crank handles have been eliminated on the handwheels,

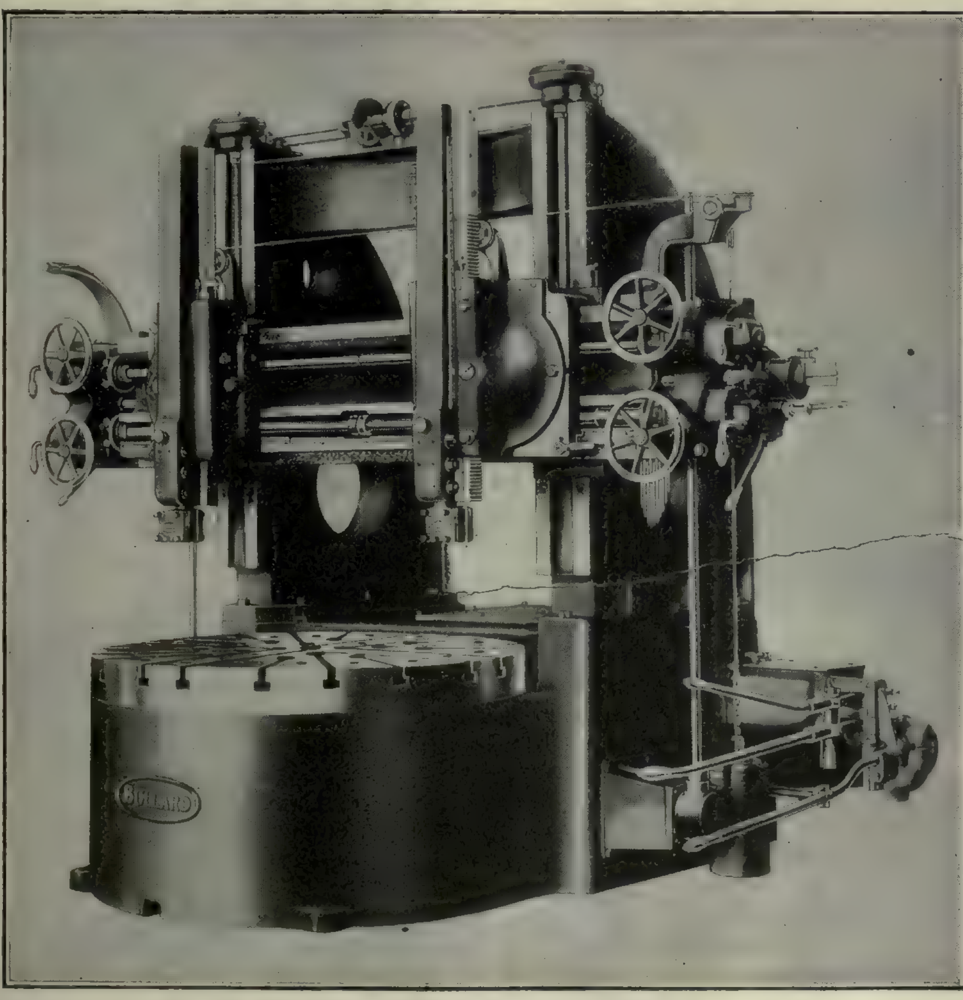


FIG. 1. FRONT VIEW OF THE BULLARD 61-IN. "MAXI-MILL"

Capacity, work up to 63 in. in diameter and 52 in. in height under the cross-rail and tool-holders; diameter of table, 61 in.; table speeds, twelve, 2.5 to 42.18 r.p.m.; feed changes, eight, 1/96 to ½ in. per revolution of table, either vertical or horizontal; vertical movement of tool slides, 36 in.; swivel of tool slides, 45 deg. either side of vertical center; driving pulley, 24 in. in diameter, 5½ in. face; r.p.m. of driving pulley, 405; motor drive, 15 hp., constant speed motor mounted on bracket at rear of machine and connected by belt; weight. 28.000 lb.; floor space with motor drive, 11 x 13 ft.; maximum height with bars in extreme upper position, 130 in.; minimum height, 118 in.

these being of the hammer type, which are claimed to make possible very fine settings of the tools. Graduated scales mounted on the face of the cross-rail and on the tool slides give the coarser settings, while micrometer dials graduated to thousandths and equipped with Bullard observation stops give the finer

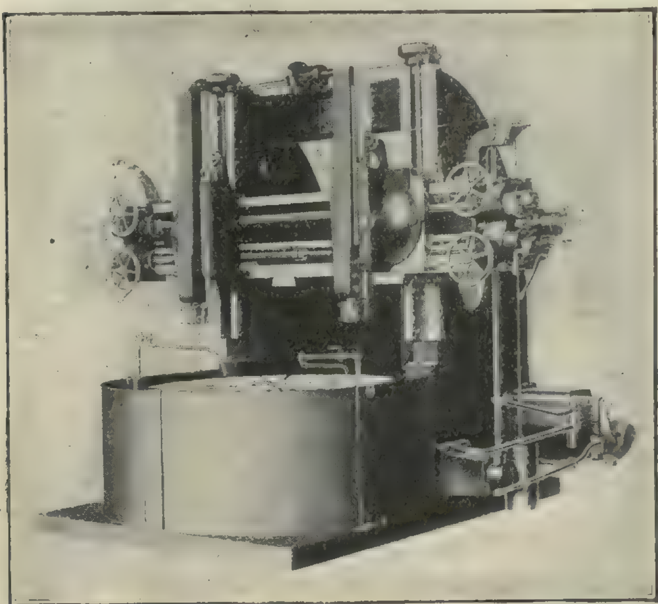


FIG. 3. THE "MAXI-MILL," SHOWING THE TABLE GUARD AND THE LUBRICANT PIPES

readings. It is believed that this is a feature which has never been previously incorporated in a boring and turning mill.

Another new feature claimed is the construction which permits the use of large and effective amounts

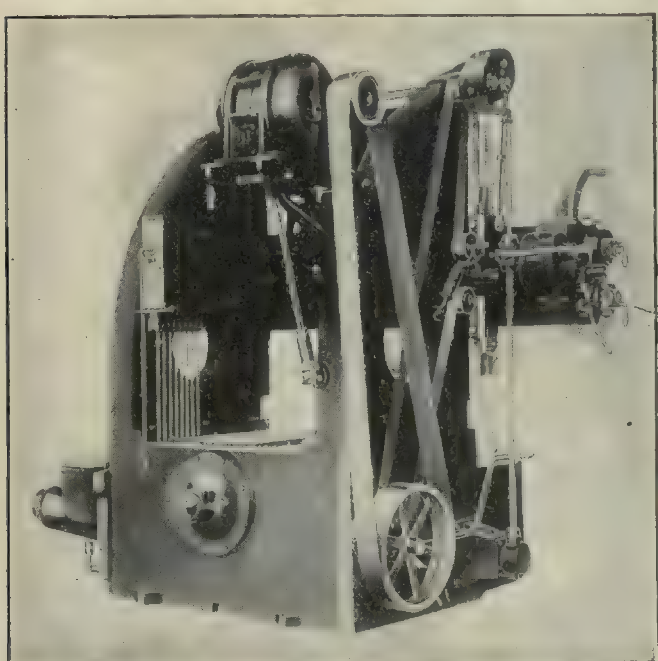


FIG. 4. REAR VIEW OF THE "MAXI-MILL," SHOWING THE OILING SYSTEM AND THE MOTOR DRIVE

of cutting lubricant on the tools. The machine has been designed with this in mind from the start, and it is claimed that the construction is such as to avoid the possibility of the cutting lubricants entering parts of the machine where they are not intended to go. Fig. 3 shows the piping at each side of the table, by means of which the cutting lubricant is led to the work. This figure also shows the table guard with which the machine is equipped. All gears are also guarded and all projecting square-ended shafts have been eliminated. Fig. 4 is a rear view of the machine and shows the continuous-flow oiling system, the motor-drive arrangement, the left clutch and brake lever, power traverse for heads, and the left feed works.

The tool slides are of cast iron, of box form with inserted toolholders. They have a vertical movement of 36 in. through a steel rack and pinion and may be swiveled 45 deg. on either side of the vertical center. Eight feed changes are available, which may be used in either a vertical or horizontal direction. The number of speeds available are 12, which are obtained by means of sliding gears and positive friction clutches operated by levers which interlock with the clutch and brake lever to avoid a possibility of accident.

When To Stop Designing

By Entropy

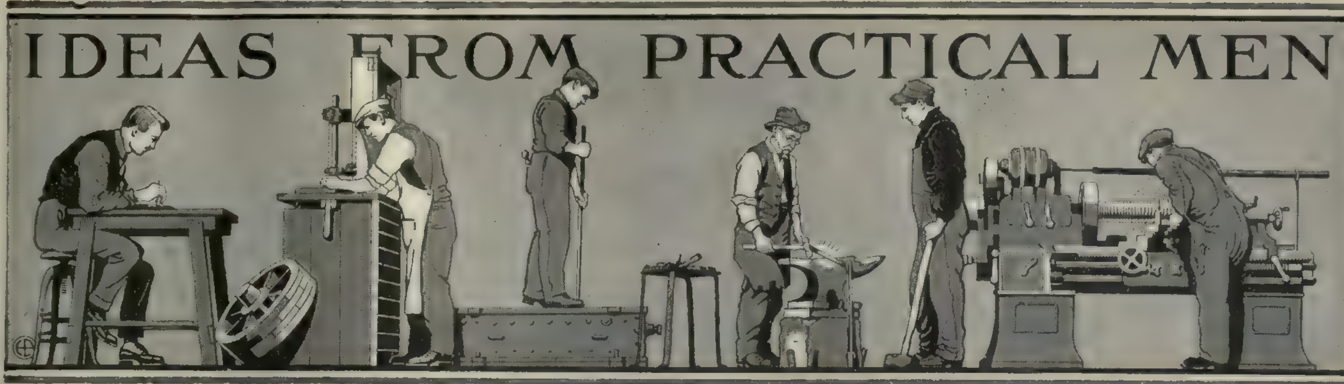
Conditions in Washington regarding design of munitions and other war material seem to indicate a tendency to keep on designing so long as any new ideas of value crop up, and inasmuch as ideas naturally gravitate to Washington at the present time there appears to be no stopping place in sight. The result is that the men intrusted with the manufacture of Government material feel as if they were in a race to see whether or not they can finish up something and ship it out between changes of drawings or specifications.

The natural course of a manufacturer is somewhat different. His designer develops a new idea, works over it for some time and lays it aside in disgust because the boss will not give it serious consideration. Some time later the sales manager reports that sales on item No. 3001 in last year's catalog are falling off because of the improved product of a competitor. Catalogs or specimens of the competitor's offering are obtained and the improvement which the designer tried so hard to get adopted a year before is dug out and the dust blown off. It seems that with a few modifications it ought to do the trick.

The designer is then told to fix it up a little and get out the details. He immediately becomes obsessed with the idea that he can improve it and sets about doing so. Soon the call comes, "Where is that new design for No. 3001?" Then friend designer has to give it up to the detailers, who whip it into shape, and it is put on sale and does its part in reviving business. In the meantime our manufacturer has stored away a lot of similar improvements, all waiting the call of the market.

In war the difference is that both sides are working under higher pressure and there is less time between revisions of design, less time to sit around and consider new improvements, and more risk in putting untried "improvements" into a tried and tested mechanism. If we are going to wait until every new and likely idea is tested out and incorporated into the first machines we will have to make some arrangement with the Kaiser to hold up the war for 10 or 15 years until we are ready to fight in our way and in our own time.

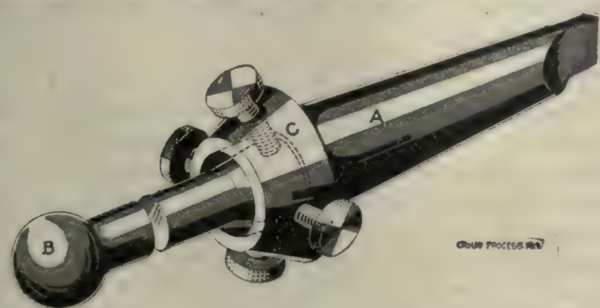
Possibly he may consent, but our allies may not.



Adjusting Locating Button

By James L. Mitton

On page 450 of the *American Machinist* William C. Betz shows an adjustable button for use in the milling machine. The writer has used a modification of this



ADJUSTABLE LOCATING BUTTON

device for some time and believes it is better than the one shown by Mr. Betz inasmuch as if care is taken to make the ball *B* truly spherical it will not be as seriously affected by any variation from truth in parts *A* and *C*, which no matter how accurate they may be in themselves are affected by the condition of the machine in which they are used.

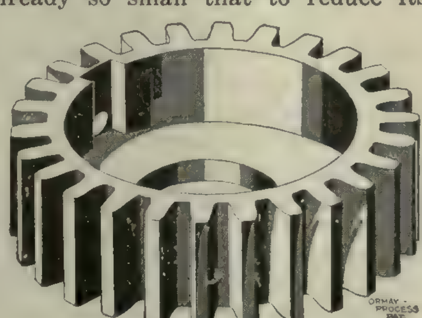
The parts in the illustration are lettered to correspond with the one above referred to.

Small Stud Gear for Engine Lathe

By M. L. Lowrey

On many screw-cutting lathes compounding becomes necessary earlier than otherwise, for the reason that the stud gear is already so small that to reduce its size further would mean to cut it open through the keyway.

To make it possible to use a stud gear with a minimum of diameter and of maximum strength the writer designed the pinion here shown.



A REINFORCED PINION

As will be seen the diameter of the gear could not well be decreased without cutting into the keyway, but the ring of metal which comes beyond the shoulder of the stud furnishes sufficient strength to make it serviceable.

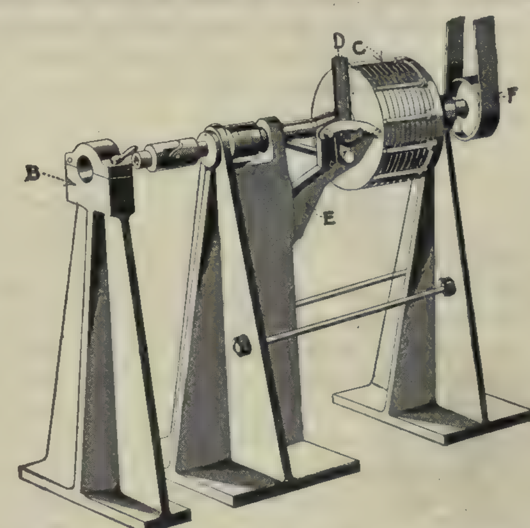
With a pinion of 18 teeth, which can be used on a lathe whose smallest stud gear is usually of 36 teeth, the finest thread is immediately multiplied by two and thus compounding is avoided.

A Testing Machine for Truck Axles

By Lloyd L. Lee,

Engineering Department, Republic Motor Truck Co., Inc.

Axles for motor trucks are rather unwieldy things to handle, and when they are assembled as a part of the truck it is a difficult and expensive operation to take them down for any minor changes or corrections that



THE TESTING MACHINE FOR TRUCK AXLES

may become necessary. To avoid this difficulty the Republic Motor Truck Co. has designed a stand upon which all such parts are tested before being built into the truck, and faults due to noisy gears, improper alignment of parts, imperfect brake and differential action, etc., are corrected before the final assembly.

The testing stand is shown in the illustration, the axle to be tested is carried upon suitable mountings with the forward part of the differential housing held on pedestal *B* by means of the hinged-cap and binding bolt.

A standard plate clutch *C* is used with a hand-brake lever *D* substituted for the foot pedal, the lever and clutch throw-out shaft being carried by the bracket *E*.

The machine is driven through the medium of the pulley *F*, which is 6 in. in diameter for a 3-in. belt. With each of these machines a man can test 50 axles a day, and defects that would not ordinarily be found until the final test or after the truck had been put into service are promptly located and remedied.

EDITORIALS

Prevent Undue Shifting of Men

THE problem of getting men for war activities has many sides—too many to even mention in one editorial. But there is one phase of the problem which demands immediate attention or production is sure to be sadly delayed in many needed industries.

The stealing of men by competing firms must stop. Just as it does not make a man richer to take his money out of one pocket and put it into another, so does it not add to the production of the country to take men away from one shop and put them at work elsewhere. And yet this is continually being done to the detriment of industry, to the congestion of railways and to the unsettling of housing conditions.

This state of affairs is a menace to our war preparations. Nearly every large industrial center has organized an employment bureau, which in one case at least is being partly financed by a portion of the Government appropriation for a new plant. These employment bureaus have a high-salaried manager whose special mission, to put it in plain English, is to steal as many men as possible from other industrial centers or from other industries.

* * *

These bureaus do not hesitate to station men outside the gates of shops already working to full capacity on war orders and to entice them away to other cities with offers of higher wages. The cost-plus form of contract makes this easily possible and at the same time adds to the profit of the contractor.

The effect of this stealing of men means more than might appear on the surface, although every manufacturer knows its significance. It not only shifts men from shop to shop or from town to town, but it adds to the congestion of the railways; it causes loss of time and it delays production in the plants in which these men have been trained, for experience in any line of work cannot be gained in a day, and the time taken to train new men or women, not to mention the loss in production and in spoiled work, is a substantial item.

There is no time now to spend teaching men and women unnecessarily. We must utilize their experience and their knowledge where it will be most immediately effective. We must not take them from one class of work to another for the mere purpose of filling one shop at the expense of another equally important one.

* * *

Some of the later contracts have a clause making it illegal for a contractor to employ a man from the shop of another war contractor within 60 days of his leaving said contractor unless by written agreement. But this does not seem to be the most satisfactory or the most scientific solution.

The rational method of handling the situation would seem to be the establishment of a national clearing house for labor engaged either directly or indirectly on war contracts. This should be in charge of a man of wide experience and of sound judgement. Such a man would handle the matter in the broadest manner; would consider human idiosyncrasies, and would secure results by coöperation rather than by enforcing his decisions. This is promised in the new United States Employment Service, whose work has already begun.

Priority in labor—for this is what such a clearing house would effect—is fully as necessary as priority in material. The problem must, however, be handled in an entirely different manner. For to consider labor in the same impersonal way that we do material is to doom any such plan to immediate failure, and deservedly so.

Nor should such a clearing house confine its attention to the mechanic. It must apply also to foremen and the higher executives.

* * *

There must be no discrimination because of the kind of work that is done. For if it is important that machines be kept at the most important work and the work for which they are best fitted it is all the more important in the case of executives. If labor is to be controlled, or regulated, as seems probable, it must extend clear up the line, with no exceptions; it must be applied to all. Every man whose service can be of value should be utilized, and he should be glad of the opportunity to serve.

The Liberty Loan slogan of Secretary McAdoo might be paraphrased to read, "Would you be more tender of your executives than of your sons?"

There is much work to be done, and the main requirement is that it be done as speedily as possible—the exact details do not matter so much at this time. Let us utilize all our resources, including man power of all kinds, at the earliest possible moment.

The Need of Trained Mechanics and Engineers

NO ONE who observes the tendency of modern times can fail to note the ever-increasing part that is being played, and that must be played, by the engineer and the trained mechanic. This is emphasized by the great war, which is so largely mechanical as to make the demand for skilled mechanics so urgent as to be almost impossible to supply.

Never was the demand for trained men so great or the supply so limited. And this applies to all branches from the skilled tool and gage maker to the highest executive. The Government can use hundreds of skilled engineers, production men, works managers, inspectors, metallurgists and men of various kinds.

Predictions as to the future are uncertain; but it is hard to conceive of the time when thoroughly practical executives and workmen, designers and engineers will not be in demand. Many who have gone to France will, sad to say, never return. And the work of reconstruction which must be done will require thousands of men

of all kinds—the trained men naturally being most in demand.

The need of men with a solid foundation of both common sense and mechanics is shown by the strenuous efforts being made in various parts of the country to train men in various ways. The broader the foundation and the wider the field of vision the more useful a man can be and the better chance he will have of attaining success. And the opportunity for this success, both now and in the future, seems to be unquestioned.

One of the great handicaps of the present is the lack of skilled men in the vital industries. The value of careful and systematic training was never more clearly shown. Many of the delays which have occurred in securing desired outputs have been due to being obliged to depend on men with a meager training.

There is probably nothing which the country needs more than a goodly supply of trained men of various kinds. The enlistment of young men of ability with engineering education for active service has been one of the mistakes of all countries and a distinct loss to the world. And this loss must be made up by training more young men to take their places. No one should neglect an opportunity to add to his knowledge of engineering and mechanical matters—not in a haphazard manner, but by systematic study and effort. In no way can the young man with mechanical ideas do more for his country and for himself.

All Kinds of Labor Needed

PRODUCTION depends primarily upon labor and materials. The machine does not become a factor until labor has secured the necessary materials and fashioned them into the various kinds of tools and machines needed. This labor is of many kinds, and includes head as well as hand—all who in any way add to production. And neither can be independent of the other. Whether they are considered of equal importance is immaterial as both are absolutely necessary.

Production also depends on the harmonious relations of the two kinds of labor and of all those who only supply the capital necessary for the undertakings. And this is one of the greatest stumbling blocks at the present time.

Man power and production are inseparable. The two are so closely tied up with the same problem that they must be considered together. And in attempting to solve the problem we must not take any narrow or untenable ground.

Production must go on without interruption—a single day's delay in the output of shells or other necessary material may easily lose a battle and add thousands to the casualty list. And no differences as to wages or hours or shop conditions should ever reach the stage of interfering with the output at a time like this.

Wages have increased to an unheard-of figure in many localities, and to those who think in terms of ten years ago they seem high enough to satisfy anyone. Yet the worker is seldom any better off than before, owing to the increase in his living conditions, which have at least kept pace with the wages and have often exceeded them. And the end is not yet.

With the decrease in available man power higher wages will be offered by war contractors, especially those with cost-plus contracts. And this will cause further shifting of men and further delays in production unless we adopt a sane and sensible method of dealing with the situation.

The local offering of higher wages does not increase the available man power. It simply shifts it from one point to another. This delays production, congests the railways and interferes with the housing conditions in various sections of the country. This is one of the reasons that all labor is not employed at present—the men are taking chances at getting the maximum wage rather than taking a job at a lower figure. And production suffers.

With the supply of labor limited, especially in the case of the skilled worker, the principal occupation of the employment manager becomes that of stealing men from some other shop or town and endeavoring to prevent the other fellow from making inroads.

The New Tax Bill

THE business men of the country will stand behind the President in his demand for the passage at this session of a new tax bill. The present bill is manifestly unfair in many particulars and it is believed that a much more equitable bill will be passed next time.

War needs are our first consideration. Nothing must delay the equipping of troops, the upbuilding of the navy, or the supply of every needed material. And this means the raising of money in ever-increasing amounts. Much of it must be raised by taxation to avoid saddling too big a debt upon future generations.

We are all willing to pay our share, but we all resent any law which makes it possible for an individual or a class to escape. This time both the House and the Senate will consult with representatives of business, as they should, but as they largely failed to do last year. Business is to have an opportunity to state its case, and it is to be hoped that it will show the proper spirit by not attempting to shift the burden unjustly.

The President is right in demanding the passage of the bill as soon as possible in order that business may adjust itself to meet the new burdens which must be imposed more readily. He is also right in pointing out that excessive profits should be made to bear a large share of the burden, for no true American desires to pile up huge profits in the materials which our boys need to vanquish the foe.

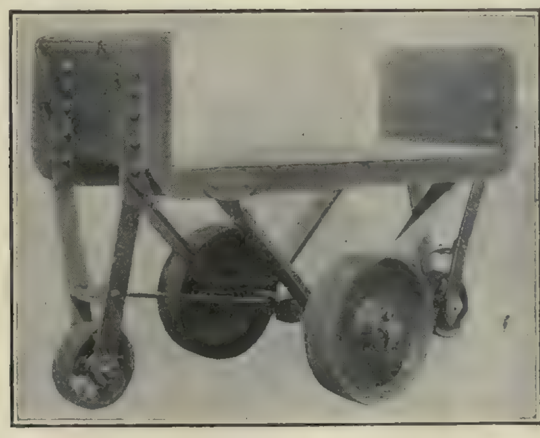
Just when Congress adjourns is immaterial—and it should certainly stay at its work until this bill is passed so that business may know what is expected of it. Washington is not a cool summer resort, and our representatives in Congress could easily be more comfortable in other localities. But we are asking our workmen to stay on the job regardless of the weather and we have more right to expect loyal service from our representatives and senators.

The work is of vital importance and it should not be hurried in the desire to get away from the halls of Congress. It should have careful consideration in every particular, even if it takes until the next session. Let us back up the President in his appeal for early consideration of this important subject and demand that it be given all the time necessary to frame a bill which shall be as fair and as just as human beings can be expected to make it.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist"

Orenstein-Arthur Koppel "High-Level" Manufacturing Trucks

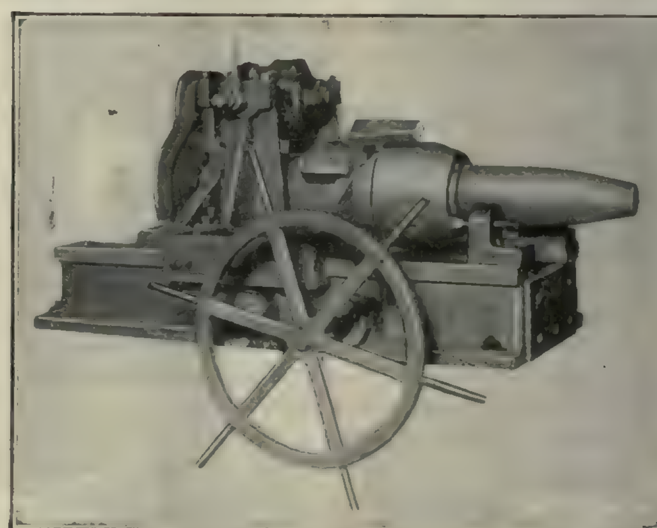
The truck illustrated is one of the recent products of the Orenstein-Arthur Koppel Co., Koppel, Penn., the feature of the device being that the surface level of the truck is considerably higher than ordinary, thus rendering it much easier for the workmen to transfer heavy parts from the truck to the machine or vice versa. It is known as the "High-level" truck. The truck is so constructed that the load is balanced on the center axle, which is provided with wide-tire, roller-bearing wheels. The truck is of heavy construction throughout and its rated capacity is two-thirds of a ton.



"HIGH-LEVEL" TRUCK

Whelan Shell-Nosing Attachment

The shell-nosing attachment shown in the illustration is designed to be attached to any standard steam or air hammer or any mechanical forging press in which the lower is the fixed die and the upper the movable one. The device is at present being built for 4.7-in., 155-mm., 8-in. and 240-mm. shells. It is the product of R. J. Whelan, 328 Fourth St., Elyria, Ohio. The machine consists of a carriage traveling on ways planed on a cast-iron bed, the carriage containing a spindle nut to which is fitted a four-jawed collet chuck. This collet chuck is operated by means of an external nut, this being tightened or loosened by revolving the spindle and engaging the nut against a projecting lug on the carriage by means of a detachable pin. The spindle is revolved by means of an air-operated motor, which operates through a geared reduction, while the carriage is fed forward by means of a rack-and-pinion mechanism, operated by the handwheel shown in front of the machine. As the shell is fed forward into the dies by means of this handwheel, the throttle of the air motor used for operation is gradually opened so that the further the shell moves into the dies the faster it revolves.



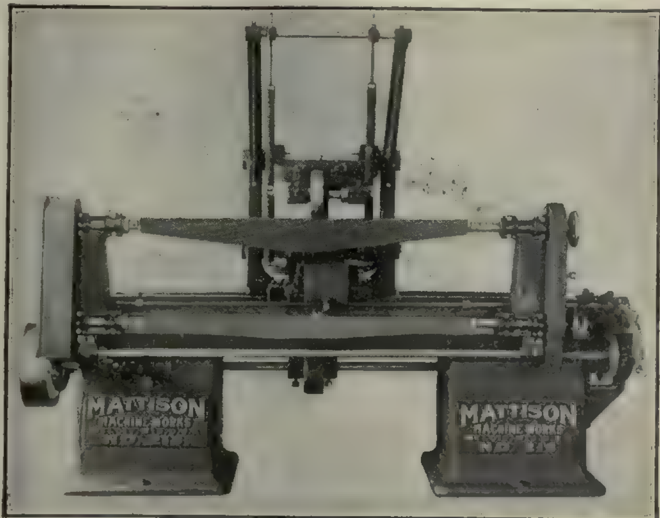
WHELAN NOSING ATTACHMENT FOR SHELLS

It is claimed that the entire operation of swaging in the nose with this attachment and the starting of the press or hammer takes but about 35 seconds.

Mattison Airplane-Strut Lathe

The illustration shows a heavy-type copying lathe for airplane struts, which is one of the recent products of the C. Mattison Machine Works, Beloit, Wis. The machine has been made up especially for strut work, and the special feature is the double end drive, which is claimed to eliminate any tendency of the work to twist or revolve with a springy or jerky motion as happens when long stock is driven from one end. This feature is claimed also to prevent wind in the finished stock and gives smooth cutting. Another feature is the double-rocker type of carriage. The main carriage feeds in both directions, which obviates the loss of time involved in shifting the carriage to the starting point

between cuts or operations. Quick-change gears give three feeds, it being possible to operate these while the machine is cutting. The cutter head is particularly adapted for spruce and the rate of feed may be varied from 7½ to 30 in. per minute. The machine is entirely self-contained and may be belted direct from an individual motor or a countershaft, as desired. The

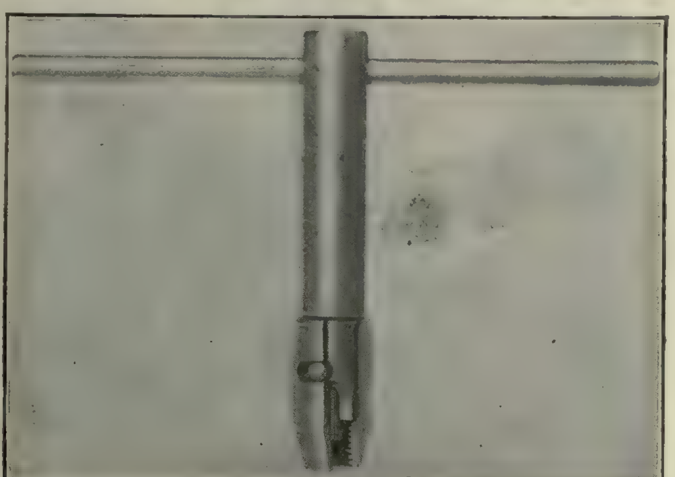


MATTISON NO. 215 LATHE FOR AIRPLANE STRUTS

standard machine takes work up to 6 ft. long, but machines of larger size can be supplied on special order. The floor space is 4 x 11 ft. and the shipping weight is 4500 lb.

Giern & Anholtt Stud Driver

The illustration shows a hand-operated stud driver that is the product of Giern & Anholtt, 33-43 St. Aubin Ave., Detroit, Mich. The tool shown has been cut away in order that the construction may be clearly seen. It



GIERN AND ANHOLTT STUD DRIVER

will be noticed that the stud is screwed into the outside, or tubular, portion which is held on the handle by means of an inclined slot working on a pin in the handle. Due to the action of screwing the stud into place the handle is advanced by means of this slot and pin and holds the stud firmly. On reversing the motion of the handle the pin moves in the slot and releases the pressure on the stud, thus allowing the driver to be easily unscrewed without disturbing the stud.

Taft-Peirce V-Blocks and Knife-Edge Squares

The illustrations show two of the recent products of the Taft-Peirce Manufacturing Co., Woonsocket, R. I. Fig. 1 shows a set of V-blocks which are approximately

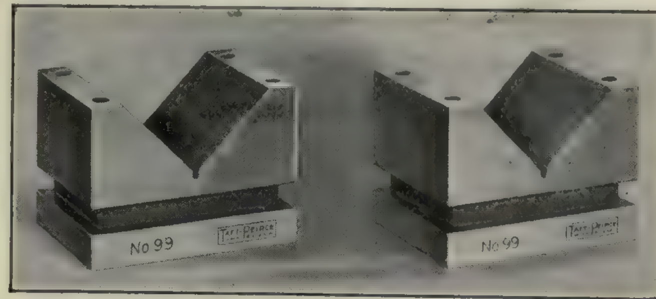


FIG. 1. TAFT-PEIRCE V-BLOCKS

2⅞ in. high, 4 in. wide and 2⅞ in. long. The V is 2⅞ in. wide at the top and the clearance groove at the bottom ⅛ in. wide. These blocks are made in pairs only and are numbered. They are made of tool steel,

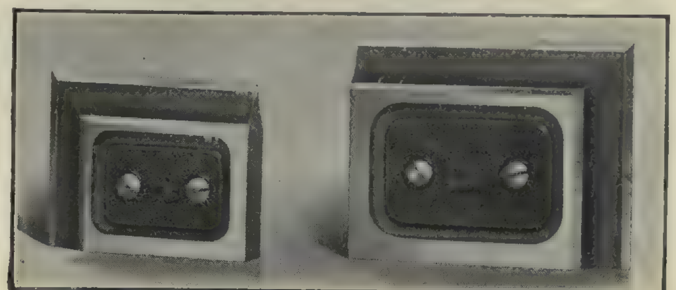


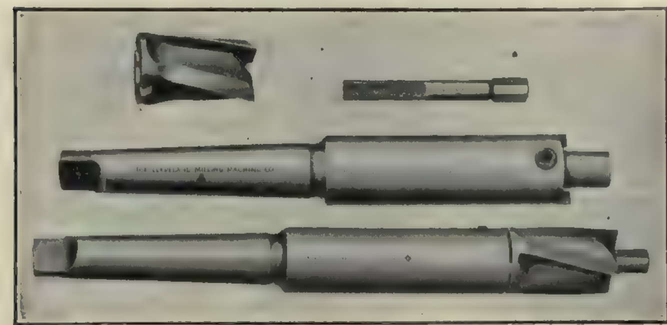
FIG. 2. KNIFE-EDGE SQUARES

hardened and ground all over. The top is left clear for work by providing wide grooves in sides and ends for clamping purposes. Fig. 2 shows the universal squares, which are made in two sizes, 2 x 2½ x ½ in. and 2½ x 3 x $\frac{9}{16}$ in. They are hardened, ground and lapped to size. The knife edges are lapped square with the flat faces so that each tool has several squares that can be used. The surplus stock is removed from the center of the tool and insulating pieces are inserted which not only make a very substantial grip but decrease the weight of the tool.

Cleveland Interchangeable Counterboring and Spot-Facing Tools

The illustration shows one of a new line of counterboring and spot-facing tools that is now being marketed by the Cleveland Milling Machine Co., Cleveland, Ohio. The illustration shows the various parts as well as an assembled tool. It will be noticed that these parts consist of a shank, cutter and pilot. The shank is made of high-carbon steel and is heat treated. The cutters are made of high-speed steel and have taper holes fitting the arbor. The cutters are driven by two face keys and the construction is such that they may be readily ground for sharpening purposes. The pilots are also made of high-carbon steel, heat treated and ground to fit the hole in the shank. The diameters of the pilots are regularly ground 0.0015 smaller than the specified size in order to avoid freezing. The holder is made in

eight different sizes and a number of different sized cutters and pilots are made for each separate size. The complete set includes cutters from ¾ to 5 in. in diameter,

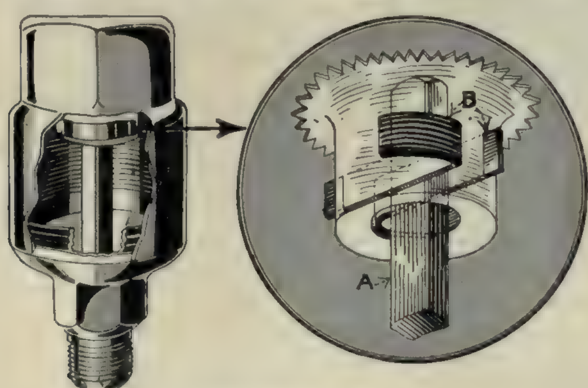


CLEVELAND COUNTERBORE AND SPOT FACER

while the pilot heads range from ¼ to 1¼ in. in diameter. The holders are made with Morse taper shanks, which vary in size from No. 1 to No. 6.

Dawson Grease Cup

The Dawson Manufacturing Co., 4928 Broadway, Chicago, Ill., is now marketing a line of grease cups, one of which is shown in the illustration. A number of styles are being made. A feature of this grease cup is the device which prevents the cap from unscrewing, due to vibration. The lower, or stationary, part of

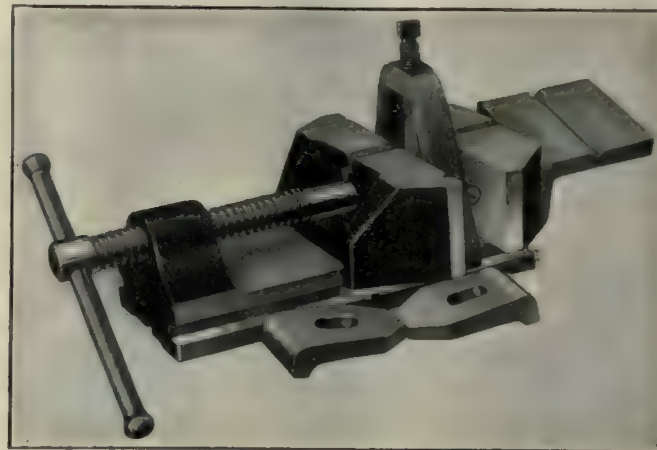


DAWSON GREASE CUP

the cup is provided with a square rod *A* fixed in place, and this projects up between two springs *B* which are secured in the cap. These two springs grip the flat sides of the rod, and while the top may be easily unscrewed the springs exert sufficient pressure to prevent its unscrewing accidentally. Another feature of the device is that the square rod enters a round hole in the portion in which the springs are secured before the threads engage. This insures the cap being lined up properly when being put in place and prevents the crossing of threads and the consequent damage. The cup is made in six styles with inside diameters of from 13/16 to 1¼ in.

Germanow-Simon Combination Vise

The combination vise shown in the illustration is for use on drilling, milling or other machines and is one of the products of the Germanow-Simon Machine Works, 58 Mill St., Rochester, N. Y. It will be noticed that the device includes a vise; a V block; an adjustable angle plate, which also has a V cut in its surface, and a removable steel clamp for holding work in the Vs. The vise jaw is operated by a square-thread screw which bears against the jaw above the center. Two Vs are cut in the face of the sliding jaw and the ends of each jaw extend 1½ in. beyond each side of the base. The angle plate is secured to the end of the vise and is held



COMBINATION VISE

No. 1 Vise: Length of base, 12½ in.; width of base 5 in.; extreme height, 5 in.; depth of jaws, 2½ in.; width of jaws, 8 in.; opening of jaws, 5 in.; capacity of clamp, 2 in.; weight, about 75 lb. No. 2 Vise. Length of base, 15½ in.; width of base, 7 in.; extreme height, 6 in.; depth of jaws, 3 in.; width of jaws, 9 in.; opening of jaws, 7 in.; capacity of clamp, 3½ in.; weight, 105 lb.

in any position by means of a single nut. Two standard ⅝-in. slots are cut in the base of the vise which makes it useful for milling-machine work. The vise is at present made in two sizes, Nos. 1 and 2.

H. P. Grinding Wheel Dressing and Truing Tools

The H. P. Co., 45 Fort St. East, Detroit, Mich., is now marketing a line of wheel-truing devices, two of which are shown in the illustrations. Fig. 1 shows the

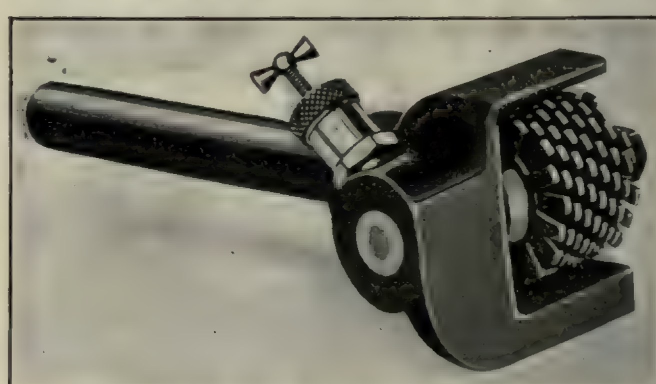


FIG. 1. H. P. NO. 1 WHEEL DRESSER

No. 1 dresser, for precision machines. This tool, it is claimed, is equipped with thoroughly lubricated dust- and water-proof bearings which allow the complete utilization of the cutters. It is claimed that one new set of cutters will give approximately 1500 dressings. It will be noticed that the device is equipped with a grease cup and is also provided with a guard to prevent broken cutters or chips from flying into the face of the operator. This dresser is also made in a No. 2 style, which is provided with an extended handle

fitting it for more general work. The cutters are $1\frac{5}{8}$ in. in diameter by 1-in. face. These two tools are primarily intended to true wheels for rough or semi-finish grinding operations. Fig. 2 shows a wheel truer which is intended for use on wheels used for finishing work. It is provided with double adjustable bearings

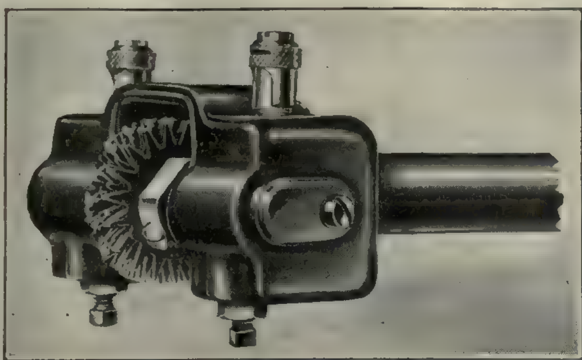
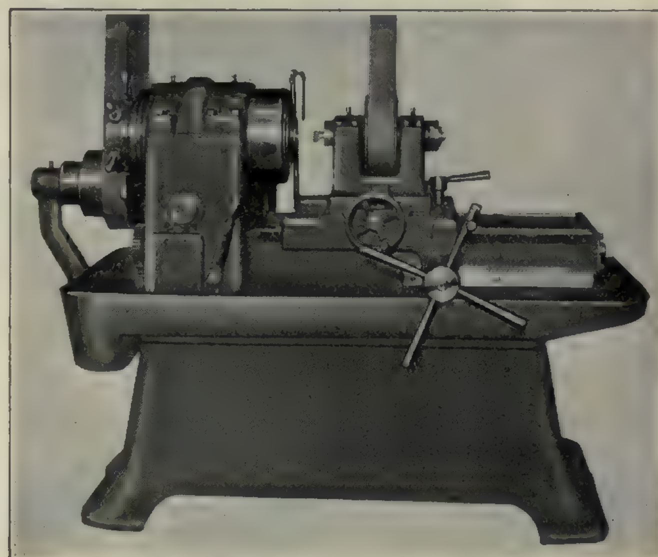


FIG. 2. H. P. NO. 3 WHEEL TRUER FOR FINE WORK

and is equipped with a set of cutters of thin metal, and it is claimed that the teeth being sharp and close together give a very smooth, sharp surface to the wheel. This truer is intended for light work only and should not be used where heavy work is being done. It will be noticed that this tool is also provided with a guard which prevents broken cutters or grit from flying into the face of the operator.

Biggs-Watterson Thread-Milling Machine for Shells

The machine illustrated has recently been placed on the market by the Biggs-Watterson Co., Guardian Building, Cleveland, Ohio, in answer to the demand for a machine for milling threads on high-explosive shells and other lines of commercial work. The head and bed are cast in one piece which, together with the oil pan, are mounted upon the pedestal. One of the improvements claimed for this machine is that the work spindle and lead screw are both driven from a single worm drive, this feature, it is said, insuring a powerful, positive and sensitive drive with maximum accuracy and precision, as well as eliminating a long train of reduction gearing. The work spindle has a hole bored through its entire length of the maximum capacity of the machine, making it possible to enter work from either end as well as to hold work of any length. The spindle can also be equipped with an air chuck if this is desired. The work and cutter spindles are driven by a single pulley from the countershaft, but motor drive can be furnished if desired. The cutter spindle is of high-carbon steel and runs in a bronze box which has provision for oiling. If desired the machine can be furnished with taper attachment for cutting taper threads on piping or other similar work. The carriage is moved along the bed by means of a lead screw, which is gripped by a nut at any predetermined point by a clamp attached to the carriage. When in clamped position the nut moves with the carriage, and when released returns automatically to the starting point, this return being effected by means of two coil springs. The lead screw can be turned either right or left hand for cutting similar threads, and is kept under tension at all times to eliminate backlash. The machine is provided with a single lever control which consists of a camshaft along the front of the machine with a lever at the side of the handwheel and directly in front of the operator. This camshaft is connected with the work-spindle-clutch lever and to the lead-screw clamp. When the spindle has made one complete revolution it turns the clamp shaft over, moves the cutter spindle back, lifts the cutter out of the work, disengages the clutch, stops the spindle and releases the clamp and leaves the carriage free to move on the ways. When a new piece of work is chucked it is only necessary for the operator to pull the lever control, which brings the cutter into the work to the proper depth, starts the spindle and clamps the carriage to the lead screw. The



THREAD-MILLING MACHINE

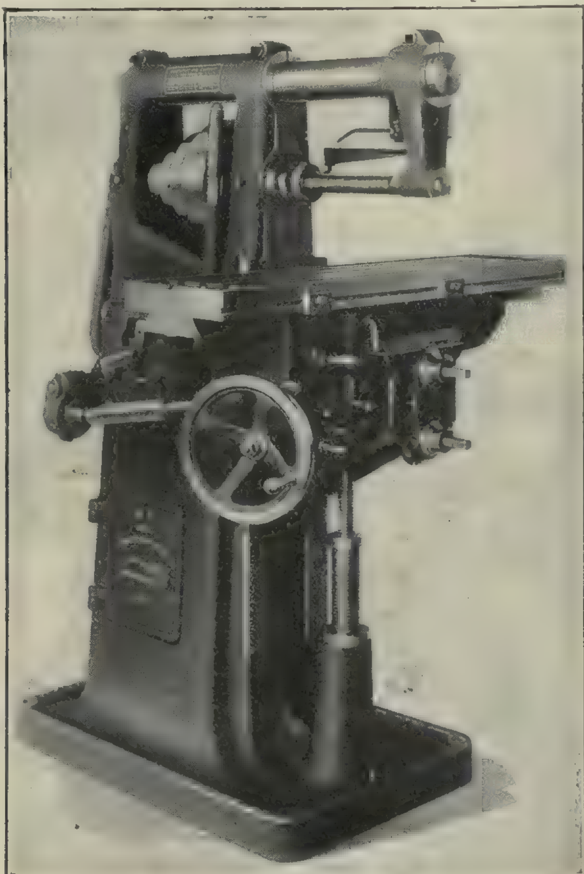
Three-in. machine: Collet capacity, $3\frac{1}{4}$ in.; taper in spindle, No. 9 B. & S.; lead screw, $1\frac{3}{4}$ in. diameter, 6 pitch; worm-drive ratio, 100 to 1; width of belt, 3 in.; floor space, 76 x 36 in.; net weight, 3000 lb. Six-in. machine: Collet capacity $6\frac{3}{8}$ in.; taper in spindle, No. 10 B & S.; lead screw, $1\frac{3}{4}$ in. diameter, 6 pitch; worm-drive ratio, 100 to 1; width of belt, 3 in.; floor space, 76 x 36 in.; net weight, 3500 lb.

handwheel is only used for making sensitive adjustments on the cutter. Threads of any pitch, either English or metric, right or left hand, can be obtained by simply changing two gears, no compounding being necessary. All gearing is completely inclosed and all control levers are within reach of the operator. The machine is being manufactured at the present time in two sizes, 3- and 6-inch.

Davenport Milling Machine

The illustration shows a new hand- and power-feed milling machine that has been placed on the market by the Davenport Manufacturing Co., Meadville, Penn. It is known as the company's No. 2 machine. The feed of the table is obtained either through the hand lever which gives rapid movement or through a handwheel which gives a slower and more sensitive feed. The hand lever may be used in any position, or disengaged entirely, by means of a spring plunger. One full movement of the hand lever moves the table about 5 in. Power feed is available in either direction, and is obtained through a chain-driven feed box, giving six changes. This is assembled as a unit and placed in

the column. All parts of this mechanism are oiled from one large pocket which is filled through an opening in the column. The table is provided with T-slots and has oil grooves on the sides and pockets at the ends. The spindle is of forged crucible steel, is hollow and runs in bronze boxes which are adjustable for wear. Large reservoirs with glass indicators to show the oil level are provided. The countershaft gives



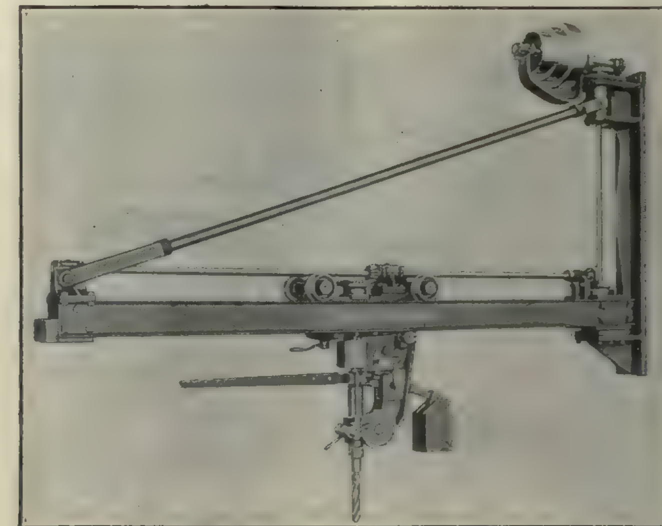
HAND- AND POWER-FEED MILLING MACHINE

Working surface of table, 36 x $9\frac{1}{4}$ in. with three $\frac{5}{8}$ in. T-slots, longitudinal feed, 22 in.; cross-feed, $6\frac{1}{2}$ in.; vertical feed, 19 in.; diameter of overhanging bar, $3\frac{1}{4}$ in.; distance from bar to center of spindle, $6\frac{5}{8}$ in.; diameter of spindle in front bearing, $2\frac{1}{2}$ in.; diameter of hole through spindle, $\frac{11}{16}$ in.; taper hole in spindle, No. 10 B. & S.; spindle speeds, eight, 65 to 367 r.p.m. right hand; feed changes, six, 0.003 to 0.016 in. per spindle revolution; weight, 1800 lb.; floor space, 45 x 58 in.

two speeds and is equipped with clutch pulleys and self-oiling bearings. Equipment includes arbor, draw-in rod, oil pot, wrenches and overhead works. If desired a lubricant, pump piping, etc., can be furnished as an extra. All machines have a reservoir cast integral with the bed.

Lynd-Farquhar Radial Wall-Drilling Machine

The Lynd-Farquhar Co., 419-25 Atlantic Ave., Boston, Mass., has recently placed on the market a line of radial wall-drilling machines, one of which is shown in the illustration. The four sizes of machines made are for drilling to the centers of 14-, 18-, 22- and 26-ft. circles. Other special sizes can be furnished, however, if desired. The arm is made of channel sections planed on the top and bottom and provided with supports at each end, the outer end being connected to the top of the wall bracket by means of a steel brace rod. The wall bracket is planed on the back, ribbed at the front to insure rigidity, and carries at the top a bevel-gear housing that can be located at three positions for convenience in connecting the belt drive. If desired a bracket can be furnished for mounting a 5- to $7\frac{1}{2}$-hp. variable-speed



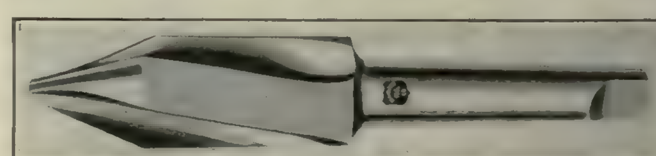
RADIAL WALL-DRILLING MACHINE

Made in four sizes to drill to the center of a 14-, 18-, 22- or 26-in. circle, with corresponding weights of 3380, 3483, 3615 and 3750 lb.; size of wall bracket, 10 in. wide by 6 ft $10\frac{1}{2}$ in. high; power feeds, two, 0.015 to 0.025 in. per spindle revolution; diameter of spindle in bearings, $2\frac{1}{2}$ in.; traverse of spindle, 7 in.; taper hole in spindle, Morse No. 4; pulleys on countershaft, 18 x 4 in.; speed of countershaft, 350 r.p.m.

motor in place of that carrying the bevel gears and cone pulley. The head moves on the arm on four roller-bearing wheels and the hand lever is counterbalanced by an adjustable weight which makes it more convenient where light work is being done. All gears are cut and all bearings are bronze bushed and renewable in case of wear. Two power feeds are provided, which can be changed while the machine is in operation. In order to prevent damage, an automatic release is provided at the extreme spindle traverse, which automatically throws off the feed when the extreme position is reached. The spindle is of carbon steel and runs in bronzed bushings within a steel sleeve. These bushings are renewable and the thrust is taken by a ball-thrust bearing. A clamp lever is provided to lock the head on the arm and tie-bar lugs are placed at the extreme end of the arm.

Standard Countersink for Ship Plates

The illustration shows a new countersink that has been recently brought out by the Standard Tool Co., Cleveland, Ohio, for special work in countersinking the plates of the new ships that are being built for our



STANDARD COUNTERSINK FOR SHIP PLATES

merchant-marine service. It is made in two styles, with taper or straight flute, and has three cutting lips. High-speed steel is the material of which the tool is made.

Niles-Bement-Pond Boring Mill and Bending Rolls

The illustrations show two new machines that have recently been placed on the market by the Niles-Bement-Pond Co., 111 Broadway, New York City. Fig. 1 shows the 28- to 42-ft. extension boring and turning mill, the former dimension being the capacity with the housing forward while the latter is the capacity with the housing at the rear as shown in the illustration. The actual swing of the machine with the housing in the two positions is 28 ft. 2 in. and 42 ft. 4 in. The maximum height under the toolholders is 10 ft. and the bar travel is 84 in. The table is driven by a 60-hp. motor through a double-pinion drive, a 25-hp. motor being used for elevating the cross-rail. Two 15-hp. motors are used, one for fast traversing the bars and saddle and the second for traversing the housing. The cross-rail has two heads with octagonal bars 10 in. across the flats, the cross-rail being 48 in. in width and 54 in. in depth from front to back. The table is designed to carry a load of 300,000 lb. in addition to its own weight, and is driven by two forged-steel pinions, one located at each side of the table. The heads on the cross-rail are provided with platforms for the operator, and the adjustment of speeds and rapid traverse for the bars and saddle is controlled from these platforms. The main driving motor may be controlled from these platforms or from stations at each side of the machine, push-button control being used for all the motors. Fig. 2 shows a large set of bending rolls of the strong-back type, which have a capacity to roll mild steel plate 1 in. thick and 36 ft. long or 1¼ in. thick and 30 ft. long. The machine consists of two large cast-iron housings connected at the top by two 20-in. I-beams and below by two heavy cast-iron side clamps with bearings for eight pairs of steel rollers, four pairs on each side to support the lower rolls. The three rolls are of forged steel, one upper and two lower, each 36 ft. 9 in. in length between the journals. The lower rolls are 16 in. in diameter while the top roll is 19 in. in diameter. These are driven by a 100-hp. motor. The top roll is reinforced by heavy built-up steel girders carrying on the underside four supporting roller bearings directly over those carried on the side frames The girder and rolls are adjusted for height by means of two steel screws, one at each end, which are operated by means of a 75-hp. motor through a mechanism so arranged that each end of the roll may be raised or lowered independently or both ends may be raised or lowered together. The operating handles are all grouped together at a convenient point at the motor end, so that one operator may completely control the machine without moving from his position on the operating platform. The machine is supplied with four top-braced skip cranes, self-contained with the machine, the posts carrying these cranes being located at the four corners of the machine. The two cranes at the front of the machine are clearly shown, the one at the right showing the construction of the ribbed upright to which the arm is secured.

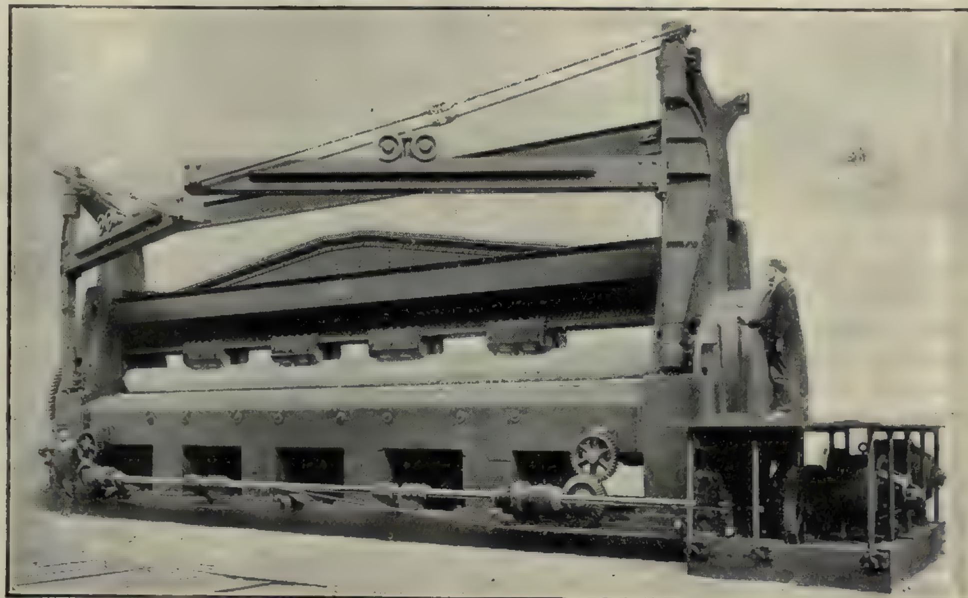


FIG. 2. NILES-BEMENT-POND HORIZONTAL PLATE-BENDING ROLLS

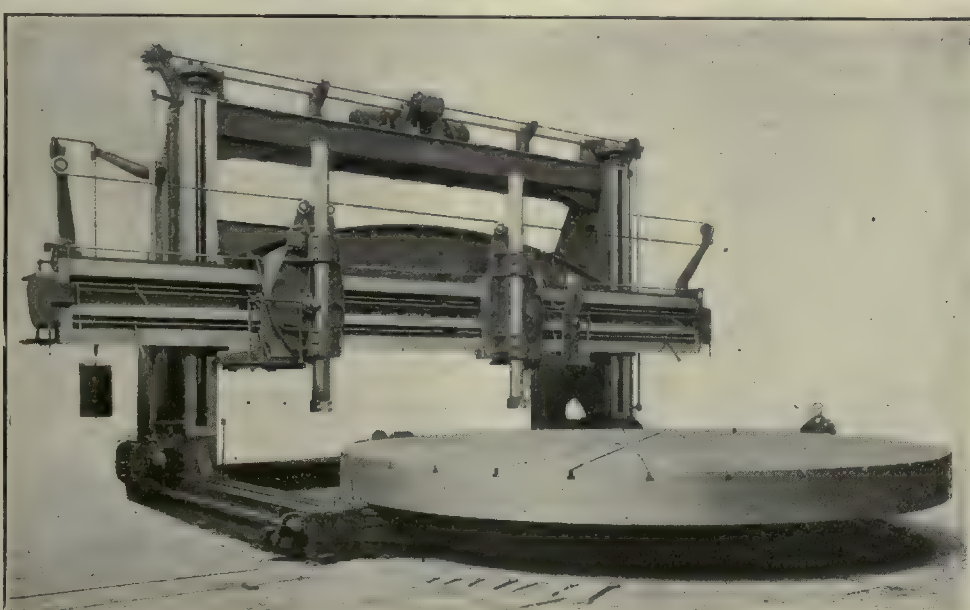


FIG. 1. NILES-BEMENT-POND, 28- TO 42-FT. EXTENSION BORING AND TURNING MILL, WITH HOUSING AT THE REAR.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., June 1, 1918.—There is every reason to believe that steady improvement is being made in the aircraft situation, and the acceptance of Archer A. Landon, vice president of the American Radiator Co., of Buffalo, N. Y., as Chief of Production of the Aircraft Division should prove of great assistance to Mr. Ryan in his gigantic task of knitting together the many loose ends and getting mass production really under way. There have been so many changes of various kinds that every manufacturer of both motors and planes will welcome orders to go ahead, and there need be no fear whatever as to the productive capacity of the country as soon as manufacturers can be told what to produce.

Some of the discussions in regard to the merits or demerits of the Liberty motor would be amusing if it were not for the fact that behind these disquieting rumors there is undoubtedly either German propaganda or a disgruntled engineer or manufacturer. People seem to forget that it is the amount of power per pound of weight which propels the plane through the air. So that all the talk about this or that motor being faster than another, about the Liberty motor not being suited to an armored plane or flying tank, can be put down to either ignorance or a desire to discourage the public. The distribution of weight in a motor has its effects upon the plane in which it is used, but planes can be adapted to different motors. And we must not lose sight of the fact that the horsepower is 33,000 ft.-lb. per minute whether it is developed by an old waterwheel, a gasoline motor or a mule's hind leg.

If the powers that be had thrown off some of the cloak of secrecy with which the Liberty motor was unfortunately surrounded and given the engineering public a good general idea of its construction there would have been far less criticism and a much greater feeling of confidence than has existed for some time. The main characteristics are now made public and are given herewith to show that the designers did not ignore the experiences of all other builders, but instead they studied them and utilized them to a marked degree. The main features of the Liberty motor follow herewith:

The cylinders follow the practice used in the German Mercédes, English Rolls-Royce, French Lorraine-Dietrich and Italian Isotta-Fraschini. They have steel inner shells surrounded by pressed-steel water jackets. The valve cages are drop-forgings welded into the cylinder head. The principal departure from European practice is in the location of the holding-down flange, which is several inches above the mouth of the cylinder, and the unique method of forging evolved by the Ford company.

The camshaft and valve mechanism above the cylinder heads are based on the Mercédes, but was improved for automatic lubrication without wasting oil by the Packard Motor Car Company.

The camshaft drive was copied almost entirely from the Hall-Scott motor. This type of drive is used by the Mercédes, Hispaño-Suiza and others.

Angle Between Cylinders.—The included angle between the cylinders is 45 deg.; in all other existing 12-cylinder engines it is 60 deg. This feature is new and was adopted for the purpose of bringing each row of cylinders nearer the vertical and closer together to save width and head resistance and to give greater strength to the crankcase, and vibration is reduced.

Electric Generator and Ignition.—A Delco ignition system was especially designed to save weight and to meet the special conditions due to firing 12 cylinders with an included angle of 45 degrees.

Pistons.—The pistons are of Hall-Scott design.

Connecting-Rods.—Forked or straddle-type connecting-rods, first used on the French DeDion car, and on the Cadillac motor car.

Crankshaft.—Same as the standard 12-cylinder practice, except as to oiling. Crankcase follows standard practice.

Lubrication.—The first system of lubrication followed the German practice of using one pump to keep the crank case empty, delivering into an outside reservoir, and another pump to force oil under pressure to the main crankshaft bearings. The present system is similar, except that the oil while under pressure is not only fed to the main bearings but through holes inside of crank cheeks to crankpins instead of feeding these crankpins up the outside face of the crank cheek and through scuppers.

Propeller Hub.—The Hall-Scott propeller-hub design was adapted to the power of the Liberty engine.

Water pump is of the Packard type.

Carburetor developed by the Zenith company for the Liberty engine.

Bore and Stroke.—The bore and stroke is 5 x 7 in., as in the Hall-Scott and Curtiss engines.

The engine develops about 35 hp. per cylinder at 170 r.p.m., and the cylinders are standard for all engines. The weight is about 2 lb. per horsepower.

The idea of developing Liberty engines of 4, 6, 8 and 12 cylinders with the above characteristics was first thought of about May 25, 1917. The idea was developed in conference with representatives of the British and French missions, May 28 to June 1, and was submitted

in the form of sketches at a joint meeting of the Aircraft (Production) Board and the Joint Army and Navy Technical Board, June 4. The first sample was an eight-cylinder model, delivered to the Bureau of Standards, July 3, 1917. The eight-cylinder model, however, was never put into production, as advices from France indicated that demands for increased power would make the eight-cylinder model obsolete before it could be produced.

Work was then concentrated on the 12-cylinder engine, and one of the experimental engines passed the 50-hr. test Aug. 25, 1917.

After the preliminary drawings were made, engineers from the leading engine builders were brought to the Bureau of Standards, where they inspected the new designs and made suggestions, most of which were incorporated in the final design. At the same time, expert production men were making suggestions that would facilitate production.

An engine committee was organized informally, consisting of the engineers and production managers of the Packard, Cadillac, Lincoln, Marmon and Trego companies. This committee met at frequent intervals, and it is to this group of men that the final development of the Liberty engine is largely due.

Skilled Enlisted Men To Be Returned to Necessary Industries

In response to appeals from all over the country the War Department has decided to permit the return to necessary industries of highly skilled men taken from such industries under a system of furloughs which will be automatic and which will not in the future as in the past leave to the discretion of company and other subordinate commanders the granting of furloughs. Thousands of applications for furloughs are now being sent out of Washington by various branches of the War Department in response to the appeals of manufacturers and other producers of war material whose draftsmen, mechanics and other employees engaged in the past and now upon Government orders for war work have been taken from them by the draft.

An application blank is furnished employers on request.

The adoption of the new policy means that enlisted men are to be returned to industry only in cases where the drafted man's employer is willing to swear that the man is badly needed and that no one can take his place. The Government department for which the manufacturer or other employer is working will upon application send one of the blank forms to the employer, which he must fill out, swear to before a notary and have a Government inspector who is conversant with the facts also sign. The application then goes to the Adjutant General's office with request from the interested Government department that the man wanted be granted an indefinite furlough, without pay, with the promise that after the need for his service has passed he will be returned to the army and will notify the Government.

While on furlough these men will not be allowed to wear the uniform, and the company employing them must furnish the Government each month a report that they are still in its employ and also state the class of work engaged in. In case the returned men leave their employment their employers must immediately notify the Government.

A large number of applications for furloughs for enlisted men in necessary industries have recently reached Washington, but permission could not be given because company commanders and other officers did not believe that certain of their men were more necessary in civil life than in the army. The Adjutant General's Office has now sent a circular to heads of War Department divisions permitting the new system. The Government is protected, from the army-in-the-ranks point of view, by the fact that wherever a fraud is perpetrated or attempt is made to perpetrate fraud sufficient persons will be familiar with the circumstances to result in the War Department being notified.

Navy Wants Trained Engineers

The Bureau of Navigation, Navy Department, is desirous of securing trained engineers for general service in the navy in steam-engineering, electrical-engineering and radio duties. Applicants for this service, if accepted, will be enrolled as ensigns in the Naval Reserve Force and will be sent to the reserve officers' school at Annapolis for a spcial course of about four months, after which those who finish successfully will be placed in further training ashore or afloat and then become available for regular sea or shore duty as the exigencies of the service may demand.

Applicants should have the following qualifications: (1) A degree in mechanical, electrical or mining engineering conferred by a college of recognized standing; (2) at least two and one-half years' practical engineering experience subsequent to graduation (exclusive of time spent as sales agent); (3) not over 35 years of age, and (4) physically strong and sound in health.

The American Institute of Electrical Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, Naval Consulting Board and National Research Council have each been requested to submit a list of 50 names equally proportional among personnel trained in (1) steam engineering duties, (2) electrical engineering duties and (3) radio duties, but the exact engineering duties to be performed in general service by each applicant will be decided after completion of the training under naval supervision.

It is probable that from among the applicants selected a class will be formed at the Naval Academy.

Each applicant should without delay forward to the Engineering Council, which is acting for the five organizations named, a résumé of his education and engineering experience, together with a small photograph, if practicable, and such letters of recommendation as it may be possible to submit, addressed to 29 West 39th St., New York.

French Shrapnel Making

In our next issue we will print an article by our Paris representative, Robert K. Tomlin, Jr., on "Making 50,000 French 75-mm. Shrapnel per Day."

Considering the enormous difficulties surrounding the getting of an article of this character at this time it should prove of unusual interest to our readers.

Personals

D. W. Brunton of Colorado was elected a member of the Naval Consulting Board at a recent meeting.

L. F. Mulholland has moved from Richmond, Va., to Schenectady, N. Y., to take up work as assistant engineer of tests with the American Locomotive Company.

Sidney J. Williams, chief engineer of the Industrial Commission of Wisconsin, has resigned, effective May 31, to accept the position of safety engineer of the National Safety Bureau, Chicago, in charge of the department of accident prevention.

Julius Alsberg announces the opening of consulting offices in the Tribune Building, Chicago. He proposes to investigate and report on mechanical, industrial and chemical engineering problems, to design plants and to supervise their installation.

F. J. Kidd, for the last five years secretary and treasurer of the Racine Manufacturing Co., Racine, Wis., has resigned from the company and has become associated with the Racine Tool and Machine Co., Racine, as general manager and assistant treasurer.

Victor Clark Parker, formerly manager of the technical department of the Buick Motor Co., Flint, Mich., has received the commission of major in charge of the industrial headquarters of the Motor Mechanics Regiment of the Aviation Section. He will be stationed at Camp Greene.

N. E. Wahlberg, chief engineer of the Nash Motor Co., Kenosha, Wis., has been commissioned a major in the Ordnance Corps, U. S. A., and was ordered on May 15 to report immediately at Washington to prepare for overseas service. He expects to leave for France in a short time.

L. L. Newton of the Luther Grinder Manufacturing Co., of Milwaukee, Wis., has resigned his position to become manager of the Stegemen Motor Car Co. of the same city. Mr. Newton's position will be filled by **Frank S. Hyland,** for several years a member of the Luther Grinder sales force.

George B. Dusinberre, Cleveland engineer, formerly manager of the Westinghouse Electric and Manufacturing Co.'s Cleveland sales office and later water works commissioner in that city, has been commissioned a major in the Ordnance Department of the army. He will be located in Washington.

Henry D. Miles, president of the Buffalo Foundry and Machine Co., has been chosen president of the Chamber of Commerce of Buffalo by the members of the board of directors to succeed **Archer A. Landon,** who has just been designated by President Wilson as first assistant of aircraft construction.

George M. Studebaker has resigned from all duties in connection with operations of the Studebaker Corporation of South Bend, Ind., and Detroit. He was a member of the finance committee, vice president and general manager. **George L. Willman** advertising manager of the corporation, has been promoted to manager of the Chicago wholesale branch.

Business Items

Geo. F. Bowen Machine Co.—George F. Bowen has acquired the entire interest of the Wadell Bowen Co., Inc., 109-111 Tichenor St., Newark, N. J., and that of the Edward Morgan Machine Co., of the same city, and will conduct the business under the name of Geo. F. Bowen Machine Co.

The Holtzer-Cabot Electric Co., Roxbury, Boston, Mass., is now handling its business in motors, dynamos, motor generators, etc., from its New York office at 101 Park Ave., at 40th St. Douglas Cairns is in charge of this office. This part of the business was previously conducted by James Goldmark Co., 83 Warren St., New York.

Obituary

Charles Mitchell, president of the Mitchell Co., Inc., Poughkeepsie, N. Y., died Apr. 20. The foundry and machinery business of the company will continue under the management of Cornelius C. Harcourt.

Charles A. Francis, superintendent of the body department of the Packard Motor Car Co., died at his home, 267 Kercheval Ave., Detroit, Monday, Apr. 29. He was 68 years old, and for 25 years was superintendent of the Studebaker factory in South Bend, Ind. He was with the Packard company eight years ago.

E. C. Meier, president of the Heine Safety Boiler Co., Phoenixville, Penn., died suddenly on May 7 while attending a meeting of the district production division of the Emergency Fleet Corporation at the Racquet Club, Philadelphia. The deceased was a son of the late Col. Edward D. Meier and was born at Wyandotte, Kan., Apr. 28, 1870. He was a director of the company for many years, and before becoming president he served several years as vice president. Upon the death of his father in 1916 he was elected president.

Joseph W. Mackenzie, president of the Duncan Mackenzie's Sons Co., iron founders, Trenton, N. J., died in the Women's Homeopathic Hospital, Philadelphia, on May 18, following a long illness. He was twice operated upon at the hospital, where he was taken after a long rest at Atlantic City. Mr. Mackenzie was born in Trenton, N. J., and after graduating from the State Model School entered the iron business of his father, Duncan Mackenzie. Following the death of his father the business was turned over to the three sons, Joseph, Duncan and Thomas. The deceased was a member of the Trenton Country Club, Trenton Chamber of Commerce and other organizations.

Trade Catalogs

Buffalo Forges. Buffalo Forge Co., Buffalo, N. Y. Catalog, Section 108. Pp. 32; 5 x 7½ in. This catalog section illustrates, describes and gives the weight and prices of stationary forges.

I. T. C. Storage Battery Tractors, Elevating Trucks and Locomotives. Industrial Truck Co., Holyoke, Mass. Booklet. Size 3⅞ x 8½ in. Specifications and illustrations are given of the four- and two-wheel drive.

What Do You Know About Brass Spelter Solder? The American Brass Co., Waterbury, Conn. Booklet. Pp. 8; 3⅞ x 6⅝ in. Illustrated and gives full information covering the different meshes, alloys and melting points.

Scientific Lubrication of Cutting Tools. The Fulflo Pump Co., 126 Opera Pl., Cincinnati, Ohio. Booklet. Pp. 16; 4½ x 7 in.; printed in two colors, and gives valuable information for the users of machine tools. A copy will be forwarded to anyone interested.

Smooth-On Introduction Book (Sixteenth Edition). Smooth-On Manufacturing Co., 547 Communipaw Ave., Jersey City, N. J. The book contains 144 pages, each page containing an illustration showing how the different Smooth-On iron cements are used for repairing purposes. It will be sent to anyone sending his name and address.

Electric Motors, Generators and Transformers. Crocker-Wheeler Co., Ampere, N. J. Bulletin Nos. 183, 184 and 185; size 8½ x 11 in. No. 183 (superseding bulletin No. 157) 8 pp.; illustrates and describes motor drive for printing machinery. No. 184 (superseding bulletin No. 153) direct-current lighting and power generators, illustrated. No. 185 (superseding bulletin No. 150) 4 pp.; coupled and belt types of alternating-current generators. These bulletins are punched for loose-leaf binding.

New Publications

Central Stations—By Terrell Croft. Three hundred thirty-two 5¼ x 8-in. pages, 306 illustrations. Published by McGraw-Hill Book Co., 239 West 39th St., New York City. Price, $2.50.

To anyone interested in central stations, this book will prove very valuable, as the descriptions and examples given are in an unusually clear and compact form. Any book on central stations must necessarily deal with generation, transmission and distribution of electric energy, and this one is no exception, though the material is not classified into these separate divisions. These subjects are very thoroughly covered, taking the 18 sections as a whole. The opening chapters are devoted to a considerable number of definitions which make the matter clear as the reader proceeds. Following these, the different factors or coefficients which are frequently utilized in central-station practice, are discussed rather exhaustively. Among these are load factor, demand factor, diversity factor, plant factor, and the like. Their application in the design and operation of central-station systems is explained and many examples given. Next, typical-load curves or charts are given, dealing with everyday work. Then the principles of circuit design for both alternating and direct current are given attention, and examples showing how circuits are computed in practice are worked out in detail. Transmission lines, substations and lightning protection follow. The final chapters of the book deal with electric-energy generating stations and their equipment. Thus automatic voltage regulators, switchboards and switch gear are treated. The three different types of prime movers, steam, internal-combustion engines and hydraulic, and the adaptability of each to certain conditions are studied; reactors and transformers are considered briefly. The book text has been carefully checked over by several authorities on electrical subjects, both for the general subjects treated and for accurate details, and the result is a book that is authoritative within its limits.

Forthcoming Meetings

The annual convention of the American Drop Forge Association will be held at 10 a.m. on June 20, 1918, at the reserve hall of the Iroquois Hotel, Buffalo, N. Y. E. B. Home, 1516 Helen Ave., Detroit, Mich., is the secretary.

American Society of Mechanical Engineers. Monthly meeting, second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers. Spring meeting at Worcester, Mass., June 4, 5, 6 and 7, with headquarters at the Hotel Bancroft.

The American Society for Testing Materials will hold its twenty-first annual meeting at Atlantic City, N. J., June 25-28, with headquarters at the Hotel Traymore. The permanent headquarters of the secretary-treasurer are under the name of the society, Philadelphia, Penn.

Boston Branch National Metal Trades' Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The next convention and exhibit of the Georgia Retail Hardware Association will be held at Savannah, Ga., June 4, 5 and 6, 1918, with the Savannah Hotel as headquarters. Exhibits and convention sessions will be held in the new municipal auditorium on Barnard St. Walter Harlan, 44 Boulevard Circle, Atlanta, Ga., is secretary of the association.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers, 29 West 39th St., New York. Summer meeting to be held at Dayton, Ohio, June 17-18. Complete war program, at least half of it being devoted to the actual demonstration of war apparatus. All meetings will be held at Triangle Park, a dinner being served Monday evening and luncheons each noon. Reservations may be secured at hotels Miami, Holden, Algonquin, Phillips and Bechel, or by writing the Dayton S. A. E. Committee, 137 North Ludlow St., Dayton, Ohio.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Condensed-Clipping Index of Equipment

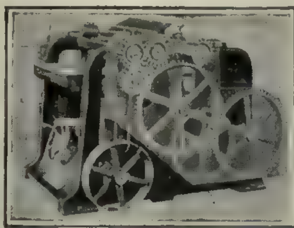
Clip, paste on 3 x 5-in. cards and file as desired

Surfacing Machine, Wood

Oliver Machinery Co., Grand Rapids, Mich.

"American Machinist," May 23, 1918

Made in two widths, 24 and 30 in. Specifications for 24 in. machine: length, 58 in.; width, $35\frac{1}{2}$ in.; height $37\frac{1}{2}$ in.; cutting diameter of cylinder, $4\frac{1}{2}$ in.; bearings, $9\frac{3}{4}$ x 2 in.; pulleys, 5 x 5 in.; speed, 3800 r.p.m.; diameter of feed rolls, 4 in.; feed-roll bearings, $4\frac{1}{2}$ x 2 in.; feeds per minute, 14, 18, 24, and 31 in.; roll gears, 6 in. in diameter, 3 pitch; main driving gears, 22 in. in diameter, 3 pitch; length of bed, 48 in.; adjustment of bed in slide, 8 in.; depth of slide, $12\frac{1}{2}$ in.; depth of table, $14\frac{1}{4}$ in.; raising screws, $1\frac{1}{2}$ in. in diameter, 4 threads per inch; floor space, with countershaft, 8 ft. 4 in. by 5 ft. 2 in., without countershaft 5 ft. 2 in. by 5 ft. 2 in.; horsepower recommended, $7\frac{1}{2}$ to 10.



Pressure Governor for Gas and Liquid Systems, Type CR 2922

General Electric Co., Schenectady, N. Y.

"American Machinist," May 23, 1918

This governor is for use on gas and liquid systems that must be maintained between certain predetermined pressures. The governor starts and stops motor-operated pumps or compressors as necessary. The device is made in various styles rated for pressures of 80, 100, 160, 300 or 500 lb., and operates within settings of from 3 to 12 lb. between high and low pressures. The governor consists of a Bourdon tube, an indicating needle, a graduated pressure scale, adjustable high and low pressure stops to determine the pressure range, and a relay which actuates the contact in the control circuit of the self starter. After being set for the desired pressure range the device is automatic in action.

Filing Machine

Barry Manufacturing Co., 5-11 East Kinzie St., Chicago, Ill.

"American Machinist," May 23, 1918

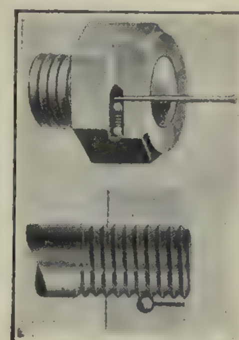
This machine is built in two sizes, Nos. 2 and 3, the illustration and specifications being of the No. 3, or larger, machine. A feature is the file-holding device, which will accommodate flat files or files with straight or taper shanks. The file may be shifted so that the entire surface may be utilized. Height from table to floor, 36 in.; dimensions of table, 14 x $10\frac{1}{2}$ in.; stroke of file, 0 to 4 in.; tilt of table, 18 deg. front and back, 10 deg. right and left; diameter of drive pulley, 6 in.; face of drive pulley, 2 in.; horsepower required, $\frac{1}{2}$; weight, 350 lb.

Nuts, "Sta-Lok"

Evertite Nut Corporation, Marquette Building, Detroit, Mich.

"American Machinist," May 30, 1918

The locking device consists of a hardened-steel ball running in a groove between the bolt threads. This ball is maintained in contact with the threads by means of a spring which causes it to immediately wedge and lock the nut the moment the latter starts to unscrew. To unlock insert a small finish nail which forces the steel ball back out of contact with the thread of the bolt, thus allowing the nut to be unscrewed. The action of the ball is, of course, such that the nut can be screwed on to the bolt without any difficulty or without the use of the finish nail as shown.

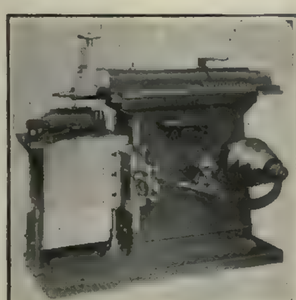


Shaping Machine,

Hollingworth Machine Tool Co., Covington, Ky.

"American Machinist," May 30, 1918

Made in 16-, 18-, 21-, and 24-in. sizes. Dimensions of the 18-in. machine being as follows: Horizontal travel of table, $22\frac{1}{2}$ in.; vertical travel of table, 15 in.; vertical movement of head, 8 in.; ram speeds, eight, 9 to 106 per minute; length of table top, 14 in.; width of table top, $15\frac{1}{2}$ in.; height of table side, $15\frac{1}{2}$ in.; vise jaws, $2\frac{1}{4}$ x $10\frac{1}{2}$ in.; opening of vise, 9 in.; back-gear ratios, 6 and $14\frac{1}{2}$ to 1; keywaying capacity under ram, $2\frac{3}{4}$ in.; size of countershaft pulleys, 12 x 4 in.; width of belt, $2\frac{1}{2}$ in.; extreme length of stroke, $18\frac{1}{2}$ in.; shipping weight, 3000 lb.



Furnace, Bench No. 108

Johnson Gas Appliance Co., Cedar Rapids, Iowa

"American Machinist," May 30, 1918

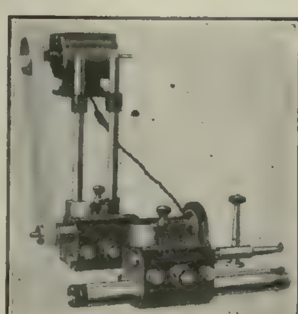
This furnace is used for heating small parts, a work-rest block affording a rest for the work, while a baffle plate partially closes the mouth of the furnace. It is claimed that these features in connection with the angle of the gas furnace and the curved shape of the hood make it possible to secure very uniform results. Size of firebox, $6\frac{1}{2}$ x 5 x $6\frac{1}{2}$ in.; size of mouth, 4 x 6 in.; length, 16 in.; height, $9\frac{1}{2}$ in.; weight, 43 lb.; maximum gas consumption, 40 cu. ft. an hour; size of supply pipe, $\frac{1}{2}$ in.

Boring and Grinding Attachment for Lathes

Nelson Tool Co., 1605 West Lake St., Chicago, Ill.

"American Machinist," May 30, 1918

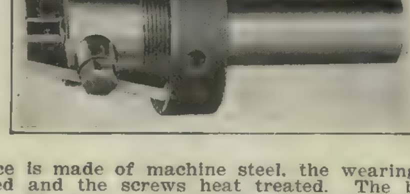
A combination boring-bar and grinding-wheel attachment for use on lathes and shaping machines. The device is placed over the toolpost and is held in place by means of the regular toolpost screw. An adjustment is provided which permits the bar or wheel to be raised or lowered. The motor is supported on two vertical bars, thus making it possible to raise or lower the motor to tighten the belt or to provide for the use of pulleys of various sizes. The boring bars are hollow and are provided with an internal-tension rod for drawing the tool bit into position. The boring attachment is shown in front of the grinding attachment to which the motor is attached. The two are readily interchangeable. Three sizes are made.



Hollow-Milling Tools, Adjustable

Genesee Manufacturing Co., Rochester, N. Y.

"American Machinist," May 30, 1918



The device is made of machine steel, the wearing parts being casehardened and the screws heat treated. The blades are of various types of steel as desired. The shank is drilled completely through. Two types are made, Style "A" having the blades set radial for brass or other comparatively soft material and Style "B" having the blades set at angle of 12 deg. for cutting steel. A complete set of 7 will handle work from $\frac{1}{4}$ to 2 in. in diameter.

Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	$40.00
No. 2X, New York	34.25	.....	46.00
No. 2 Northern Foundry, Chicago	33.00	37.00	47.00
*Bessemer, Pittsburgh	36.15	37.25	50.95
*Basic, Pittsburgh	32.00	33.95	45.00
No. 2X, Philadelphia	34.25	33.75	45.50
*No. 2, Valley	33.00	33.95	45.00
No. 2 Southern Cincinnati	35.90	35.90	42.90
Basic, Eastern Pennsylvania	32.75	33.75	42.50

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.195	$4.195	$5.00	$4.20	$5.00	$4.20	$5.00
Soft steel bars	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Soft steel bar shapes	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Plates, ¼ to 1 in. thick	4.445	4.445	8.00	4.20	7.00	4.45	7.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.00
Warehouse, New York	4.70	4.60
Warehouse, Cleveland	4.10	4.50
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
*No. 28 black	5.00	6.445	6.445	10.00	6.385	9.00	6.45	9.00
*No. 26 black	4.90	6.345	6.345	9.90	6.285	8.90	6.35	8.90
*Nos. 22 and 24 black	4.85	6.295	6.295	9.85	6.235	8.85	6.30	8.85
Nos. 18 and 20 black	4.80	6.245	6.245	9.80	6.185	8.80	6.25	8.80
No. 16 blue annealed	4.45	5.645	5.645	9.70	5.585	8.20	5.65	9.20
No. 14 blue annealed	4.35	5.545	5.545	9.60	5.485	8.10	5.55	9.10
No 10 blue annealed	4.25	5.445	5.445	9.50	5.385	8.00	5.45	9.00
*No. 28 galvanized	6.25	7.695	7.695	13.00	7.695	10.50	7.70	11.00
*No. 26 galvanized	5.95	7.395	7.395	12.70	7.335	10.20	7.40	10.70
No. 24 galvanized	5.80	7.245	7.245	12.55	7.185	10.05	7.40	10.55

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 10%	List plus 25%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Current	One Year Ago
New York	$15.00	$13.00
Cleveland	15.00	12.00
Chicago	17.00	11.50

In coils an advance of 50c. usually is charged.

Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

3/8, 11/32, 5/16, ¼, 7/32, 3/16	21.00@30.00
No. 8, 3/32 and No. 10	
1/8	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
3/8 by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

1/8	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel	7.50	8.00	7.50
Spring steel (crucible analysis	11.00	11.25	11.00
Coppered bessemer rods	9.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel	9.00	8.25	8.50
Floor plates	6.19½	6.00	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜	44%	17%	⅜ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	40%	22½%	⅜ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	41.9%	26.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	37.9%	23.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	30.50
Tin, in 5-ton lots	103.00	85.00	64.00
Lead	7.05	7.25	12.00
Spelter	7.50	7.50	9.25

*Government price.

ST. LOUIS

Lead	6.85	7.10	12.00
Spelter	7.25	7.25	9.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper sheets, base	32.50-33.00	32.00	42.00	34.00	42.00	32.50	43.00
Copper wire (carload lots)	31.00	32.00	39.50	34.00	41.00	32.00	40.00
Brass sheets	31.75	30.75	45.00	30.00	43.00	30.00	43.50
Brass pipe base	36.50	36.50	47.50	41.00	50.00	40.00	47.50
Solder ½ and ½ (case lots)	69.75	62.00	40.38	60.00	39.50	70.00	39.00

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	42.00
Chicago	28.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 19.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	21.00	22.00	21.25	23.00
New York	17.00	23.00	17.50	23.25
Chicago	21.00	22.50	21.50	23.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	12.50	29.00
Chicago	13.50	28.00
Cleveland	15.00	29.50

Making 50,000 French 75-MM. Shrapnel per Day

By Robert K. Tomlin, Jr.
PARIS REPRESENTATIVE McGRAW-HILL CO.

Our French allies have had the same problems in building great establishments for the manufacture of munitions that are now confronting us. This article describes one of these interesting works built by André Citroën in Paris, France, with illustrations of some of the general machine installations.

IF IN Paris three years ago you had left the beaten track of tourist sightseers and visited that strip of land which flanks the River Seine in the western outskirts of the town you would have found a most uninteresting spot in what is known as the Quai de Javel. There three years ago was nothing but a few rickety buildings and truck gardens, but today that spot has undergone a magical transformation.

Acres of long, low buildings are built upon it; railroad cars and motor trucks are busy delivering to and taking away from it huge volumes of materials; men and women by the thousands come and go daily, and the steady hum of machinery continues day and night. All of this activity is the result of the work of a man with a purpose. In the early days of the war André Citroën decided to manufacture artillery munitions, and he chose this spot as the site for his plant. Ground for the foundation of his shops was broken in March, 1915, and four months later, in July, buildings were erected, machinery installed and finished shells were actually being shipped to the front for use by the famous French 75s.

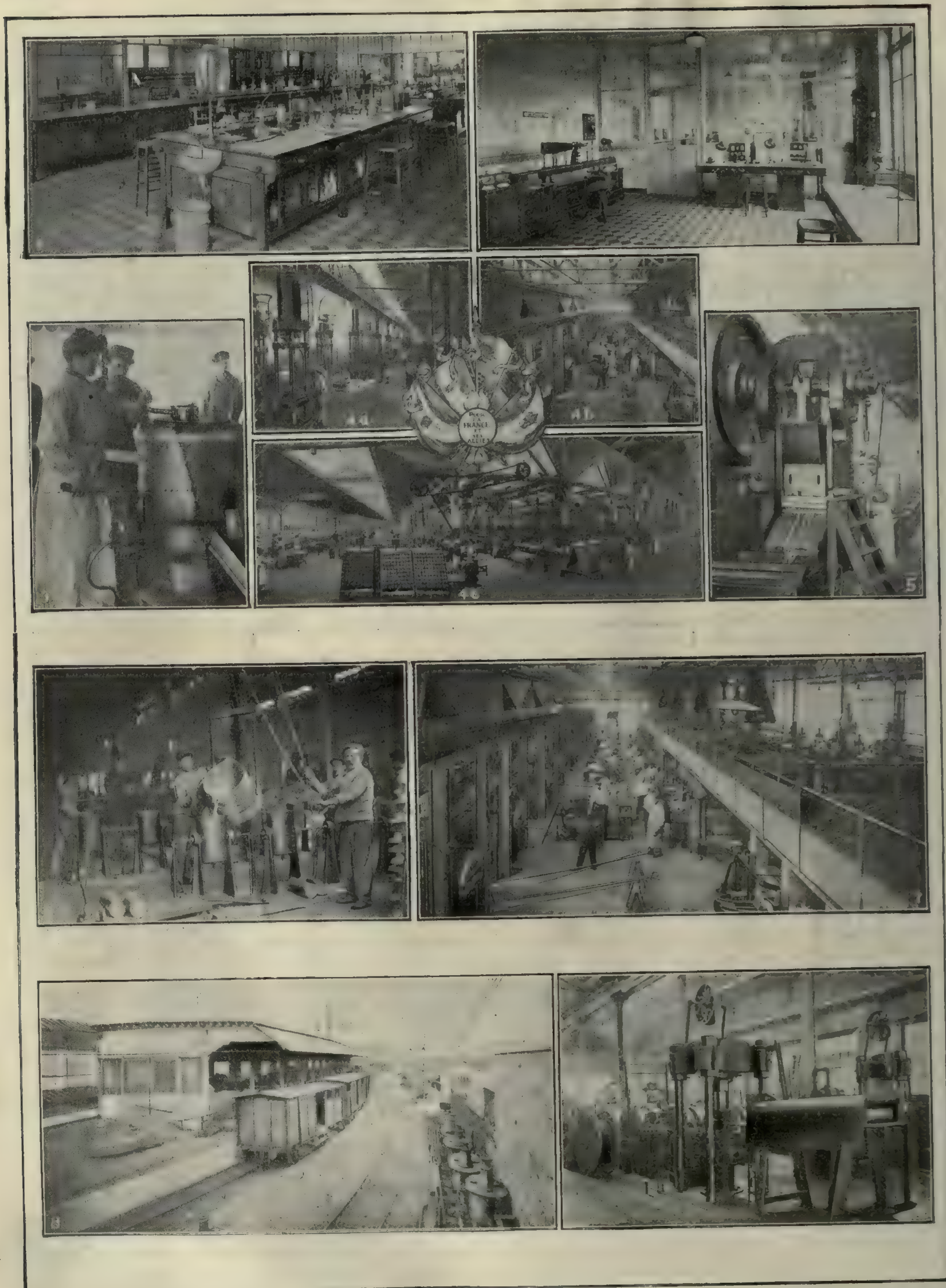
Citroën is not the kind of man who is content to do things on a small scale. Starting with a daily output of 10,000 shells, the plant capacity was soon increased to 20,000. In 1916 the output was again doubled, and today the enlarged works shown in the headpiece are delivering the stupendous quantity of more than 50,000 shells every day.

Along with this achievement other things have happened. War's draft upon the manhood of France has made the manufacture of munitions largely woman's work, thereby introducing into the industrial problem entirely new elements. Obviously, old precedents had to be discarded and new conceptions of machine-shop administration formed. To this task Citroën applied himself with characteristic energy, individuality and thoroughness, and created a new order of things in French industrial life, the workings of which I was permitted to observe during a recent tour of the plant. The outstanding impression which I carried away was this: In organizing the work of producing 50,000 shells day after day at the Citroën plant the human problem—the problem of the worker as a woman or as a man—has received fully as much attention by the executive heads of the company as has the problem of machines and materials.

In our tour we passed through the executive offices and the library, in which 100,000 volumes are available for the use of the company's employees. We also visited the chemical, metallurgical and testing laboratories, all equipped with the most up-to-date apparatus, Figs. 1 and 2.

It will be clear from the nature of our visit that no detailed technical description of the process of shell manufacture is possible, yet I shall endeavor to outline in a very general way the principal shop operations, and give at some length an account of what we may call the human side of the institution.

Raw material for shells is delivered in the form of steel bars 82 mm. (3.22 in.) in diameter, which are broken into billets by powerful hydraulic presses—the invention of Mr. Citroën, Fig. 3. The breaking is done in two operations: The stock bars, marked at the points where they are to be fractured by means of a punched templet, are fed by hand into the presses, where they are first nicked by steady pressure. Then they are subjected to sudden impact and the piece falls off, cleanly broken. There are 28 of these presses, each one capable of breaking 6000 pieces of steel a day. In addition,



FIGS. 1 TO 9. VARIOUS VIEWS SHOWING WORK IN A FRENCH SHRAPNEL FACTORY

Fig. 1—Chemical laboratory. Fig. 2—Metallurgical and testing laboratory. Fig. 3—Hydraulic press for breaking steel bars. Fig. 4a—Hydraulic forging presses. Fig. 4b—Heating furnaces. Fig. 4c—General shop view. Fig. 5—Press for making shrapnel balls. Fig. 6—Casting alloy ingots. Fig. 7—Heat treating shells. Fig. 8—Loading shells for transport. Fig. 9—Manning alloy rods

FIGS. 10 TO 16. SOME OF THE DIFFERENT PROCESSES IN MAKING 75-MM. SHRAPNEL

Fig. 10—Tumbling shrapnel balls. Fig. 11—Electric truck with elevating platform. Fig. 12—Trucking forgings. Fig. 13—Trucking hot material. Fig. 14—Tube-drawing shop. Fig. 15—Forging bars of high-speed steel. Fig. 16—Forging shrapnel nose pieces

about one hundred other machines of the same type have been distributed to various munitions works in France, which break all of the steel bars used in manufacturing the 75-mm. shells employed by France and her allies.

The rough steel billets next go to the heating furnaces, Fig. 4b, from which they are removed and delivered to great vertical presses, Fig. 4a, arranged in two long lines parallel to the longitudinal axis of the furnaces. Here is one of the few places in the entire plant where more men are used in proportion than women. Men handle the hot forgings and feed them into the presses with long-handled tongs, but women actually operate the presses, working the controls which produce the downward and upward strokes. Two operations are necessary in forming the rough shells. In the first press the red-hot billet is stamped out to about half of its ultimate length, and the second press completes the drawing. Each shell after leaving the second press is stamped with an identifying mark. Connected with these operations are the processes of heat treatment, Fig. 7, and the testing of the physical properties of the steel in the shell cases. The forgings are then ready for machining, the bulk of this latter work being done by women on machine tools of American manufacture.

The machine shop is a huge building equipped with 14 identical rows of machine tools belt driven from overhead shafting, each row having an output of about 4000 shell bodies a day. The rough forging starts at one end of the line and progresses from one machine to the next, including about fifteen major machining operations, all the work of women, only the foremen being men.

"Tables de Montage"

The machine work is followed by the operations of assembling and filling the shells performed at 14 *tables de montage* (assembling tables) corresponding to the 14 rows of machine tools. To these tables are delivered at carefully timed intervals the lead balls, the caps and other accessories needed for the finished shells, so that there is never an over or an under supply of these accessory parts to impede progress. Shell cases arrive at the rate of 200 an hour for each table, a total of 4000 a day of 20 hours. Lead balls are delivered at the rate of 500,000 an hour, representing a daily total of from 10,000,000 to 12,000,0000 balls, each weighing 12 grams or over 158 tons a table. Caps, diaphragms and tubes arrive at the same speed as the shell bodies; and resin heated in tanks is at hand for filling the cases after the balls are in place. The final operations consist of cleaning, polishing, painting and boxing for shipment. The crates are then loaded into railway cars from the outgoing shipping platform, Fig. 8, 18 cars forming a trainload carrying 18,000 shells.

One large department is devoted exclusively to the manufacture of balls for the shrapnel. A mixture of lead and antimony melted in gas-heated furnaces is cast in water-jacketed cylindrical molds (Fig. 6) and allowed to cool, forming ingots each weighing about 60 kg. (132 lb.). These ingots are pressed cold by the hydraulic presses, Fig. 9, into five cylindrical strands, or rods, which are wound upon large reels which, when full, weigh about 1000 kg. (2204 lb.) each. In the next operation the lead strands are unwound and fed into ball-forming presses, Fig. 5, containing pairs of semi-cylindrical dies, which press the lead alloy rods into strings of bullets. These dies do not cut out separate bullets, but deliver strands of roughly formed spheres held to one another by thin collars like a necklace of beads. These strips are collected in skips, picked up by overhead cranes and dumped into octagonal containers, seen at the right of Fig. 10, mounted horizontally on trunnions, which are revolved, causing the strips of bullets to churn and tumble about. This process breaks the spheres from their strips, rubs the surfaces smooth and produces the finished lead balls. All waste material is saved and recast into ingots. The balls are passed down a short inclined chute, where women inspectors cull out any imperfect pieces. Then, by underground conveyors and bucket elevators, the finished bullets are delivered to the assembling tables, where they are placed in the shells.

To take care of the great transportation problem in this plant electric storage-battery trucks of the platform-elevating type are employed, all operated by women. These trucks are illustrated in Figs. 11, 12 and 13, showing their adaptability for different operations. The material is loaded on four-legged low platforms of sufficient height so that the truck can just be run under them and the load picked up by elevating the truck platform.

Another interesting feature of the works is the tube-drawing shop, Fig. 14, which salvages all material spoiled in the shell-body work by drawing this into steel tubes. This is located in a shop 120 x 450 ft., fitted with equipment of their own design for this work. The rejected shells are converted into tubes from 4 to 6 ft. in length. This shop employs about 50 workers and produces daily about eight tons of drawn tubes.

The Citroën plant has also specialized in the production of high-speed steel intended for its own use. To make this it has installed crucibles with a daily capacity of 6000 kg. (13,200 lb.), although its own daily consumption is only 200 kg. (441 lb.), the remainder being sold to other plants. The forging of these cast billets of high-speed steel is done by the hammer method, as illustrated by Fig. 15.

An adaptation of American-made forging machines for the forming of the nose piece for the shell is shown in Fig. 16, where the work is illustrated in actual process of manufacture.

The Trademark Situation

American manufacturers and exporters are greatly disturbed over a trademark situation that has recently arisen and which has been brought to their attention. It has been made known that 13 foreign countries, including Germany, Austria-Hungary, Spain and Brazil, have a treaty arrangement whereby a trademark may be registered in any one of these 13 countries and hold good in all of them. Through Austria, German merchants have been pirating the trademarks of many prominent American concerns, such as the American Steel and Wire Co. and the manufacturers of Firestone tires, that have neglected to register their trademarks in the aforementioned countries of the alliance. It is said the matter will be made a subject of an investigation by the Department of Commerce and a diplomatic issue made of it.

Series for the PLANNING DEPARTMENT

Preliminary Planning of Shop Operations

By ALBERT A. DOWD

The shop foreman who gives a piece of work to a mechanic without fully instructing him in the details of how he wishes it done is not working toward the highest degree of shop efficiency. In this article the writer goes further, and advocates the planning of all the operations and tooling requirements before the order for the work is sent to the foreman in the shop.

WHERE a manufacturer is to produce work in quantity it is to his advantage to know how much it will cost, what machine tools and equipment the work will require and how much production he can get. It is better for him to know these things in advance rather than have the cost department tell him the cost of the work after the product is finished. Then he can regulate his price, establish his profit to better advantage and determine how great a production he can figure on, how much stock he would need in a given time, and how many days' or hours' overtime would be necessary to get out the work in a shorter length of time. If a man intends to build a house he wants to know in advance how much it is going to cost, and although incidental expenses may occur to alter the estimated figures, he nevertheless has a pretty good knowledge of the cost. The manufacturer, however, many times goes at his estimating blindfolded, trusting to his shop executives to get out the work as best they may. He may have a good idea due to previous experience as to the cost and how quickly the work can be produced, but to know whether the work is being routed through the various operations to the best advantage and whether the tool and machine equipment is up to its maximum efficiency is one of the late developments of efficient shop methods. Generally speaking the writer believes that the average manufacturer does not know beforehand, as he should, what results he will get; although there is a commendable desire on the part of many modern ones for this information.

Manufacturers of automobiles are perhaps more up to date in this respect than many others, and no present-day manufacturer in that line would attempt to put his work into the factory until the planning department had carefully laid out all the work to be done, specified the tool equipment, machine tools, gages and cost of production. There is excellent reason for this preliminary work, and as a matter of economy these big manufacturers have found out that it pays to have all matters connected with production known before the work goes to the factory. Probably nowhere is there more inefficiency in manufacturing than that found in the setting-up and tooling work on turret lathes and screw machines. Many executives believe that the foremen of these departments are perfectly competent to plan the method of tooling up the machines so as to enable the shop to obtain maximum production. Consequently these departments are allowed to get out the work in their own fashion, no one knowing whether the effi-

NO 3-A UNIVERSAL HOLLOW-HEXAGON TURRET LATHE 13

Specifications

AUTOMATIC CHUCK CAPACITY:	
Round	3½" or 4½"
Square	2⅜" or 3 3/16"
Hexagon	2¾" or 3⅞"
SCROLL CHUCK CAPACITY	16"
SWING:	
Maximum	21½"
Over Carriage	17¼"
LENGTH TURNED	44"
TURRET:	
Diameter across Faces	17"
Feeds (Revolutions of Spindle to feed one inch): 10, 14, 20, 28, 40, 54, 76, 109, 153, 218.	
Power Rapid Traverse: Feet per Minute	35
CARRIAGE:	
Cross Travel	12"
Longitudinal Travel	30"
Feeds, Cross or Longitudinal; Revolutions of Spindle to feed one inch: 10, 14, 20, 28, 40, 54, 76, 109, 153, 218.	
SINGLE BELT DRIVE PULLEY:	
Diameter	16"
Width of Belt	5"
Speed, r. p. m.	440
Spindle Speeds: 8, 11, 15, 20, 27, 38, 53, 71, 100, 132, 178, 250.	
COUNTERSHAFT: TIGHT AND LOOSE PULLEY, R. P. M.	440
TOOL STAND ACCOMPANIES EACH MACHINE.	
HORSE POWER REQUIRED	10
THREADING CAPACITY:	
Recommended	2"
By Using Two Die Heads	3"
LENGTH OF MACHINE	11' 8"
WITH RATCHET FEED (OVER ALL)	16' 8"
WIDTH OF MACHINE (OVER ALL)	4' 8"
WEIGHTS (POUNDS) MACHINE WITH BAR EQUIPMENT:	
Net	8000
Crated	8350
Boxed	9900
BULK, BOXED FOR EXPORT (CU. FT.)	270

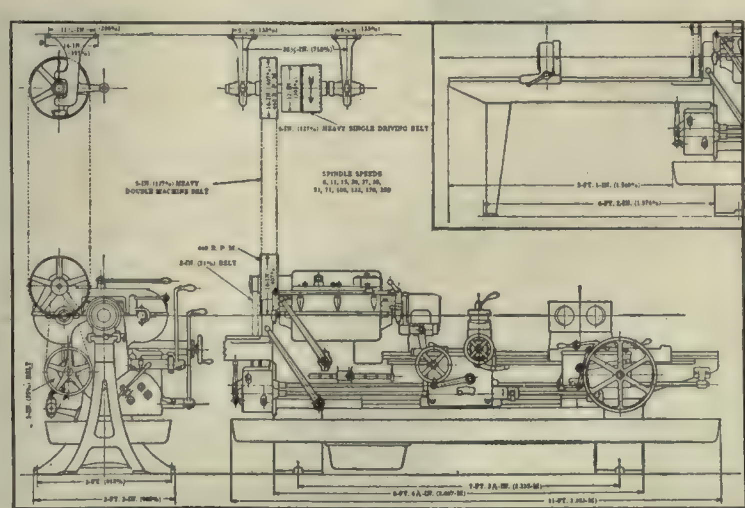


FIG. 1. CONVENIENT SETTING-UP PLANS AND SPECIFICATIONS FOR TURRET LATHES

ciency is low or high, except possibly the foreman of that department. Within the past two months a deplorable state of affairs was discovered in the turret-lathe and screw-machine department in a large factory near New York City, which is at present engaged in important Government work. The conditions in the

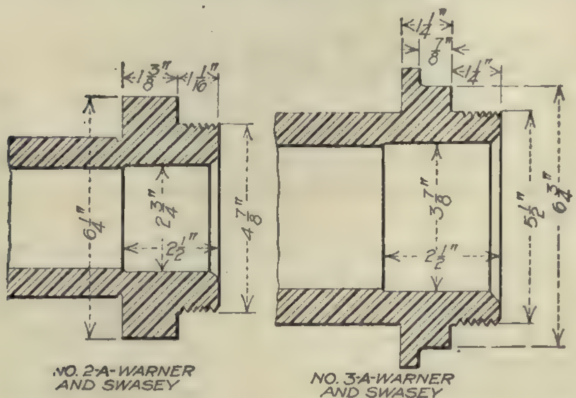
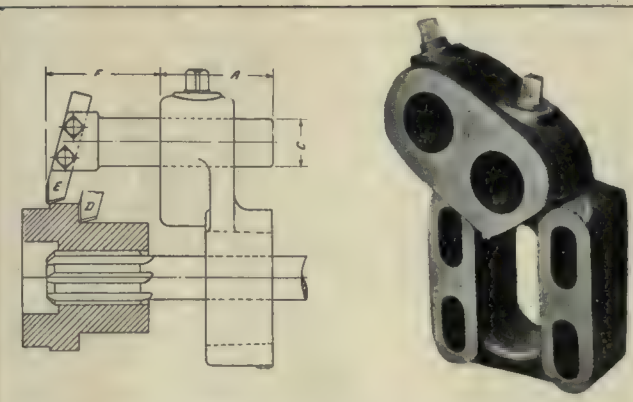


FIG. 2. DETAILS USED IN TOOL DESIGNING FOR THE LATHE

factory were as follows: Time studies were being made in this department and a record taken of the method used in machining the work, together with the various operations, the cutting speeds and feed and other data connected with the manufacture. After the data had been collected an instruction card was made out showing the work with enough dimensions on it to make plainly apparent the sizes that were to be machined in each operation. All other dimensions having nothing to do with this particular operation were deleted. In addition the instruction sheets contained all the data necessary for the operator to know in connection with the tools used, the speeds and feeds and the type of machine; the length of time necessary to make the piece was also given on this sheet. A determination was reached as to the cost of the work, and piecework prices were set from the data collected in the factory. Now this process is evidently wrong, because it takes for granted that the ordinary machine operator who originally set up the work produced it under the best possible conditions.

The mechanical department should not send out a number of pieces to be drilled and reamed, and which would require a jig, without first designing the jig and having it built; nor should the turret-lathe department be an exception to this rule. And why should the tooling, feeds and speeds and other important processes be left entirely to the operator or foreman of the department? This method of procedure, we know, obtains in many factories, with results more or less satisfactory according to the ability of the workmen and the foreman, but it is evident that such methods cannot be compared with the results that may be had by preliminary planning and laying out of the turret-lathe and screw-machine work by a thoroughly competent man.

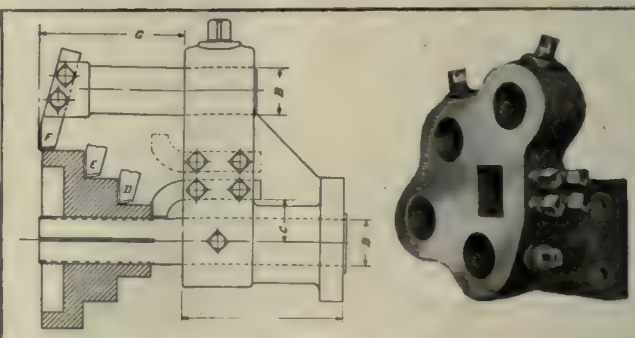
In this respect a fact of importance is that competent men capable of planning turret-lathe and screw-machine work are not found in every factory. The value of planning work of this kind has been fully proved, and the manufacturer who feels he cannot afford to keep men on this class of work continually has two courses open: one is to employ spasmodically an outside specialist who has made a study of this class of work, and the



Adjustable Turning Heads

Machine used on	No. 2 S. M. 12" T. L.	No. 4 S. M. No. 4 Univ. 14" T. L.	No. 6 S. M. 16" T. L. 18" T. L.
Tool Number	M-689	M-601	M-649
Length of body ... A	$2\frac{3}{8}$	$3\frac{7}{16}$	$3\frac{7}{16}$
Width of body	$4\frac{5}{16}$	$4\frac{7}{8}$	$5\frac{5}{16}$
Diameter of holes ... C	1	$1\frac{1}{2}$	$1\frac{1}{2}$
Diameters possible to be turned ... D	$\frac{3}{4}$ to $3\frac{1}{8}$	$1\frac{1}{2}$ to 5	$1\frac{3}{4}$ to $5\frac{5}{8}$
E	$2\frac{1}{2}$ to $5\frac{3}{8}$	4 to $7\frac{7}{8}$	$4\frac{1}{2}$ to 8
Length that can be turned with standard holder F	$3\frac{1}{8}$	$4\frac{1}{2}$	$4\frac{5}{8}$
Vertical adjustment on turret	$\frac{7}{8}$	$\frac{7}{8}$	$1\frac{1}{8}$
*Cutter holders used, styles A, B, C or D	M-695	M-603	M-603

*When ordering cutter holders specify style wanted. For description of these holders see pages 17, 18, 19, 20.



Multiple Turning Heads

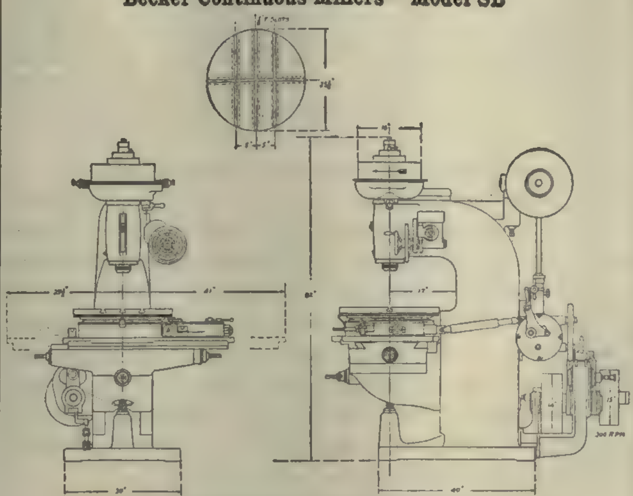
Machine used on	No. 1 S. M.	No. 2 S. M. 12" T. L.	No. 4 S. M. No. 4 Univ. 14" T. L.	No. 6 S. M. 16" T. L. 18" T. L.
Tool Number	M-825*	M-687	M-600	M-604
Length of head ... A	$1\frac{3}{4}$	$3\frac{3}{4}$	$5\frac{3}{8}$	$5\frac{3}{8}$
Width of head	$3\frac{1}{2}$	$5\frac{1}{4}$	$7\frac{1}{2}$	$7\frac{1}{2}$
Diameter of hole ... B	$\frac{5}{8}$	1"	$1\frac{1}{2}$	$1\frac{1}{2}$
Size of rectangular slot	None	$\frac{11}{16}$x$1\frac{1}{4}$	$1\frac{1}{8}$x$1\frac{5}{8}$	$1\frac{1}{8}$x$1\frac{5}{8}$
Lower edge of rectangular hole from center line of spindle ... C	....	$\frac{7}{8}$	$1\frac{1}{4}$	$1\frac{1}{4}$
Largest possible diameter turned in the three positions ... D	$\frac{3}{4}$	2"	$3\frac{1}{2}$	$3\frac{1}{2}$
E	$1\frac{5}{8}$	$3\frac{3}{8}$	$5\frac{1}{2}$	$5\frac{1}{2}$
F	$2\frac{1}{2}$	5	$7\frac{1}{2}$	$7\frac{1}{2}$
Length that can be turned with standard holders ... G	2"	$3\frac{1}{4}$	$4\frac{3}{4}$	$4\frac{3}{4}$
†Cutter holders used, styles A, B, C or D	M-831	M-695	M-603	M-603
‡Tool bushings used, styles B, C or D	....	M-682	M-630	M-630

*This tool is furnished with a $\frac{5}{8}$-inch shank instead of a flange to bolt on face of turret.
†When ordering cutter holders always specify the style wanted. For description see pages 17, 18, 19, 20.
‡Specify style bushing wanted. See pages 28, 29.

FIG. 3. DETAILS OF STANDARD LATHE TOOLS

other is to hire a man who is well versed in planning and who can be switched over onto some other work after his regular task has been done. A good, bright practical designer having an analytical mind can be used for several classes of work providing he has had the shop experience and a knowledge of machine tools in general. Better results can sometimes be obtained by working in harmony with the foreman of a department

Becker Continuous Millers—Model SB



Front and Side Elevation — Model SB Continuous Miller

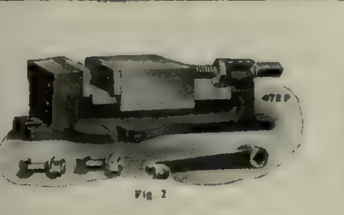
Specifications of Model SB Continuous Miller

Diameter of rotary table	25¼″	Greatest distance between center of spindle and neck	17″
Length of table support	37″	Greatest distance between end of spindle and table	19″
Longitudinal adjustment of table, automatic or by hand	26¼″	Spindle speeds, c.s. pulley running at 300 R.P.M.: Open belt, 63-80-110-140-180-250-315 R.P.M. B.G. 12-16-22-28-36-50-68 R.P.M.	
Feeds per revolution of spindle	from .004″ to 1.000″		
Vertical adjustment of knee, by hand	15″		
Vertical feed of spindle, automatic or by hand	7¼″		
Diameter of spindle, main bearing	3″		
Length of spindle, main bearing	7½″	Floor space	82″ high × 77¼″ long × 70½″ wide
Diameter of spindle pulley	16″	Weight complete, net, about	5,340 lbs.
Diameter of constant-speed pulley	14″	Weight boxed for ocean shipment, about	6,100 lbs.
Hole in spindle	No. 11 B. & S. taper	Weight crated, about	5,590 lbs.
Threaded end of spindle	3 per inch U.S.S. R.H.	Cubic contents in feet, about	213

Machine may be equipped with power longitudinal and head feed if desired.
Equipment regularly furnished includes 4″ double belt and full complement of wrenches.
Spindle is made of high-carbon crucible steel with bushed bronze bearing. All gears high-carbon steel forgings.
Bearings subject to wear are bushed with bronze. Ball bearings are standard of the highest grade.

FIG. 4. DETAILS FOR TOOL PLANNING FOR CONTINUOUS MILLING OPERATIONS

and leaving some of the setting-up schemes to him, although layouts may be made to show the various operations, which can be worked out in detail, to complete a given piece of work. From the foreman's experience frequently the proper speeds and feeds can be determined and a time study made in advance, which will show how much time is necessary. From this time



Plain Vises

Size Miller	Vise No.	Depth Jaws	Width Jaws	Jaws Open	Net Weight	Shipping Weight	Code Word
18″ & 1 Mchs.	2c	1⅜	5⅛	2¾	35	50	Vici
2 Mchs	3c	1⅝	6⅛	3½	58	90	Vial
3 Mchs	4c	2	7⅛	5	106	130	Vite
4 and 5 Mchs	5c	2½	8⅝	7	158	185	Viza

Swivel Vises

Size Miller	Vise No.	Depth Jaws	Width Jaws	Jaws Open	Net Weight	Shipping Weight	Code Word
18″ & 1 Mchs.	2c	1⅜	5⅛	2¾	40	55	Vigu
2 Mchs	3c	1⅝	6⅛	3½	75	100	View
3 Mchs	4c	2	7⅛	5	135	155	Vivo
4 and 5 Mchs	5c	2½	8⅝	7	230	260	Vink

THE CINCINNATI MILLING MACHINE COMPANY, CINCINNATI, OHIO

FIG. 5. DETAILS OF INFORMATION FOR TOOLING MILLING MACHINES

study piecework prices can be set, so that when the work goes into the factory all of the processes and the tools necessary to do the work will have been determined beforehand and experimenting by the workman largely eliminated.

By far the best way for manufacturers to get the desired results in this direction is to engage a man of the requisite experience who will organize a planning department when the factory is of a size to warrant the expense. A minor instance in this connection is a case that came under my observation some years ago of a small repair shop employing about 50 men, with a very practical and painstaking foreman. The foreman was accustomed to making free-hand sketches of the tools for any job of importance which came to the factory. He would then turn over the sketches with a little memorandum of instruction on them to the workman selected to perform the job, who would go ahead according to the suggestions. The result of this preliminary work, even on a small scale and in so crude a fashion as this, was remarkable, and the work was generally turned out in much less time than it would have been under other conditions.

For larger shops it is obvious that the planning and tool-engineering departments should be very closely affiliated so that the data on various machines accumulated by one department may be easily accessible to the other. It is evident that the most complete data must be provided for all the machines which are in production use in the factory, such as the milling machines, turret lathes, screw machines, engine lathes, grinding machines, etc. The accumulation of this data is by no means a small job, yet in order to be of value it must

Nos. 2, 3, 4 and 5 Plain High-Power Cincinnati Millers

	No. 2	No. 3	No. 4	No. 5
Table				
Working surface	47¼″ x 12″	55¾″ x 13½″	64¼″ x 16½″	76½″ x 19″
Size over all	50¼″ x 12″	58¾″ x 13½″	68¼″ x 16½″	80¼″ x 19″
T-slots	Three ⅝″	Three ⅝″	Three ¾″	Three ¾″
Range				
Longitudinal	28″	34″	42″	50″
Cross	10″	12″	14″	14″
Vertical	19″	20″	20″	21″
Quick traverse	Hand	Hand	Power, 100″ per minute	Power, 100″ per minute
Full Width				
Face of column to braces	28⅝″	30⅛″	35″	36⅜″
Spindle—Chrome nickel steel	Flanged End	Flanged End	Flanged End	Flanged End
Diameter in front bearing	3 7/16″	3 7/16″	3¾″	4 1/16″
Size taper hole (B. & S.)	No. 11	No. 11	No. 12	No. 12
Size hole through	13/16″	13/16″	13/16″	13/16″
Spindle speeds—Number	16	16	16	16
Spindle speeds—Range	15 to 375	14 to 350	14 to 350	13 to 335
Overhanging Arm				
Diameter	4¼″	4½″	5″	5¼″
Distance to center of arbor	6⅜″	6⅝″	7¾″	8½″
Arbor—Not included	No. 16, 1″x10″	No. 81, 1¼″x12	No. 92, 1½″x14″	No. 94, 1½″x26″
Sizes sent on approval	No. 86, 1½″x29″	No. 86, 1½″x29″	No. 103, 2″x36″	No. 103, 2″x36″
Arbor Supports	Two	Three	Three	Three
Drive				
Pulley, size	18″ x 3½″	20″ x 4½″	22″ x 5½″	24″ x 6½″
Pulley, speed	325	325	300	325
Motor recommended	7½ H. P.	10 H. P.	15 H. P.	20 H. P.
Feed				
Width of silent drive chain	1½″	1½″	2″	2″
In inches per minute				
Number of feeds	16	16	16	16
Range of feeds	½″ to 20″	½″ to 20″	½″ to 20″	½″ to 20″
Or in thousandths per rev.				
Number of feeds	16	16	16	16
Range of feeds	.007 to .300	.007 to .300	.007 to .300	.007 to .300
Miscellaneous				
Vise	6⅛″ wide 1⅝″ deep Opens 3½″	8″ wide 2″ deep Opens 10″	10″ wide 2″ deep Opens 10″	10″ wide 2″ deep Opens 10″
Countershaft (extra)	See Catalogue			
Floor space	81¼″ x 94″	85¾″x108½″	96⅝″ x 126″	102″ x 146″

FIG. 6. GENERAL DATA USED FOR SEVERAL SIZES OF MACHINES

be very complete. Data obtained from catalogs are good as far as they go, but they are not usually perfect enough to form a record such as is needed for this class of work. In addition to machine data the special equipment for the various machines should also be listed and kept in such shape that the most intimate details can be determined without delay. For example, the turning-tool and multiple-tool holders used on turret lathes should be in the form of drawings, or blueprints, which give all the necessary dimensions. Boring bars or cutting heads should similarly give the necessary dimensions, and so

with all other equipment tools of a flexible nature which can be used for more than one piece of work.

A few examples of data sheets containing machine details that have been found useful by the writer are shown herewith. Fig. 1 shows the setting-up plans and specifications for a Warner & Swasey 3-A universal hollow-hexagon turret lathe. The convenience of an arrangement of this kind for preliminary planning on turret-lathe work is apparent. Enough details are given in the specifications to permit the planning department to set the speeds and feeds for any given piece of work, and the outline views make an excellent reference for the tool designer.

Fig. 2 shows in section the end of the spindles on the 2-A and 3-A Warner & Swasey turret lathes. These drawings are very useful when a faceplate is to be fitted or a special chuck or cat-head is to be made. There are so many cases in turret-lathe work when a bushing or special internal mechanism is needed in the spindle that a sectional view like this is very important. Also as the tool equipment of a turret lathe is a potent factor in the production of work at maximum efficiency it is important that the special-tool equipment furnished with any machine be listed with the other data on the machine. Referring to Fig. 3 a sheet of this kind will be seen in which both the adjustable turning head and multiple turning head used on the Warner & Swasey machines are shown in some detail. The specifications given with these tools indicate the range of work to which they are suited as well as considerable other important data.

Naturally there are several sheets of this kind for each machine to show the different varieties of tools furnished. In addition to the data shown there should be also a drawing or blueprint of the cross-slide block in sufficient detail to permit special tools to be applied to it, and there should also be a drawing of the turret giving enough dimensions so that special tooling can be applied to it and bolted firmly to it.

Other Data Sheets

Taking up another example of machine data sheets it is quite frequently possible to obtain reproductions of standard machine tools, as in Fig. 4, which is an outline view with dimensions and specifications for the same machine. In a number of cases manufacturers in making up their catologs give outline views similar to these that are shown, and when this is the case it is only necessary to cut this out from the catalog and paste it onto a suitable sheet for reference. Additional dimensions can be added to the outline view if found necessary.

Some of the data used in connection with milling machines are shown in Fig. 5. The left view shows a halftone illustration of the machine, the right gives the specifications for several sizes of milling-machine vises with dimensions for the jaws so that special jaws can be fitted without difficulty. Fig. 6 gives the specifications on the Nos. 2, 3, 4 and 5 plain high-power Cincinnati milling machine. Nearly all catalogs contain specification data of this kind, so that this also can be clipped out of the catalog and pasted on the data sheet. Fig. 7 gives the specifications for a number of different arbors for shell end mills, collets and fly-cutter and cutter-screw arbors. Fig. 8 also gives specifications of arbors of various styles to suit a number of different milling machines.

The writer has used two methods for keeping data on machine tools and equipment. The utility of these two methods is somewhat dependent upon the size of the planning and tool department, and it will be found that either will give good results. One way is to paste the data on substantial cards about 9 x 12 in. in size and index the cards in a large-size card-catalog index. There are some advantages to this method in that any card giving data on a certain machine can be taken out and used by anyone and returned after it has been used. Its disadvantage, however, is the possibility of its being lost or of its being in use when wanted by another.

Another method, which is preferred by the writer, is to paste all the data on heavy paper that is punched at the edges to go into a loose-leaf book. The data can then be kept alphabetically for the different manufacturers and various books made up, each of which contain data on a number of machines of the same type, but manufactured by different firms. For example, a book can be made up on turret-lathe and screw machine; another on automatic screw machines; another on milling machines, plain and universal; another on vertical milling machines, and so on.

Machine-Tool Lists and Floor Plans

It is important that the planning department should have in connection with its other data a complete list of the various machines in the shop. They should be listed and grouped according to the number of machines in each class, and the machine numbers which are affixed to them should also be given to show their position in the factory as also indicated by the floor plans. As machine-tool equipment is subject to change a list of the machine tools should be arranged so as to be flexible enough to be added to without disturbing the system. I believe the card-index system is the best for this purpose. The machines can be arranged on a card similar to that shown in Fig. 9, and they should be indexed according to the type and not by the maker's name. A separate card should be used for each type and further subdivided by separate cards for each manufacturer even of the same type machine. When additions or subtractions are made from the equipment a new card can easily be written to show the change.

Reference to the cards illustrated in Fig. 9 will show that the swing of the machine, the manufacturer, the manufacturer's number, the shop number of the machine and the department where the machine is located are all clearly indicated. In addition there is a column for remarks.

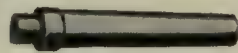
Fig. 10 shows a floor plan of one department, which indicates how the machines are placed on the factory floor, and by their respective numbers it is easy for the planning department to determine the routeing of any piece of work from one machine to another. This is an important factor in high-speed production, as the handling of the work and the distance which it travels should be so planned as to lessen the cost of handling.

The planning department must be properly equipped in all its branches, and in addition to the data already mentioned it must have complete information as to feeds and speeds with tables to show the suitable diameters

THE CINCINNATI MILLING MACHINE COMPANY

Arbors for Shell End Mills


STYLE F


STYLE A


STYLE B

Please Order by Number

No.	Style	No. of Taper	Diameter of End for Cutter	Diameter of Mills	Price	Code	No.	Style	No. of Taper	Diameter of End for Cutter	Diameter of Mills	Price	Code
201	A	9	¾	1⅝ and 1¾	$4.50	Crop	213	A	11	1¼	2¾, 3 and 3½	$7.00	Dew
202	A	9	⅞	1⅞ and 2	4.75	Crown	213-C	B	11	1¼	2¾, 3 and 3½	8.00	Ditch
203	A	9	1	2¼	4.75	Cruet	217	A	11	1½	4 and 5	8.00	Diney
204	A	10	¾	1⅝ and 1¾	5.25	Crum	217-C	B	11	1½	4 and 5	9.00	Dingo
205	A	10	⅞	1⅞ and 2	5.50	Dab	218	A	11	1½	6	8.00	Divan
206	A	10	1	2¼	5.50	Dado	218-C	B	11	1½	6	9.00	Dixie
207	A	10	1⅛	2½	5.75	Dale	219	B	12	1¼	2¾ and 3	10.00	Dode
208	A	10	1¼	2¾, 3 and 3½	6.00	Dance	220	B	12	1¼	3½	10.00	Dogma
209	A	11	¾	1⅝ and 1¾	6.00	Davit	221	B	12	1½	4 and 5	10.50	Drasa
209-C	B	11	¾	1⅝ and 1¾	7.00	Dazed	222	B	12	1½	6	10.50	Drake
210	A	11	⅞	1⅞ and 2	6.25	Decoy	223	A	10	1½	4 and 5	6.00	Dauk
210-C	B	11	⅞	1⅞ and 2	7.25	Deft	228	F	11	1½	4 and 5	8.50	Daery
211	A	11	1	2¼	6.50	Delta	229	F	11	1½	6	8.50	Darky
211-C	B	11	1	2¼	7.50	Delve	230	F	12	1½	4 and 5	11.00	Debri
212	A	11	1⅛	2½	6.75	Demit	231	F	12	1½	6	11.00	Debet
212-C	B	11	1⅛	2½	7.75	Deuse	232	A	12	1¼	2¾, 3 and 3½	9.00	Depot

These prices are net, f. o. b. our factory.
Style "B" Arbors are suitable for only those High Power Machines that have threaded spindle ends.
All the above Arbors are tapped ⅝"—11 for draw-in bolt.

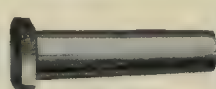
The cutter end of these Arbors is made about ½ of 1-1000 of an inch larger than standard. The cutters should have standard holes and standard keyways. They should be shrunk on the Arbors. To do this, warm cutters by immersing them in hot water, which expands them enough to go on easily, and, on cooling, shrink on tight. This makes practically as good a combination as if the cutter and shank were made in one piece.

Do not Drive or Press the Arbors into the Cutters.

Collets for Millers

Always Order by Number


STYLE 1


STYLE 2


STYLE 3

Size	Style	Outside Taper	Inside Taper	Price	Code Word	Size	Style	Outside Taper	Inside Taper	Price	Code Word
A	1	7	4	$2.00	Drayo	GG	2	11	9	$7.00	Earth
R	1	7	5	3.00	Ewor	PP	2	11	10	7.25	Easel
C	1	9	5	3.00	Dram	T	2	12	9	7.50	Dual
B	1	9	7	4.00	Drift	M	1	12	9	7.00	Dumb
E	1	10	7	5.00	Drua	H	2	12	10	8.00	Duct
F	1	10	9	5.00	Druid	N	1	12	10	7.50	Dyzz
Q	1	11	7	5.50	Dwarf	I	2	12	11	8.00	Duke
G	1	11	9	6.25	Dryud	II	3	12	11	9.50	Eaves
P	1	11	10	7.00	Eclat	O	1	12	11	7.50	Doril
QQ	2	11	7	6.25	Earl						

These prices are net, f. o. b. our factory.
Collets styles 2 and 3 are suitable for those High Power Machines that have threaded spindle ends.

Fly Cutter Arbors

We carry the following sizes in stock. A piece of steel ¾" square by 3" long is furnished with each arbor.

No. of Arbor	Size of Hole	No. of Taper	Price	Code Word
401	¾" sq.	10	$7.50	Asp
402	¾" sq.	11	10.00	Ant

Cutter Screw Arbors

We carry in stock arbors for machines with No. 10 taper. The end for cutters has ⅜ 20 right-hand thread.

Price . . . . $4.00 Code Word . . . . . Ace

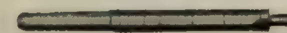
Prices on this page are net, f. o. b. our factory.

FIG. 7. DATA FOR ARBORS AND COLLETS

THE CINCINNATI MILLING MACHINE COMPANY

Arbors for Millers

Always Order by Number


STYLE A

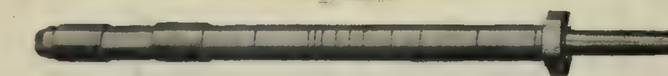

STYLE B


STYLE C


STYLE D


STYLE F


STYLE G


STYLE J

We carry in stock arbors as listed. We no longer put tangs on arbors, because tangs do not hold arbors securely enough to do the heavy work that is now being required of milling machines. The small end of the arbor shank is tapped ⅝" 11 for drawing-in bolt, and a ⅝" bolt long enough to reach through the spindle of the machine and draw the arbor firmly into the taper is furnished as part of the equipment of every machine. All arbors 1" diameter and over are splined for standard keys.

MACHINES ON WHICH THEY FIT	No.	Style	No. of Taper	Diameter	Length from Shoulder to Nut	Diameter of Bearing Collar	Flanged	Price	Code Word
18" and 18" H. G	08	A	9	⅞	5			$7.50	Brail
	09	A	9	1	6			8.00	Bream
	7	A	10	1	6			8.00	Broth
1 and 2 Plain and Universal Cone Machines; also No. 2 High Power when Spindle End is Threaded	9	A	10	1¼	6			9.00	Bugle
	*10	A	10	⅞	8			9.00	Bung
	11	A	10	1	8			9.00	Buoy
	13	A	10	1¼	8			10.00	Busby
12" Plain Manufacturing Machines use Arbors Nos. 41 and 43.	41	D	10	1	14½	2		12.50	Chime
	43	D	10	1¼	14½	2		15.00	Chink
	44	D	10	1¼	27	2		18.00	Chix
	45	D	10	1½	27	2⅜		19.00	Choir
	16	B	11	1	10	2⅜		10.00	Cabal
No. 3 Plain and Universal Cone Type with Threaded Spindle End 12", 18", 24" Automatic Machines.	18	B	11	1¼	10	2⅜		10.50	Calp
	53	D	11	1	18½	2⅜		15.50	Clang
	55	D	11	1¼	18½	2⅜		17.00	Cliff
	56	D	11	1½	18½	2⅜		17.00	Cloud

These prices are net, f. o. b. our factory.
*When it is necessary to use a ⅞" arbor on the larger machines we recommend this No. 10 arbor in connection with standard collets as follows:
No. 3 Cone Type machines with Threaded Spindle Ends, use "P" collet.
No. 3 High Power and No. 3 Standard machines with Threaded Spindle Ends, use "PP" collet.
No. 2 and 3 High Power and No. 3 Standard machines with Flanged Spindle Ends, use "P" collet.
No. 4 and 5 machines with Threaded Spindle Ends, use "H" collet.
No. 4 and 5 machines with Flanged Spindle Ends, use "N" collet.

FIG. 8. CUTTER ARBORS FOR MILLING MACHINES

and speeds. Tables of this kind are readily available in handbooks, but for convenience in estimating they may be got up in blueprint form of proper size to compare with the loose-leaf book containing machine-equipment data. A copy can then be placed in each book for reference. Tables of this kind should show the correct number of revolutions required for work ranging from $\frac{1}{16}$ to 20 in. in diameter or greater if the product requires data on greater diameters. Cutting speeds should be given from 20 to 100 ft. inclusive, by 5 and 10; that

TURRET LATHES – AUTOMATIC CHUCKING						
NO. MCHS	SWING	MAKER	MFR'S NUMBER	SHOP NUMBER	DEPT.	REMARKS
1	$21\frac{7}{8}$	Potter & Johnston	6A	222	CHUCK.	CHUCKG EQUIP.
1	"	" " "	"	223	"	" "
1	"	" " "	"	224	"	" "
1	"	" " "	"	413	"	" "
1	"	" " "	"	414	"	" "
1	"	" " "	"	416	"	" "
1	"	" " "	"	218	"	" "
1	"	" " "	"	219	"	" "
1	"	" " "	"	372	"	" "

FIG. 9. METHOD OF KEEPING CARD INDEX OF SHOP TOOLS

is to say the cutting speeds of 20 ft. should be succeeded by that of 25 ft., then 30, 35, 40, 45 and 50, and from 50 the progression can be by 10. A good way to arrange these tables is to have one giving fractional sizes from $\frac{1}{16}$ to 4 in. inclusive and another from 1 to 20 in. inclusive. Another way is to have one table large enough to take fractional sizes up to 4 in., and above this by progressive stages 1 in. at a time. If space will permit it will be more convenient to arrange the tables all in one.

In estimating the production on a piece of work there are a number of things to be considered, as follows: First, the kind of metal to be cut and its quality; second, the matter of cutting lubricant and whether the work will be cut with a lubricant or without; third, the type of machine to be used must be considered and the kind of fixture or jig; fourth, the feeds and the speeds which can be used to the best advantage. The matter of setting up and removing the work from the fixture must also be noted.

The man in charge of estimating work must be one who is familiar with shop practice in all its forms and he must have access to all data pertaining to the machine tools and the equipment; he must possess excellent judgment and be able to know just how a piece of work should be done and be acquainted with the permissible feeds and speeds. Some people think that this kind of preliminary estimating is of little value, owing to differences in shop conditions, methods, machine tools and operators. However, no factory executive should be so shortsighted as to permit the shop to run of itself and to dictate in any way the methods of governing his planning department. There are cases when the planning department is not efficient and the shop foreman dictates the method of its conduct; but this is never the case when the man in charge of the planning is thoroughly familiar with his work and is able to dominate the situation by turning out the work according to his ideas. The solution of this problem is that if the planning department is not efficient changes should be made to make it so, but never to permit the shop to dictate.

Let us assume that the planning department is fairly conversant with the work to be manufactured, and let us further assume that the man in charge can dominate the situation. In such a case the planning department should establish cutting speeds and feeds and determine just how long it will take to manufacture a certain piece of work. Under these conditions a planning department will be considered to have done enough to pay for itself.

Diversity of opinion exists regarding the proper cutting speeds which can be used for certain classes of ma-

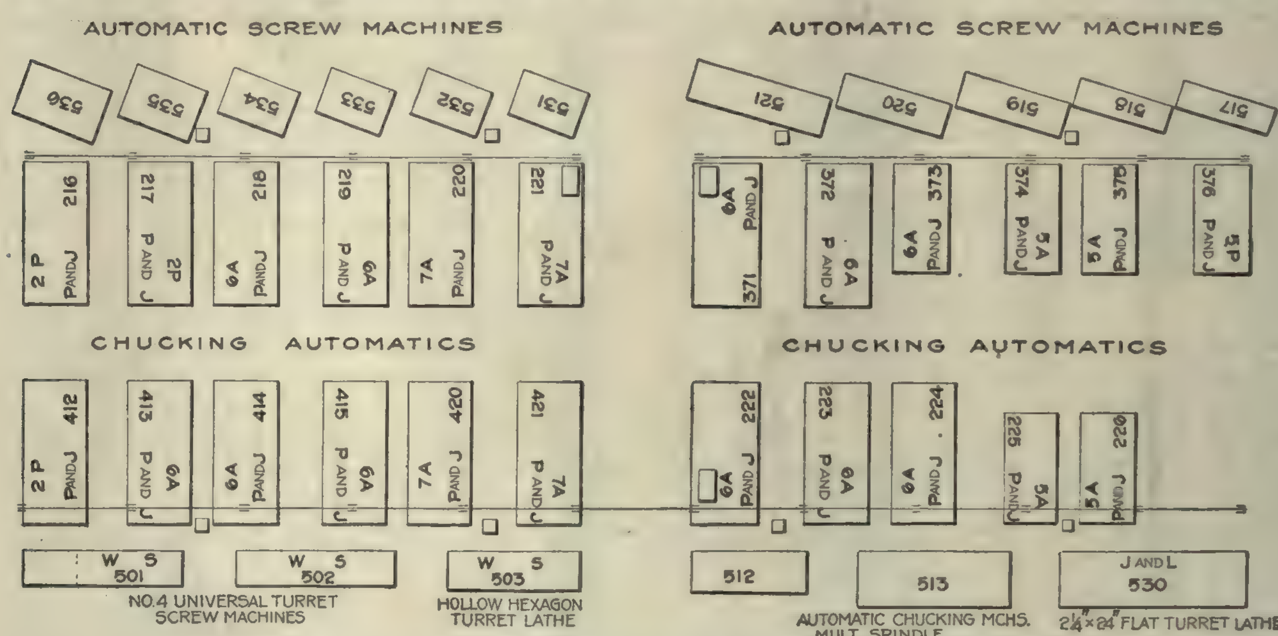


FIG. 10. FLOOR PLAN OF SHOP FOR USE OF PLANNING DEPARTMENT

The lettering in regard to each machine is so placed that the way the machine faces is clearly indicated, the lower side of the lettering indicating the front of each machine

terial; but in the planning department this matter must be followed up most carefully, because one foundry will furnish a grade of cast iron, for instance, totally different from another and requiring different cutting speeds and feeds. There is no hard-and-fast rule for the determination of proper cutting speeds and feeds, but a conservative table is here submitted, which can be varied to suit conditions:

	Ft. per Minute
Cast iron	50
Cast steel	60
Malleable iron	70
Machine steel forgings (15 to 20 point carbon)	65
Machine steel (black stock)	70
Tool steel forgings	35–40
Steel alloys (containing nickel and chromium, depending on alloy)	30–50
Yellow brass	250
Composition brass	120–150
Bronze (depending on alloy)	30–80

It is assumed that an ample supply of cutting lubricant is used for metals requiring lubrication in the above table. Cast iron and brass are usually run dry, but the latter can be used with a lubricant if desired.

For the proper cutting speeds for various diameters the following formulas can be used:

In the case of a piece of work of given diameter which is to be machined at a predetermined cutting speed in feet per minute the number of revolutions per minute required can be easily determined by a mental calculation. Let

$D =$ Diameter of work in inches;

$N =$ Number of revolutions per minute;

$C =$ Cutting speed in feet per minute;

Then

$$\frac{4 \times C}{D} = N$$

Example: Diameter of work $D = 20$ in. Cutting speed desired $C = 50$ feet per minute.

Then

$$\frac{4 \times 50}{20} = 10 \text{ r.p.m. required}$$

If we wish to know the cutting speed at which a piece of work is running and knowing the number of revolutions per minute at which it is revolving the formula can be reversed as follows:

$$\frac{D \times N}{4} = C$$

These formulas are not exactly correct, but they are within 5 per cent., which is near enough for ordinary figuring, as they enable a man to quickly obtain the desired information by a rapid mental calculation.

About Delays in Government Payments

By Capt. Walter D. Cline, O.R.C.

By direction of the Acting Chief of Ordnance

The correspondence with reference to delay in payment to concerns furnishing the Government with materials has been referred to this office for reply.

There can be no question but that serious delays have been occasioned heretofore, much to the embarrassment of contractors furnishing the Government with materials; this is due to a number of causes which formerly existed but which are now being rapidly lessened.

One of the principal reasons has been the method by which contracts were entered into, it being the practice to make tentative arrangements with contractors for articles to be furnished, pending the official execution of a written contract. Delays were occasioned by various controversies which came up with reference to the terms which were to be incorporated in the final draft of the contract, and in some cases the work to be done was completely finished before the official contract was signed. Owing to the fact that disbursing officers were not permitted to make payments until the official contract had been signed this course occasioned holding up of payments on the contract. This is no longer the practice, as all preliminaries must be settled and the contracts signed before the work is begun on the same.

Another instance was in the case of the cost-plus form of contract. In this class of contract it was necessary that the cost of labor and materials and other items entering into the matter had to be audited before payments were made in order to arrive at the proper amounts due the contractor.

Ignorance of Methods

Very often manufacturers were ignorant of the methods of procedure with reference to vouchers and other items which were conditions precedent to payment, and time was consumed in the interchange of communications relative to the proper manner in executing the papers upon which disbursing officers were authorized to make payments.

In other instances manufacturers sought to do Government work without sufficient capital to finance the same, depending upon the Government to furnish the money.

The rapid expansion of the business of the department, growing as it did from an organization consisting of 65 or 70 officers in the whole department—of whom about 18 or 20 were assigned to duty in Washington—to the organization as it now exists, consisting of over 4000 officers, 3000 of whom are now stationed in Washington, created some confusion, of course, and some time was necessarily consumed in ironing out the wrinkles occasioned by this fact.

About Past Mistakes

It is not the policy of the department to attempt to conceal the fact that mistakes have occurred, and friendly criticism, we think, is helpful to the proper administration of its affairs. Careful attention and effort is being directed to the reduction of the evils which have heretofore existed and it is the hope of the department that causes for criticism will rapidly be eliminated.

In the specific instances cited in the correspondence it might be observed that in one case the firm was communicated with regarding the delay and no reply was received from it, and in the other case the matters complained of were with the Quartermaster's Department and Signal Corps respectively, and the company was advised by this office under date of Apr. 19 to communicate with those branches of the army.

These are only a few of the causes that have contributed to the conditions that have heretofore existed, and by the removal of the causes a corresponding improvement in results has been noted, at least in the number of complaints received.

The Responsibility

By Rufus T. Strohm

There's a powerful pile of talkin'
    As to how we're goin' to win,
An' some of it's sound an' full of sense
    An' much of it's weak an' thin;
For it mostly calls on others
    For the help to pull us through,
When the simple truth of the thing is this—
    It's a job for me an' you.

There's a lot of 'em loudly shoutin'
    That an endless line of ships
Will knock the cup of the conqueror
    From the Hohenzollern lips;
An' while I am not denyin'
    That their wish is comin' true,
I'm sartin sure that the final punch
    Will be up to me an' you.

Yet a bunch of 'em keep insistin'
    That our hopes are based on guns,
An' others say that the nation's wealth
    Will defeat the hated Huns,
While some pin faith to our fighters
    In the work they're called to do;
But as for me, I am still convinced
    It's a job for me an' you.

No, we ain't at the front in Flanders,
    Where the blood-red rivers run,
But safe at home in the busy land
    Where the war tasks must be done;
If earth's to be rid of the Kaiser
    An' his dirty Prussian crew,
There's work for a hundred million hands—
    So it's up to me an' you.

WAR-TIME REPAIRS IN THE NAVY

II. Work on Engine Parts

By FRANK A. STANLEY

This chapter on naval repairs on board ship includes some of the features of shop work that appeal to engineers and machinists and gives details of such processes as reboring of cylinders; turning of brasses and rings; application of the dial test indicator in setting up heavy work; finishing of slippers, connecting-rods, and so on.

ALTHOUGH this account of shop operations on board ship under war conditions is headed by a title which might suggest that repair work only is to be considered, the fact is that the activities to be described include not only a varied line of strictly repair and overhauling undertakings, but the execution of an important percentage of entirely new work as well.

The "Vestal's" shop performances are by no means restricted to the doing of those things that comprise the important items generally designated as repair work in the narrow sense of the term. The welding and brazing of broken parts; the reboring and relining of engine and pump cylinders; the pouring of babbitt and composition boxes; the stripping and overhauling of a service pump or a dynamo engine—all of these operations and many more are carried along on the diversified schedule of the ship's repair orders. In addition considerable work is executed that is new from start to finish.

While comparatively little of the latter is put through on orders calling for the manufacture of a considerable number of duplicate parts, still there are, first and last, various instances where fair-sized lots are required of such parts as special couplings and bolts, valves and other steam fittings, shackles and pins, port shutter attachments, and so on.

Of new work made up singly or two or three pieces at a time there are numerous interesting examples. In many instances the shop operations must commence at the patternmaker's bench, and occasionally the design of the casting to be molded is of such character as to require the application of all of the patternmaker's resources in the construction of the pattern and core boxes.

At times in the forge shop such skillful manipulation of a big bar of hot metal is to be witnessed as will hold one's unflagging attention for hours while the material is passed through successive heats and shaped under forging press, steam hammer and sledge to the characteristic outlines of a connecting-rod or some other member belonging to a high-speed engine. When these castings or forgings reach the machine shop the work assumes certain aspects of still greater interest, for it is rarely the case that any appliance in the nature of a special fixture can be adapted to the exigencies of the problem.

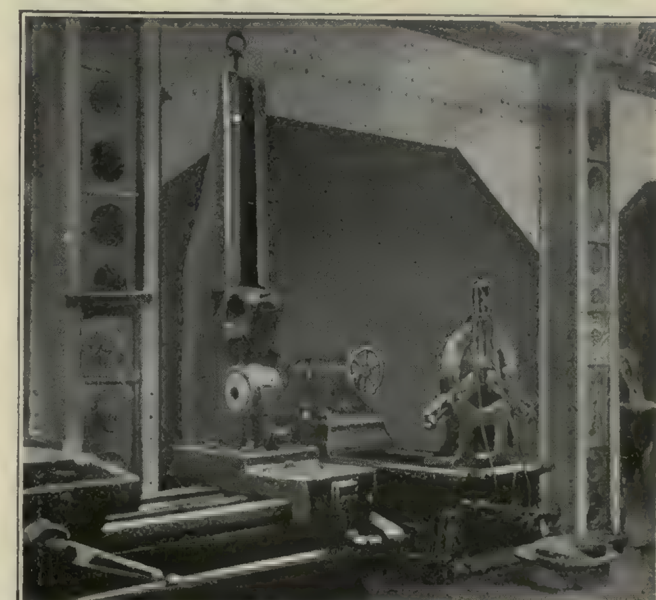


FIG. 8. ALL TOOLS ARE NEATLY STORED IN THE SHOPS. NOTE THE TWO LONG STRAIGHTEDGES AT THE SIDE

Aside from the use of fundamental appurtenances—angle irons, parallels and the like—and possibly the application of some simple templet for laying out centers and marking lines, the machinist must in the main rely upon personal skill and knowledge of shop equipment. He has usually received an excellent training, and the character of the machine tools is such that he should experience no special difficulty in finishing the work to the requisite limits of accuracy and a minimum of time.

This feature comes readily to our attention as we step down into the main machine shop of the "Vestal" and

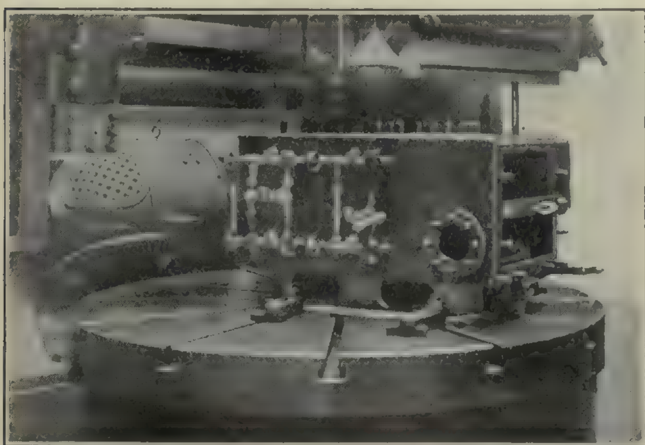


FIG. 9. SETTING A CYLINDER FOR REBORING IN THE VERTICAL BORING MACHINE

notice, for instance, the method of stowing the two long straightedges shown in Fig. 8. These straightedges are 10 or 12 ft. long and about 12 in. deep. They fit nicely into the channels formed in the riveted vertical ship's members, and here they are retained by substantial straps across the faces of the columns against falling or jarring free under the roll of the vessel when at sea.

So with chucks, faceplates, steadyrests, boring bars and other attachments and appurtenances for machine

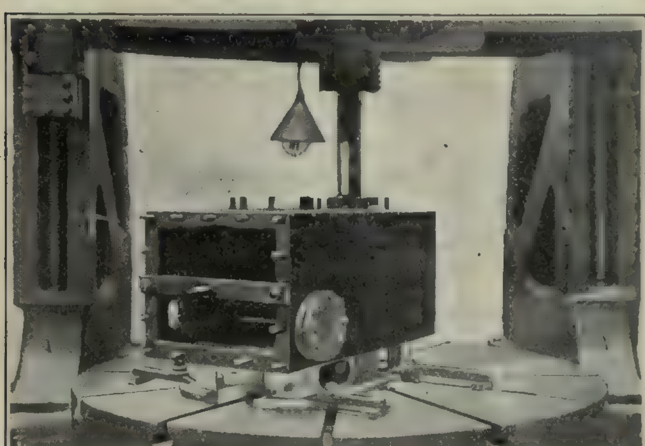


FIG. 10. THE REBORING JOB UNDER WAY

tools. When not in service they are secured safely to the ship's bulkhead or side plates where they can neither cause nor suffer injury.

Incidentally the illustration, which is of the starboard side of the shop, includes the table and outboard support of the horizontal boring machine and the ends of several lathes situated under the gallery.

Now that we are in the main shop we are fortunate in having the opportunity to observe the method of handling a typical piece of ship work on the vertical boring machine located athwart the ship near the after bulkhead.

The work in hand is the overhauling of one of the "Vestal's" own dynamo engines, a compound engine combined with a 32-kw. generator, and the operation under way on the vertical boring machine is the reboring of the cylinders for new pistons and rings.

The high- and low-pressure cylinders and the piston-valve chest are combined in one casting. The appearance of this unit as seen from sides and ends is well shown in Figs. 9 and 10, which also serve to illustrate the manner of clamping the casting fast to the boring-machine table.

Fig. 11 shows the method adopted for setting the work centrally by means of an indicator prior to starting the boring cut.

An undertaking of this character is not to be regarded as trivial or easy of accomplishment by almost anyone with a few months' shop experience. First, the work

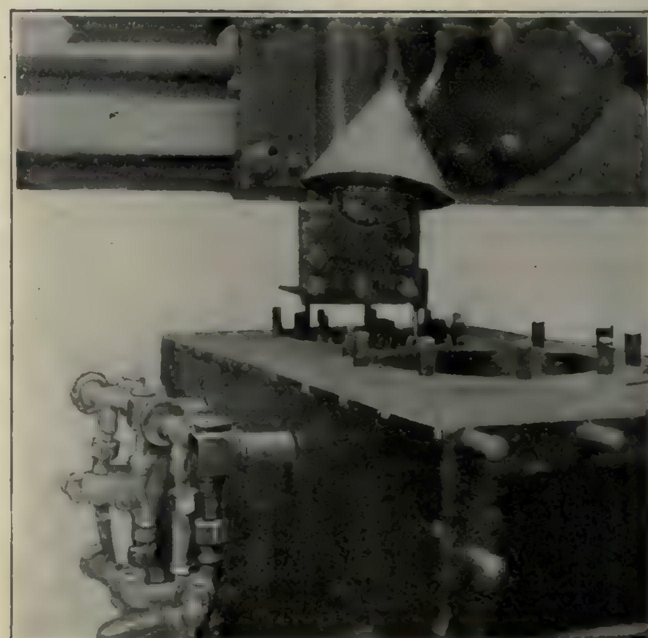


FIG. 11. HOW THE DIAL INDICATOR WAS APPLIED IN SETTING THE WORK

requires to be set accurately by the old cylinder bores so that the original center distances shall be retained and the lateral positions of the center lines remain undisturbed; and, second, the new cylinder bores must be parallel for their full depth and perpendicular to the lower face of the flange on the base.

The flanged base provides a very convenient means of securing the work to the boring-machine table, for when scraped clean it rests squarely upon the table surface and its projecting flanges form a gripping surface for the ends of the U-straps which are applied at either side.

Considerable skill is required at the outset in locating this cylinder casting, which weighs half a ton or more, so that its bore will be centered over the table axis and therefore run correctly for the reboring process. With the central location once assured complete familiarity with the manipulation of heavy machine tools of this character is essential if the best results are to be derived

in the limited period through which the engine can be tied up in the repair shop.

If attention may be directed for the moment to the illustration, Fig. 12, the method of using the test indicator will be made clear. The indicator is mounted on the lower end of a holder which is formed integrally with a clamp head by means of which the instrument may be attached to a tool shank in a boring machine or a planer as readily as it can be secured in a straight holder for use in a lathe. As the cylinder bore in work of the kind illustrated is sure to be worn more or less irregularly and therefore to be out of round to a greater or lesser degree, the indicator should be applied to the counterbored surface.

When boring deep cylinders or other parts where the cut must be run down to a depth of 2 ft. or more, with the tool bar extended below the ram a corresponding distance plus several inches for clearance, and in addition the ram itself fed down out of its guide in the swivel head by an even greater amount, it is an experienced boring-machine operator who can at the outset so adjust conditions as to enable him to produce at the first cut a hole that is straight from top to bottom. Especially is this true in respect to work on board ship where under certain aspects of wind and weather or because of a list of the ship due to bunker contents and cargo, the tool equipment may at times be in service under a condition hardly appreciated by men who have never worked on anything more unstable than a permanently fixed shop floor.

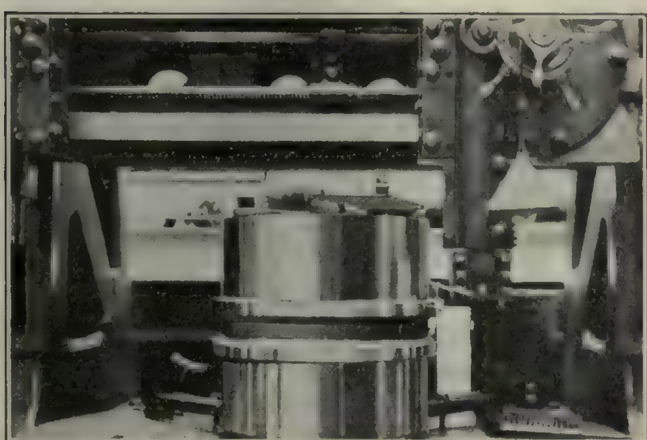


FIG. 14. LARGE CRANK BRASSES ON VERTICAL BORING MACHINE WITH INDICATOR APPLIED

We have to recognize on ship board that the only support of the tools consists of one deck plate and the cross-beams below, while on shore they would be erected on heavy concrete foundations and leveled and aligned with utmost care. In view of this lack of stability, as understood when applied to tool foundations, it is not strange if the ship's mechanics have learned to exercise proper care when starting cuts on heavy work to make adjustment of gibs and clamps, to eliminate backlash and generally to take precautions against the possibility of irregularity in the working of the machine due to the above circumstances.

Another piece of work and a special boring bar which is occasionally found quite as serviceable for turning material in one of the big lathes are illustrated in Fig. 13. This work, which consists of a follower ring for a 32-in. high-pressure piston, was sent over to the repair ship to have a small amount of metal turned from the periphery, and it was handled in the lathe by gripping it internally in a 24-in. four-jaw chuck, where it was adjusted until it ran true and then turned by means of the special tool bar shown bolted to the cross-slide.

The bar, included in the illustration, was made for just such operations and for boring a variety of work adapted to the lathe chuck. It is 3½ in. in diameter and 48 in. long, so it is obviously suited to a wide range of work. It is drilled through crosswise with a series of holes spaced about 6 in. apart and large enough to receive ¾-in. bolts, two of which are required for holding it in position.

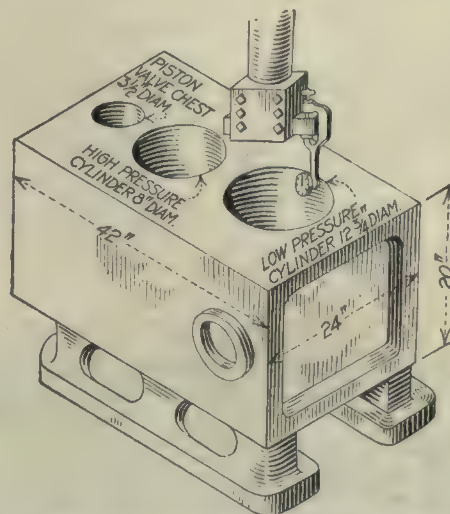


FIG. 12. THE INDICATOR CLAMPED ON BORING TOOL

The bar rests in a concave seat formed in the top face of a block which is tongued at the bottom to fit into the toolpost slot in the lathe cross-slide, and on the top of the bar are a pair of concave-faced collars which serve as washers under the heads of the holding bolts. The threaded ends of the latter fit tapped holes in a steel

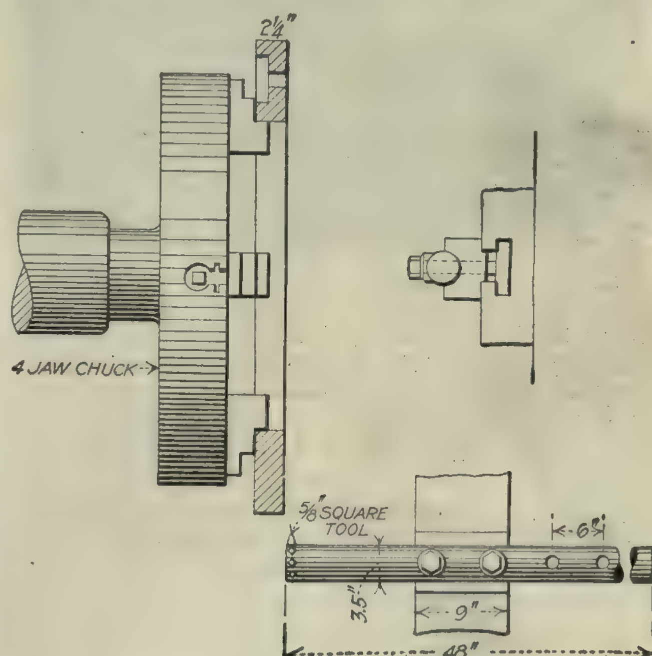


FIG. 13. TURNING A HIGH-PRESSURE FOLLOWER RING WITH A SPECIAL BAR

plate which slides into the enlarged lower portion of the cross-slide slot.

The block under the bar is 9 in. long, and when the bolts are tightened the bar is held rigidly in place. The series of holes drilled at regular intervals along the length of the bar allow the working end with the tool to be held closely to the supporting base block for short pieces of work or to be extended as far as necessary for longer cuts.

The end of the bar is slotted crosswise to receive tools of $\frac{3}{8}$-in. square section, and these are held firmly in place by three setscrews.

Turning back to the boring machine now for a moment the illustration, Fig. 14, shows another method of using the dial test indicator for setting work—in this instance a pair of crank brasses made from a single piece and afterward cut apart. The work has been bored and turned, and in setting up for the finishing process is secured lightly to the boring-machine table by straps out-

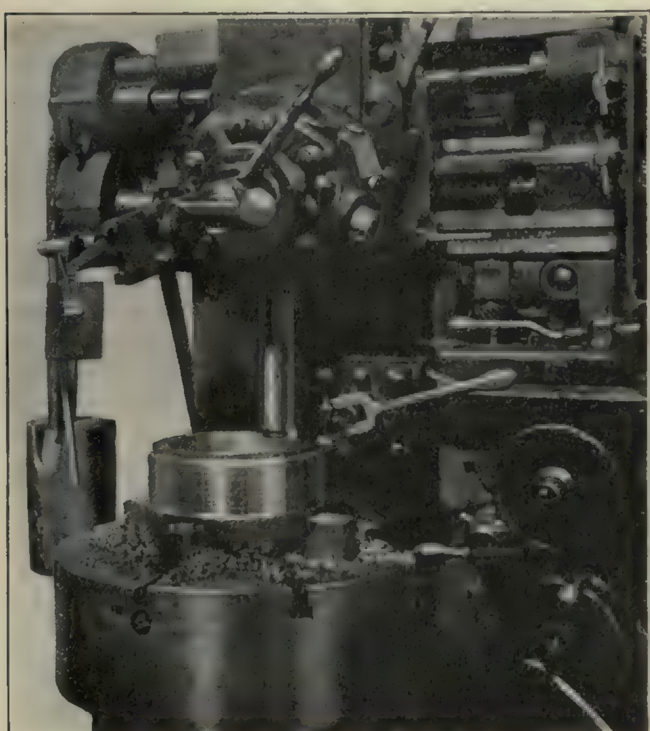


FIG. 15. RING WORK IN VERTICAL TURRET LATHE

side at the bottom and by inside straps drawn down on the upper edge of the work. Then the test indicator is applied to the outer surface to assure its running true before finishing. The method of securing the indicator shank to the tool head will be understood from the illustration.

Another instance of work made in two or three pieces from a single long section and then cut off is represented by the ring-forming operation illustrated in Fig. 15, where a 24-in. vertical turret lathe is shown in the process of finishing the final piece in the chuck. The rings are made from a heavy drum long enough to produce three or four pieces; their width being about 2 in. The end of the drum is caught in the chuck jaws and the remainder of the piece is then clear for internal and external operations, which are accomplished with the boring bar, turning tool and cutting-off tool carried in the main and side turrets.

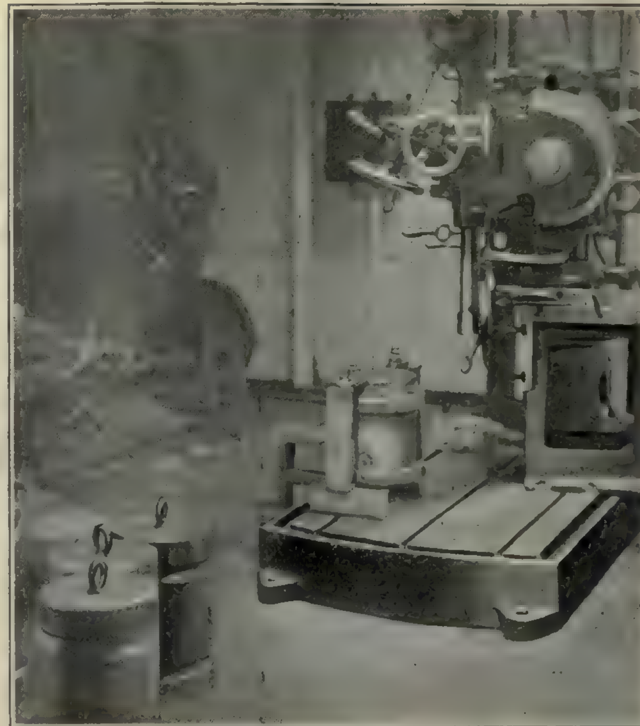


FIG. 16. RADIAL DRILLING-MACHINE WORK

These rings are used on a lot of special drum-shaped affairs made up of cast bodies weighing several hundred pounds, and which for the purpose may be called special weights. They are built up in such a way as to provide annular grooves to receive the two rings and have attached at the end, by means of countersunk head screws, flat steel plates through which eyebolts are screwed to receive a hoisting cable.

A number of these affairs will be noticed in Fig. 16, which also shows a 48-in. radial drilling machine that is kept pretty busily employed on a varied line of operations. The piece of work shown strapped down on the

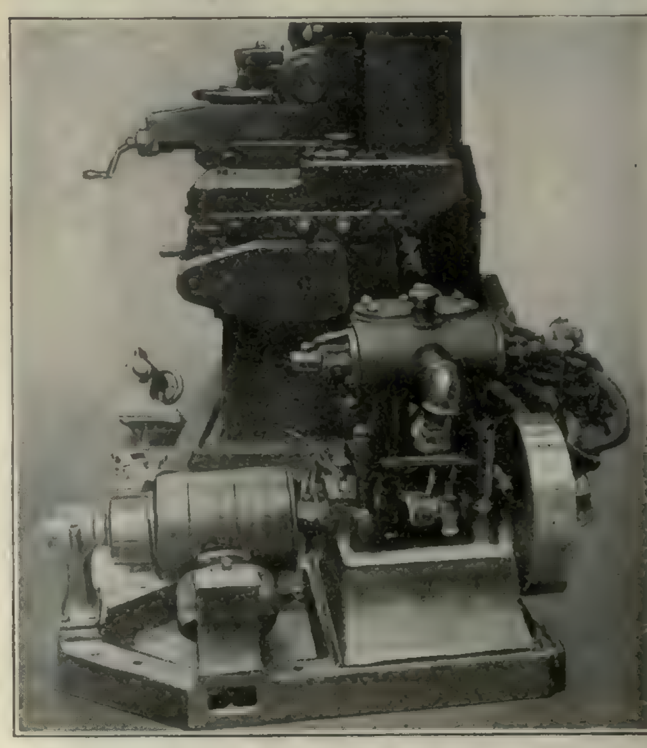


FIG. 17. DYNAMO ENGINE TO BE OVERHAULED

machine base has just been drilled, and the radial arm and spindle have been swung aside to permit the holes to be tapped for the cover screws before the work is released from its straps.

In the main shop there are among other machines in more or less constant use a medium-sized open-side planing machine, a 30 x 30-in. x 6-ft. standard planing machine, a half-dozen or more lathes ranging in size up up to a 48 x 72-in. extension-gap lathe, a horizontal bor-

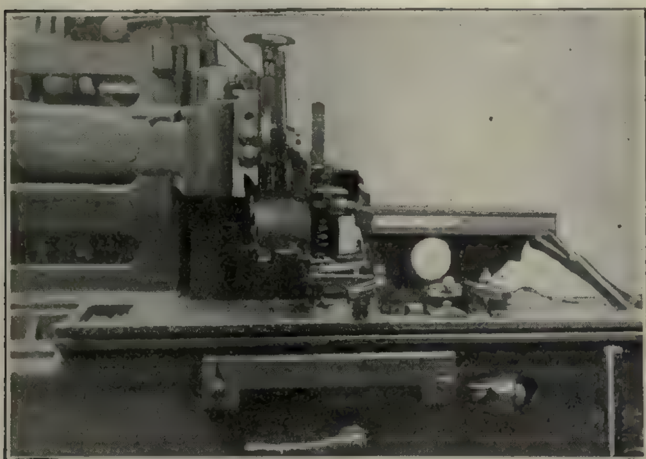


FIG. 18. FINISHING SLIPPERS ON PLANING MACHINE

ing machine, a 72-in. cylindrical grinding machine, two or three shaping machines (the largest 24 in.), a 10-in. vertical slotting machine, a 30-in. radial drilling machine, besides several upright drilling machines, grinding machines, and so on. These data refer specifically to the equipment of the main shop floor, the galleries above having much additional machinery in the line of

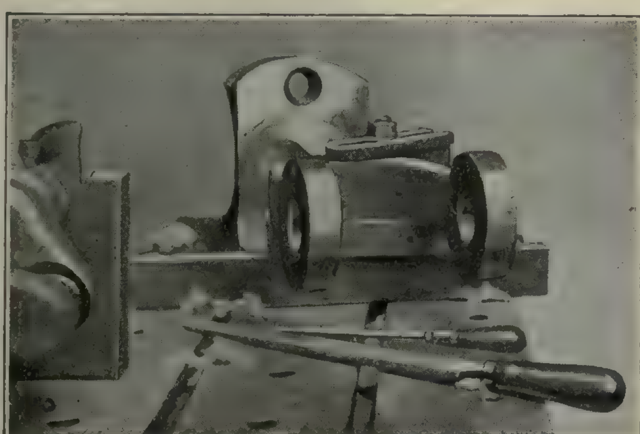


FIG. 19. WORK ON A HIGH-SPEED CONNECTING-ROD

milling machines, lathes, turret machines, etc., which will be noted in due course.

With this sort of machine-tool equipment it is apparent that the repair ship is well able to take care of an extensive line and range of mechanical troubles that may develop on board the numerous vessels. And in this connection it may be noted that the repair ship occasionally has the task of completely overhauling and putting into shape some machine tool that has been worn from service.

One of the job orders of this kind recently completed consisted in going over a 14-in. lathe for one of the fighting ships, replaning the ways on the bed, replaning and scraping in the carriage ways, fitting the cross-slide guide, planing and scraping the V-bearings under the head and tailstocks, overhauling the spindle bearings and aligning head and tailstocks, besides refitting various other parts.

These operations involved the application of some special methods and are referred to here to show the diversity of work that comes into the shop of the "Vestal."

Other Repairs

Mention has been made that occasionally a complete generating unit or some other piece of auxiliary apparatus is sent over to the "Vestal" for general overhauling, which means usually the refitting of various members and the making of a number of new parts before the order can be satisfactorily completed. In this line of operations the small dynamo and engine in a single unit, illustrated in Fig. 17, is representative of some of the ship's most important work.

The machine is seen here on the deck of the main shop partially stripped and ready for taking down all the way through for thorough examination. Doubtless the shaft bearings will have to be refinished, new boxes furnished for both main bearings and connecting-rod, the cylinders will be rebored and new rings fitted for the pistons, the commutator trued up, and various other things done before the machine is passed for return to service.

In examining this illustration, attention should be drawn to the lathe tailstock shown in front of the horizontal boring machine behind the dynamo engine. This lathe is part of the 14-in. lathe which is now on board awaiting thorough overhauling and refitting as already noted.

Two other jobs under way are represented in Figs. 18 and 19. The views should be self-explanatory, but it may be pointed out that the first is a cross-head slipper on the open-side planing machine, where it is undergoing finishing operations on face and sides, the casting being secured to the platen by a series of straps along its flange and backed up by adjustable rear struts. The second, Fig. 19, is a connecting-rod for a high-speed engine which is receiving finishing touches with file and scraper.

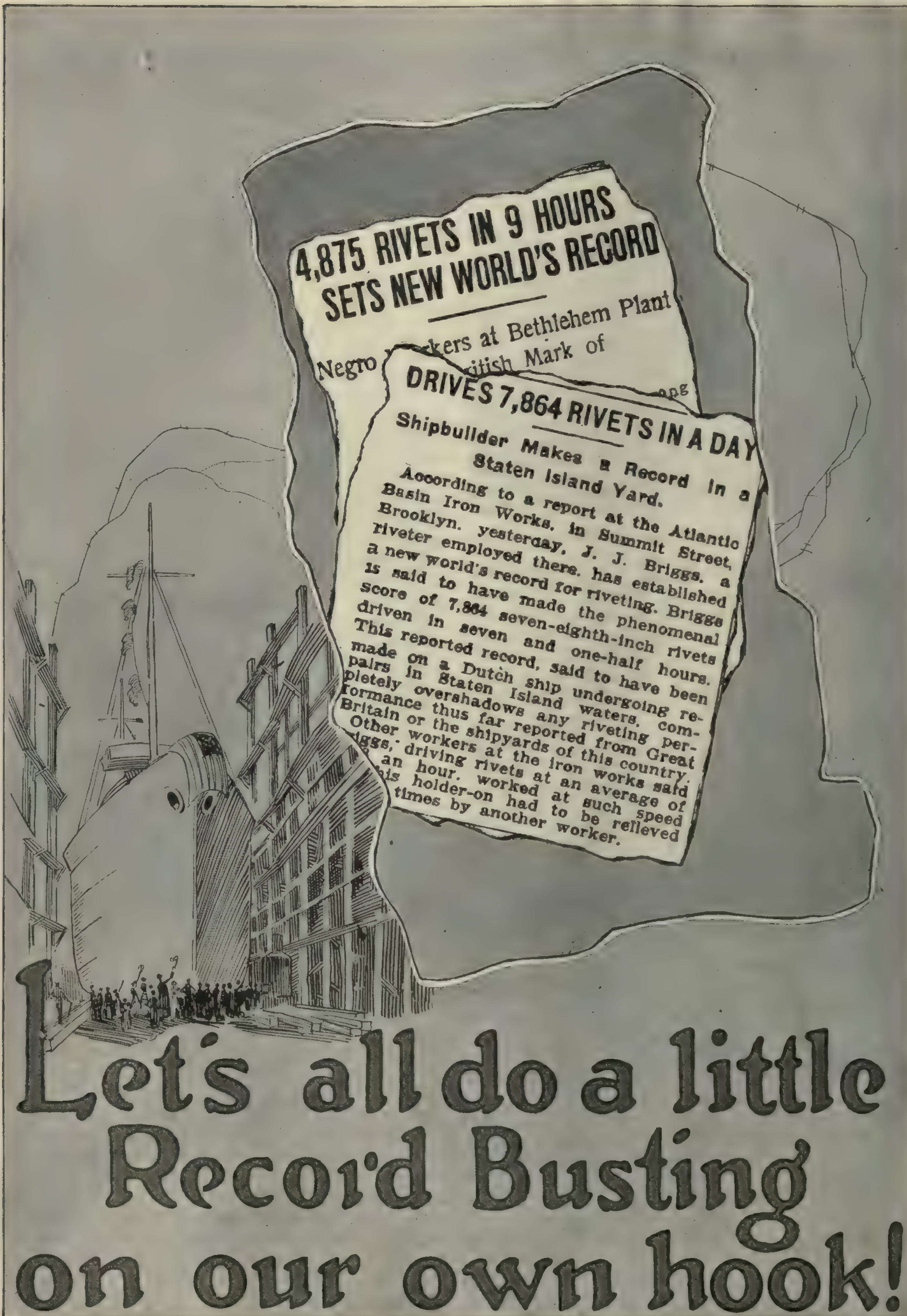
Recutting Files

By C. J. Morrison

On page 568 an article by H. D. Murphy on "Recutting Files" draws the interesting conclusion that the men did not want a new file, but another file for each job.

Experience with recut files would indicate that the reason the men stoped exchanging files was because they discovered that the recut file handed out to them was no better than the used file that they were handing in.

Exhaustive tests made with recut files a short time ago demonstrated that these files were only 30 to 50 per cent. as efficient as new files, and that the best way to raise the cost of filing operation was to cease furnishing new files and supply those which had been recut. As the process of recutting files has not been improved since these tests were made it would seem that the recut files could be no more efficient today than they were at that time. I would suggest that Mr. Murphy either make some tests with new and recut files or some time studies on the jobs and see if he is not increasing his expenses by furnishing recut files.


4,875 RIVETS IN 9 HOURS SETS NEW WORLD'S RECORD
Negro ...kers at Bethlehem Plant ...itish Mark of
DRIVES 7,864 RIVETS IN A DAY
Shipbuilder Makes a Record in a Staten Island Yard.
According to a report at the Atlantic Basin Iron Works, in Summit Street, Brooklyn, yesterday, J. J. Briggs, a riveter employed there, has established a new world's record for riveting. Briggs is said to have made the phenomenal score of 7,864 seven-eighth-inch rivets driven in seven and one-half hours. This reported record, said to have been made on a Dutch ship undergoing repairs in Staten Island waters, completely overshadows any riveting performance thus far reported from Great Britain or the shipyards of this country. Other workers at the iron works said ...iggs, driving rivets at an average of ... an hour, worked at such speed ...is holder-on had to be relieved ... times by another worker.
Let's all do a little Record Busting on our own hook!

The President's Readjustment and Reconstruction Commission—II

BY WINGROVE BATHON
Washington Representative McGraw-Hill Co., Inc.

This article takes up the possibility of organizing to continue the rehandling of products which have been forced here by the exigencies of war. The subject is worthy of much careful study, not with the sole idea of self-aggrandizement, but as an aid to handling the world's commerce more economically for all concerned.

AN OUTLINE of a proposed Presidential readjustment and reconstruction commission to deal in this country, now, with problems that will present themselves after the war was suggested in these columns last week. It was suggested that such a commission, appointed by executive order of the President of the United States, with personnel selected from leaders in private industrial effort in the United States, should have the assistance of an advisory council, also appointed by executive order, whose personnel should be selected from executive officials and legislators of the Government.

Such an advisory council should be selected from those who are especially charged with the conduct of affairs vital to the industrial, commercial, financial, transportation, labor and educational worlds. Realizing the demands made by the war on chief cabinet officers it should not be expected that they should serve actively on such a council, although in one or two cases, such as that of William P. G. Harding, the Governor of the Federal Reserve Board, principal officials, rather than those second in command, ought to be selected. In the case of legislators many chairmen of Senate and House committees are also too much occupied with war legislation to deal now with after-the-war problems. Officials of executive departments on such an advisory council should be charged not only with the duty of giving advice and outlining Governmental policies of the present and possible policies of the future, but should detail to the service of the commission experts in their own departments. In the following, strict order of precedence and rank in the Government is not followed, but such an advisory commission or council should include:

Frank Lyon Polk, counselor for the Department of State, for all international contact.

F. M. Simmons, chairman of the Senate Committee on Finance, for contact on future Government revenues.

Claude M. Kitchin, chairman of the House Ways and Means Committee, for contact on future Government revenues and taxes.

Duncan U. Fletcher, chairman of the Senate Committee on Commerce, for contact on legislation affecting commerce.

Thetus W. Sims, chairman of the House Committee on Interstate and Foreign Commerce, for contact on legislation affecting commerce.

Gilbert M. Hitchcock, chairman of the Senate Committee on Foreign Relations, for contact on future international legislation.

Henry D. Flood, chairman of the House Committee on Foreign Affairs, for contact on future international legislation.

John Bassett Moore, vice chairman of the United States Section, International High Commission, for contact with international law, patents, trademarks, etc., in Latin America.

John Barrett, director general of the Pan-American Union, for Latin-American contact in detail.

William P. G. Harding, governor of the Federal Reserve Board; Charles S. Hamlin, president of the Capital Issues Committee, and Sherman Allen, treasurer of the War Finance Corporation, for contact on finance.

E. R. Stettinius, Assistant Secretary of War, for contact in industrial war production, and Rear Admiral Samuel McGowan, paymaster general of the navy, for contact on industrial naval production.

Maj.-Gen. E. H. Crowder, Provost Marshal General, for contact on reintroducing returned soldiers to industry.

William H. Taft and Frank Walsh, chairmen War Labor Board, for contact with war labor problems and activities.

John A. McIlhenny, president of the Civil Service Commission, for contact on Government employment.

Carl Vrooman, Assistant Secretary of Agriculture, for contact with the soil and its agricultural products.

Edwin F. Sweet, Assistant Secretary of Commerce, for contact with the census and other bureaus dealing with commerce.

William B. Colver, chairman of the Federal Trade Commission, for contact with the coming administration of the Webb Act, which permits combinations for foreign trade, and for contact on unfair practices under the Newlands Act.

F. W. Taussig, chairman of the United States Tariff Commission, for contact on material now being gathered by the commission on after-the-war problems.

Raymond B. Stevens, vice chairman of the United States Shipping Board, for contact on tonnage available after the war.

Herbert Hoover, United States Food Administrator, for contact on food licenses during reconstruction period and possible repeal of laws.

H. A. Garfield, United States Fuel Administrator, for distribution of coal and oil and possible repeal of laws during and after reconstruction period.

Walker D. Hines, assistant to the Director General of Railroads, for contact with transportation and terminals after the war.

A. Mitchell Palmer, Alien Property Custodian of the United States, for final disposition of enemy-owned plants and other property.

Bernard M. Baruch, chairman of the War Industries Board, for contact on sources of supply of raw materials and finished products.

Walter S. Gifford, Director of the Council of National Defense, for contact on reviving less essential industries.

Vance C. McCormick, chairman of the War Trade Board, for contact on licenses for imports and exports after the war.

Executive secretary (when named) of the Water Power Commission of Cabinet Officers which is about to be created.

Daniel C. Roper, Commissioner of Internal Revenue, for contact on collection of excess profits taxes, etc.

Charles D. Walcott, president of the National Academy of Sciences, for Government contact with the sciences.

Charles F. Nesbit, Division of Military and Naval Insurance, for contact on personal-insurance problems and defectives on his rolls who are returned soldiers.

Philander P. Claxton, Commissioner of Education and Secretary of the Federal Board for Vocational Education, for contact on educational statistics and statistics on defectives.

George Creel, chairman of the Committee on Public Information, for assistance and contact in educational work.

It is respectfully submitted that this is far more than a mere list of names. Broadly speaking it is an analysis of the industrial war organization of the United

States, and a reading of the suggested contacts will show that the work of these officials and that of their departments, bureaus and associates will be just as vital to the solving of after-the-war problems as it is vital to winning the war now. The two problems cannot be separated. All national contacts today are international. We think and move in terms of world-wide importance.

After four years of war England has found it necessary to tear up and move to France between 15 and 20 per cent. of her main-line tracks. If the war goes a long while, if there is not iron enough, if there is not steel enough, if there is not labor enough, if there is not constant maintenance, something like that might happen in this country. Then there will be need for actual physical reconstruction in this country, as there is abroad, instead of need merely for readjustment. Plans for such possibilities must be made now.

Again, it is estimated that we shall have within a year from 45 to 50 million tons of steel-ingot producing capacity and probably 100 per cent. greater finishing-machine producing capacity than we had in 1913, in which year we were obliged in many lines to go abroad for a market for our surplus production. What plans are in the making for our surplus production after the war? Again, it is estimated that we shall have, with what we now have, 15,000,000 tons in merchant ships available after the war. What definite trade routes from American ports to the other ports of the world are being thought out?

The biggest American business which has been built up abroad has been in machine-finished steel products, such as talking machines and music machines, cash registers, agricultural machinery, adding machines, sewing machines, etc. Plans must be made to introduce these special products. One company now represented in Washington desires to open an office at Rio de Janeiro; another desires to send 600,000 tons of shipping to Australia next year. Is there any governmental agency or semigovernmental agency in Washington to offer encouragement or authoritative advice? No!

The Business of Rehandling

What is being done to divert to American ports the rehandling business previously done in Europe, such as the bringing of rice from India, to reclean it, regrade it and reship it? What is being done to hold for the United States the rubber now coming here, to avoid two trips through the submarine zone, which formerly went to England? What is being done to hold for the United States the business in tin which formerly went to England and Holland from Bolivia? What is being done to hold for the United States the business in coffee which originally went almost entirely to Europe, at which time we paid for the longer freight haul and commissions in London, Hamburg and Bremen, and much of which now comes to this country?

An advisory council such as has been outlined in this article, working with the proposed Presidential Readjustment and Reconstruction Committee or Commission, could answer these questions if answers are in existence, and if not could place industry through the commission in a position to meet such problems as have been suggested and a thousand more. The United States Tariff Commission is one of the few governmental agencies which is avowedly gathering data for after-the-war problems. The Federal Trade Commission, the Department of Commerce and the War Trade Board are also collating some information. But there is no apparent coördination of these efforts, such as there is in England and other countries. The next article in this series will deal with what is being done in that respect in England.

Rounding the Ends of Steel Links

By Fred H. Bogert

An example of how valuable time can be wasted by doing simple operations in roundabout ways came under my observation a short time ago. A quantity of steel links ½ x 1¼ in. 6 in. long made of cold-rolled steel were being rounded at the ends, so that each link would seat in a circular socket and relieve the pins of the thrust. The foreman was laying out each separate link—scribing the half circles at the ends with a pair of dividers, roughing them down approximately to the line in the shaping machine and finishing by hand-filing. From two to two and a half hours were being consumed in rounding both ends of each link, and a rather rough job was being turned out by a man none too skilful in the use of a file. A suggestion to the foreman that it would be quicker to profile-mill the ends brought out the fact that he had spent several hours in making a try at that, mounting the links on a ½-in. arbor through the end holes and revolving them on centers by means of the dividing head. It had been necessary to take four cuts. The strain of the cut kept turning the links on the arbor, thus disturbing the set-up, so after some hours of fussing he had abandoned this method and resorted to that first described.

As there was still a quantity remaining to be done and the high-speed end mill was in the machine I suggested that we experiment to determine if they could not be milled without so much trouble. A block of cold-rolled steel 1¼ x 2 x 4 in. was drilled and reamed, and a bolt of the proper length forced into the hole. This block was secured in the vise on the milling-machine table and the links were held in place one at a time by a washer and nut, the tension being just enough to hold the link firmly yet leaving it possible to swing it by hand through a half circle. It took about an hour to rig up for the job, and the remainder of the lot of links was finished at an average of 10 min. each.

An end mill of a diameter at least three times the thickness of the link should be used, and in order to get a flat surface the cutter must be set with its cutting edge somewhat ahead of the center of the link pin; otherwise the resulting milled surface will be concave. Likewise, if it is set too far ahead it will be convex, for reasons that will be clear to any mechanic. One or two trials on the roughing cuts will determine the correct position.

When the foreman and the workman who had been machining these links caught on to what I was planning to do they exclaimed: "You can't do that. You can't hold and turn those links in your hand; they'll get away from you." But they did not get away, and the work was finished more accurately and in one-twentieth the time it would have taken the other way.

Charts for the Design of Helical Springs

BY M. M. BRAYTON

Springs are one of the most universally used mechanical devices, but in spite of this the average shop foreman or mechanic knows very little about them. Most men who have occasion to handle springs know that there are formulas by which they may be designed, but very few take the trouble to look them up, learn how to use them and learn their advantages and limitations.

THE purpose of this article is to bring spring formulas to the practical man in such a way that he may be able to use them in his daily work without having to look them up and go through a lengthy calculation on the slide rule or by hand. Graphical charts solve these formulas very nicely and are not only of use to the man whose knowledge of mathematics may be limited, but to the technical engineer as well, to whom they may mean the saving of much valuable time.

Helical springs are usually made from wire of circular cross-section and may be designed for either tension or compression. The spring formulas apply equally well in either case. In the design of these springs we have several factors to consider, namely, diameter of wire, outside diameter or mean radius of coil, maximum safe axial load, number of coils per inch, maximum safe shearing stress of the steel and the deflection of the spring under a given load. Fig. 1 shows a chart built up from the formula

$$W = \frac{\pi S d^3}{8(D - d)}$$

where

W = Total safe load on spring in pounds;

d = Diameter of wire in inches;

D = Outside diameter of coil in inches;

S = Maximum fiber stress in lb. per. sq. in. taken at 60,000.

The chart solves this formula by merely drawing two lines perpendicular to each other, as shown. Suppose, for illustration, that the diameter of the wire is desired and that the outside diameter of the coil and safe load are known. Draw on a piece of transparent paper two lines at right angle and lay the drawing on the chart. Let one line pass through the coil diameter on the left-hand scale, and the other through the safe-load diagonal scale. The two lines should then cut out the proper diameter of wire on both the right-hand vertical scale and the bottom horizontal scale. The two values should check. On the chart the dash lines have been drawn to illustrate a known value of 1 in. outside diameter of coil and a diameter of wire equal to 0.16 in., the problem being to find the load which can safely be applied to this spring. The coil diameter and wire diameter are first connected as shown by the horizontal dash line; a second line is then drawn from the wire diameter as given on the lower scale perpendicular to the first line, and this will cut out the proper safe load on the diagonal scale, here given as 115 lb. This chart can be read very quickly by simply scratching on a piece of celluloid two perpendicular lines. Any one of the three variables can be read off in this way.

It is sometimes convenient to have the formula in Fig. 1 charted in terms of the mean radius of the coil rather than the outside diameter. This formula then becomes

$$W = \frac{\pi S d^3}{16R}$$

the notation having the same meaning as above.

It will be noted that this is a formula of the simple-product type and therefore can easily be built up into a very simple chart. Such a chart is shown in Fig. 2. Here we have but three variables and the chart is read by merely laying a straightedge across the scales connecting the two known variables; the unknown will then be cut out on the third scale. The dash line shows that when the diameter of wire is taken at 0.15 in., and the mean radius of coil at 0.7 in., the safe load will be about 56.5 lb. Any of the variables may be solved in this way. A copy of this chart may be kept at hand, and the time saved will be considerable if the chart is used often.

We come now to a consideration of the deflection of a spring under a given load. We have here five variables, and the chart that would solve this relation must necessarily be more complicated, and more effort would be required to read it. The formula is given by

$$\Delta = \frac{64PR^3N}{Gd^4}$$

where

Δ = Deflection of spring in inches;

P = Total load on spring in pounds;

R = Mean radius of coil in inches;

d = Diameter of wire in inches;

G = Shearing modulus of elasticity, taken at 12,000,000;

N = Number of coils in spring.

Fig. 3 shows a chart built up to solve this formula graphically. Let us first consider this formula without the N, i.e., the deflection per coil. This leaves but four variables, and Fig. 3 shows this solved on the two vertical scales. Any one of these four unknowns can be found by connecting the mean radius of the coil on one left-hand scale with the diameter of the wire on the right-hand scale. Then from the total load on the scale to the right draw through the point of intersection of the first line and the diagonal, and the line thus drawn will cut out the deflection on the scale so marked at the right. This deflection will be per coil as noted above. The dash lines shown on the chart illustrate a mean radius of coil of 0.8 in.; a diameter of wire of 0.175 in.; a total load of 160 lb., and the deflection under these conditions would be about 0.47 in. per coil. In a similar manner any of the four variables can be determined when the other three are known or assumed.

Let us now go a step further and determine the total deflection of a coil having N coils of wire. Remembering that total deflection = deflection per coil $\times$ number of coils, we have a three-variable equation of the product type similar to that charted in Fig. 2 above, and we can therefore plot this in a similar manner. In order to

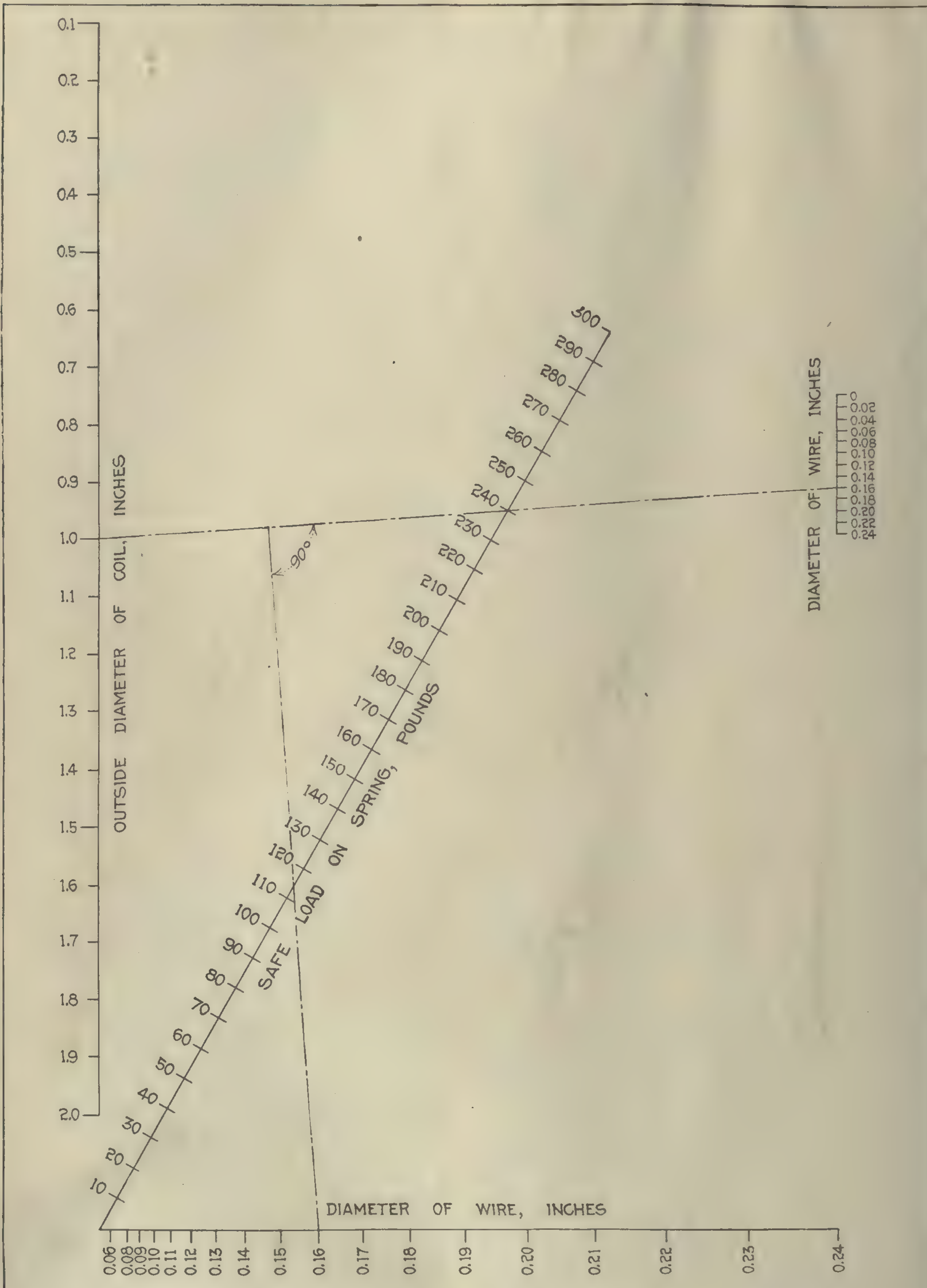


FIG. 1. CHART FOR THE FORMULA $W = \frac{\pi S d^3}{8(D-d)}$

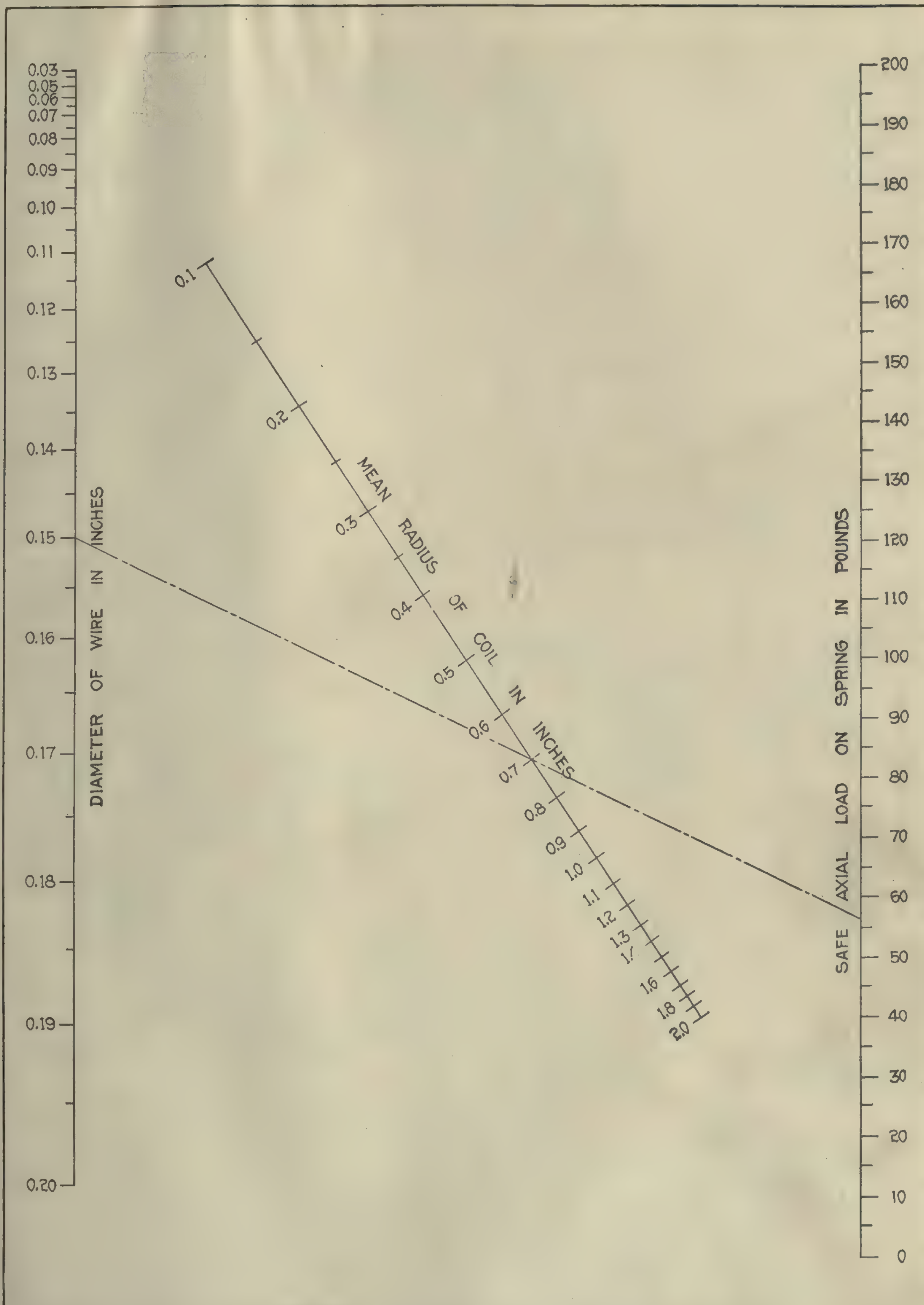


FIG. 2. CHART FOR THE FORMULA $W = \frac{\pi S d^3}{16 R}$

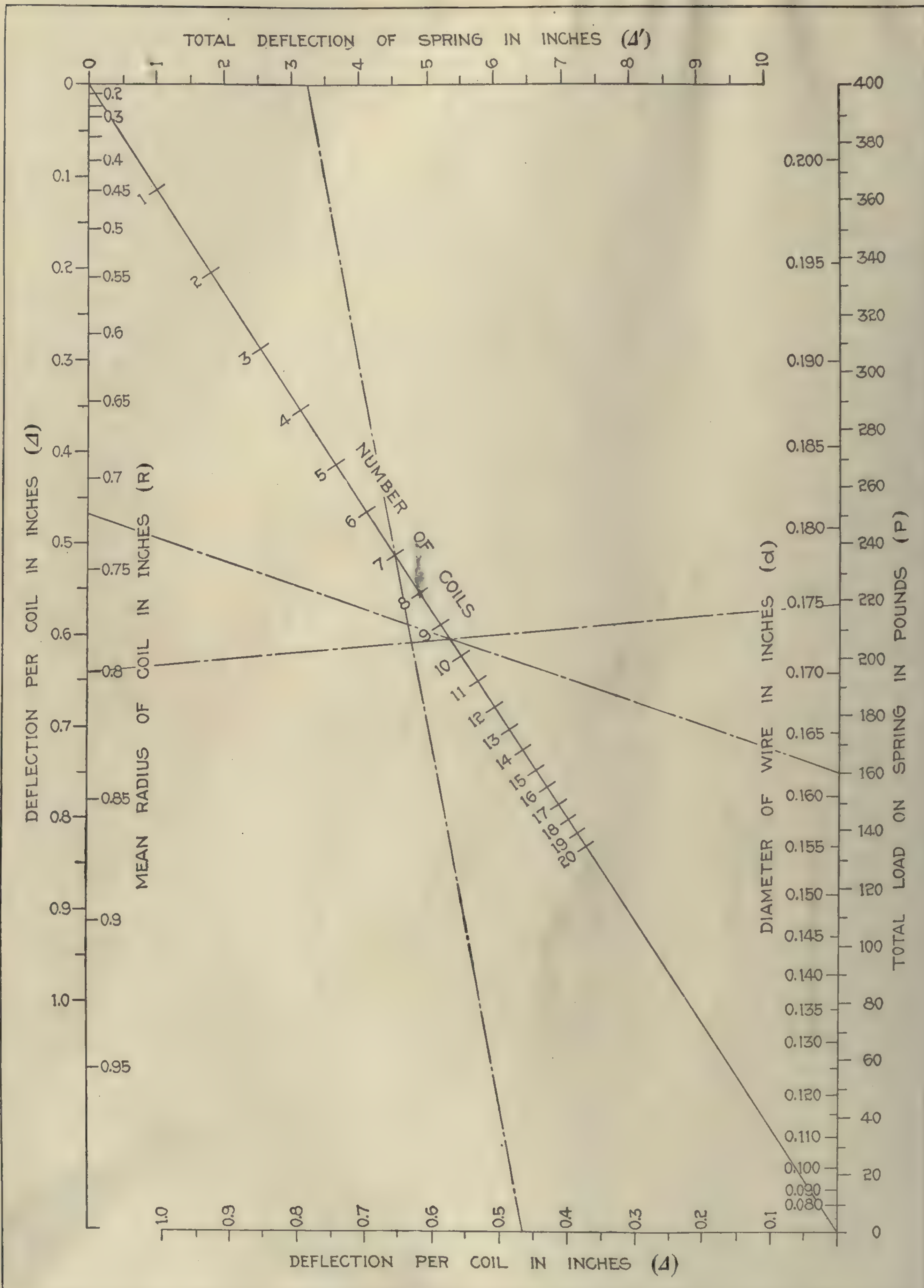


FIG. 3. CHART FOR THE FORMULA $\Delta = \frac{64\ PR^3N}{Gd^4}$

keep it all together we will chart this on the same sheet, as shown in Fig. 3. A dash line connects the deflection per coil of 0.47 in. as given in the problem above, and an assumed value of 7 coils which cut out a total deflection of about 3.25 in. This whole five-variable formula can thus be solved by drawing only three lines, an operation which can be done before a handbook can be obtained and the formula even looked up, to say nothing of solving it.

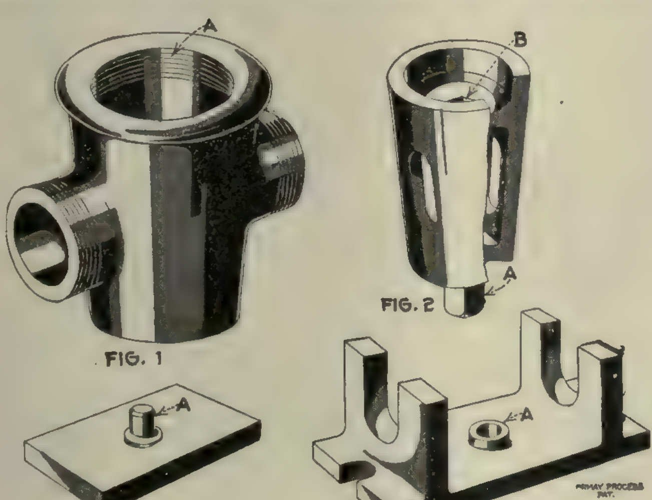
Machining Air Cocks in a Small Shop

By P. M. Herrick

Some recent descriptions of the methods employed in machining valves were particularly interesting to the writer, as he has been machining several thousand air cocks, which were about the same size and similar in design. These air cocks were made of malleable iron, and were required to withstand an air pressure of 70 lb. without perceptible leakage. The machine equipment available for this work consisted of drilling machines, engine lathes, a universal grinder and a lapping machine.

Fig. 1 shows the body of the cock, and Fig. 2 the plug. The bodies were threaded at *A*, Fig. 1, on the inside of the large end of the taper hole to permit a brass cap to be screwed in. This brass cap forced a spiral spring down against the plug and kept same properly seated when there was no air pressure applied to the cocks.

The plugs were formed square at the small end at *A*, Fig. 2, for pinning on a handle when the cocks were assembled. The large end of the plugs were closed



FIGS. 1 TO 4. MACHINING A STOP-COCK

Fig. 1—The body. Fig. 2—The plug. Fig. 3—Jig for first operation on body. Fig. 4—Jig for taper-boring and threading body.

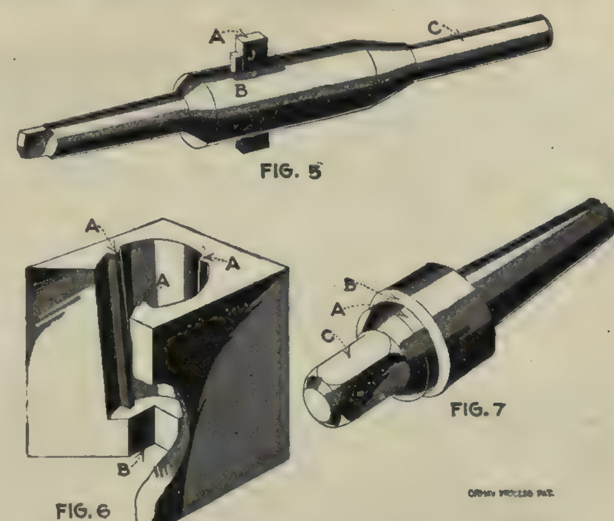
except for a cast square hole *B* in the center, which was used for a driving plug when machining the outside taper. All machining operations, with the exception of the taper on the male plugs, were performed on drilling machines.

The first work done on the bodies was to hollow mill and thread the arms. An inexpensive fixture was made, Fig. 3, for holding the bodies for this operation from a piece of cast iron, in the center of which was placed a steel plug *A* a little smaller in diameter than the cored hole in the arms. The plate was bolted to the drilling-machine table, with the steel plug directly under the center of the spindle. A small angle iron bolted to the table prevented the work from turning when the tools were in operation.

The bodies were all hollow milled; then the hollow mill was exchanged for a die holder and die and the threading done. For the boring, facing and tapping of large end of the taper hole in bodies the fixture shown in Fig. 4 was used. It was located with the bushing *A* directly under the center of the drilling-machine spindle.

A combination boring and facing cutter shown at *A*, Fig. 5, was made from a piece of high-speed steel, and a holder *B* for same was made of machinery steel, with a taper shank to fit the spindle of the drilling machine. The other end *C*, which acted as a pilot, was hardened and then ground to a running fit for bushing *A* in the jig, Fig. 4.

The bodies were dropped into the fixture and would instantly center themselves when they came in contact



FIGS. 5 TO 7. TOOLS FOR MACHINING A STOP-COCK

Fig. 5—The counterbore. Fig. 6—Jig for holding plug. Fig. 7—Driver for plug.

with the cutter. The bodies were held in this same fixture for the taper reaming and tapping operations.

For the taper reaming, roughing and finishing reamers were made of high-speed steel screwed on machine-steel shanks. The teeth in the finishing reamer were cut on a spiral to avoid chattering. Two of the bodies were reamed very carefully, then tagged and afterward used as gages, one for testing the reamers when it became necessary to have them sharpened and the other for testing the plugs when they were being ground.

The first work on the plugs was to face off and bore the large end for a center when the plugs were being turned and ground. To hold the plugs for this operation, a cast-iron fixture, shown in Fig. 6, was made from a cheap pattern. The inside was cored out to match the shape of the outside of the plugs, with the small end down. The plugs, with the large end projecting above the top of the fixture, rested on three ribs which were about ¼ in. wide, and equally spaced, as shown at *A*. At the bottom of the fixture a square hole *B* kept the plugs from revolving when being machined.

A combination boring and facing tool was used to face this end, which was in design similar to the one shown in Fig. 5, but had no pilot. The centering operation on the plugs was done on a small high-speed drilling machine.

The operation of rough turning the taper was taken care of in an engine lathe. A driving fixture was made, as shown in Fig. 7, with a taper shank to fit the taper hole in the live spindle of the lathe. On the other end the short bearing shown at *A* was made about 0.001 in. smaller than the diameter to which the large end of the plugs had been bored. The large end of plugs were forced on the fixture against the shoulder *B* by the tailstock center of the lathe, so that the square end of the fixture *C* projected through the square-cored hole in the plugs for driving.

A universal grinding machine was equipped with the same kind of a fixture for the finish grinding, which was the last operation on the plugs. The plugs were then assembled with bodies and lapped thoroughly with oil and the finest flour emery in a lapping machine until they showed a good bearing the entire length of the taper.

After lapping, each pair of plugs and bodies were carefully washed in gasoline and then were assembled with spiral springs, brass caps and handles. The final operation was to test the cocks carefully under air pressure of approximately 100 lb. per square inch.

The Test of Electric Welding for Constructing Ships

A report of the purposes and possible benefits of the ship-welding test now being conducted by the Emergency Fleet Corporation at the Federal Shipbuilding Co.'s plant at Newark, N. J., under the direction of Arthur J. Mason, has been made to Charles Piez, vice president of the corporation.

The text of Mr. Mason's report follows in part:

The committee of which Prof. C. A. Adams is chairman has been enlarged and is active in bringing to bear all the knowledge and apparatus available.

Electric welding in its various phases has for years been employed in shipyards and in the arts generally, but for a number of reasons the work has been confined to odd jobs and repairs. The proposal to extend its use to the major part of ship construction has met with gratifying approval from the shipbuilder. It remains for us through this large test to demonstrate its economy in time and money and its adequacy to build a stanch ship.

Purpose of the Test

The purpose of this test is to demonstrate these advantages—to do it in such a way that all may see and contribute, and finally to test the structure itself so completely that there will follow a heart-whole and unanimous belief in the method. The test itself will take the form of building part of a hull at the Federal Shipbuilding Co.'s plant at Newark, N. J.

It has been necessary to design a ship to suit the material available without encroaching on that needed for the regular ship construction at the plant. This has been done. The hull will have the outline, dimensions and strength conforming to the ships the Federal company is building. It has been thought best to conduct the work at a site apart from the shipways so as not to interfere with that program.

A 10,000-ton ship costing $2,000,000 now costs but $70,000 to rivet. It must be plain that if electric welding only promises to modify this amount no very substantial gain offers.

Splendid benefits we all feel do offer themselves in the possible change in the whole régime of shipbuilding. Our test has in view abolishing or greatly diminishing:

1. The railroad journey from rolling mill to fabricating plant when the latter is not at the shipyard.
2. The templet-makers' work.
3. The markers' work.
4. The punching.
5. Much of the work of the fitters and bolters who flog and pull the pieces to fit on the ways.

There lies in the above items an excellent likelihood to save a month's time in construction and a saving of no less than $40 a ton in the cost of steel structure, at least $100,000 a hull on a 10,000-ton vessel.

Briefly the program is to assemble a hull rapidly by spot welding, tacking the ship together much as a tailor bastes his work in assembling a suit of clothes. The structure then becomes a house favorable for work in all weather and at night in which the completion of the ship may go on.

After the material is thus assembled and fastened with spot welds, so that it is sufficiently strong to hold its shape, the work is completed by arc welding all seams to insure strength and render the work watertight. Roughly we expect the spot welds to be about 10 in. apart.

Both Welding and Riveting Used

One quarter of the structure will be riveted and the other three-fourths welded, so that the tests of strength will afford a basis of comparison.

Electric welding offers a great field for lightening a ship. In this design various views of this opportunity will be tried out. The field here is very great—ultimately 10 per cent. of the steel may be eliminated.

One derrick will bring material and the other derrick will support the spot-welding yoke, whose function is to tack the material together, fastening the plates either to the frames or to the adjoining plates.

If one visits the ways at any shipyard it becomes obvious that at any time only a portion of the men are for the moment at work. This is unavoidable under the present system. We hope to establish a plan of assembling with more continuity and less waiting on one another.

Only a fifth of the men on a hull are riveters. The spot-weld yoke will forthwith pull the parts to place with a much more vigorous agency than flogging and pulling to place by numerous bolts, now done by the other four-fifths.

Problem of Fitting

The problems of fitting in place the parts of a hull are almost wholly problems arising out of the necessity to make a number of little holes in a plate made by one man at one time and place match a number of little holes made by another man at another time and another place.

Once all holes are left out of the material all parts fit. The creeping and kindred problems so perplexing to the shipbuilder disappear. Every plate becomes a closer. Every plate justifies itself.

The manufacture of the spot-welding yoke and appliances is placed in the hands of the Universal Electric Welding Co., Long Island City. The early stages of the arc welding are to be accomplished by the Wilson Electric Co., which was so successful in the work on the German ships' repairs; but it is the intention to call in all men with ideas and apparatus and to give them a field to test out in actual work. To this end Professor Adams' committee is searching out all available talent.

An adequate system of testing the work when done is under consideration. The primary test will consist of filling the hull with water and shifting the points of support under continual and close scrutiny. As one-quarter of the whole will be riveted in the normal manner there will be always a gage of comparison with that portion which is welded.

Likewise there will be a chance for comparison of the two forms when subjected to abuse by bumping with rams and in various other ways.

It is a pleasure to report on the strong interest and ready help extended by the Federal ship people, whose plant and organization we are using for the purpose.

Rocking Type Electric Brass Furnace

By H. W. GILLETT and A. E. RHOADS
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This article describes a new type of electric-arc furnace developed by metallurgists of the United States Bureau of Mines. Comparison is made with other types of furnaces, and a record is given of comparative tests with coke-fired furnaces. The power consumption and costs of operating this new type of furnace are given in detail.

IT SEEMS inevitable that the next few years will see electric furnaces largely replacing crucible furnaces in the brass industry; a development comparable to that which the last few years have seen in the steel industry.

With Klingenberg clay not available, and Ceylon graphite requiring ships needed for other purposes, crucibles, despite the good work done by crucible manufacturers, the Bureau of Standards and others on the problem, are, speaking generally, still of much poorer quality and many times more costly than they were under pre-war conditions. The time is ripe for the practical elimination of the crucible from the brass industry.

With the huge tonnage of brass required for war purposes, the use of the small units—averaging 200 lb. per charge—in which crucible melting is done by the brass rolling mills, seems, and is, an anachronism. Besides the avoidance of crucibles and the ability to melt larger charges, electric melting (in a suitable type of furnace) decreases the loss of metal by oxidation and volatilization, prevents the taking up of sulphur from the fuel, gives better and more healthful working conditions, and has many minor advantages, such as freedom from handling and storing fuel and ash. Electric furnaces give crucible quality of metal without using crucibles.

Brass Melting Requires Furnaces of Special Characteristics

However not every type of electric furnace can be used for brass melting. If brass did not differ materially from steel in its behavior during melting, electric furnaces would long ago have superseded crucible furnaces. But brass is made up of copper and zinc, and zinc is volatile at brass melting temperatures. For this reason, fuel-fired furnaces of the reverberatory type can be applied to brass only at the expense of a zinc loss so high as to prohibit the procedure. Similarly, the direct-arc type of electric furnace used for steel melting, such as the Heroult, can be used only on bronzes practically free from zinc, because of the high local temperature of the melt under the arc.

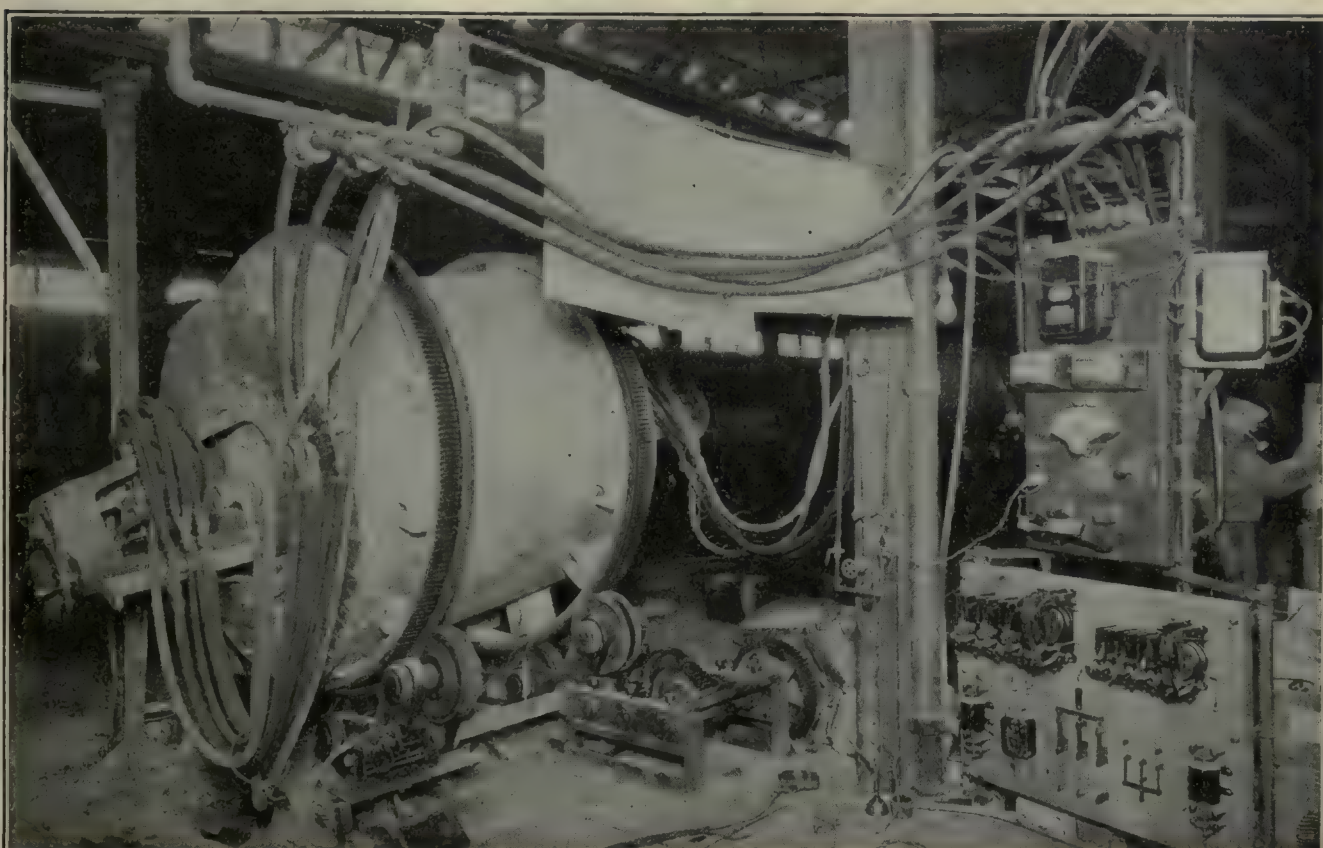


FIG. 1. REVOLVING ELECTRIC BRASS FURNACE AT MICHIGAN SMELTING & REFINING CO., DETROIT

Indirect-arc furnaces, such as the Rennerfelt, can be used on brasses carrying up to about 20 per cent. zinc, but are not suitable for ordinary yellow brass on account of the formation of a superheated layer on the surface of the melt directly under the arc and the resulting volatilization of zinc.

Induction furnaces of the ordinary horizontal-ring type, like the Rochling-Rodenhauser, cannot be used on brass or bronze because the high electrical conductivity of these alloys requires a secondary current so high that the "pinch effect" causes rupture of the secondary ring.

Hence it has been necessary to develop types of furnaces radically different from those in use for steel in order to meet the requirements of brass.

Electric Brass Furnaces in Commercial Use

There are, however, two types of steel furnaces which have been applied to brass (using the term brass loosely to include bronze, red brass, etc.), the Snyder, a single-phase direct-arc furnace, and the Rennerfelt, a two-phase indirect-arc furnace. At the Chicago Bearing Metal Company, Chicago, Ill., two one-ton Snyder and two one-ton Rennerfelt furnaces are melting bronze for railroad bearings, high in lead, but practically free from zinc. The metal losses are not much reduced from previous practice in crucibles and open-flame oil furnaces, but the furnaces are making savings in melting cost as compared with either the crucible or the open-flame furnaces under present conditions.

The Philadelphia Mint is melting nickel and coinage bronze in a 1000-lb. Rennerfelt furnace. The Gerline Brass Foundry Company, Kalamazoo, Michigan, melts Monel metal, red brass and brass containing up to about 20 per cent zinc in an 800-lb. Rennerfelt. The furnace at the Gerline plant is run on a 9-hour basis, while the other furnaces mentioned operate 18 to 24 hours a day.

Two other types of furnace designed especially for brass melting, have also found commercial use, the Baily and the Ajax-Wyatt.

The Baily furnace uses a single-phase granular resistor, the heat from which is reflected down onto the hearth from the roof. It takes charges of about 1000 lb. Baily furnaces are installed at the Lumen Bearing Company, Buffalo, N. Y., Hays Mfg. Co., Erie, Pa., Bridgeport Brass Co., Bridgeport, Conn., and the Baltimore Copper Smelting and Rolling Company, Baltimore. Md. The Baily furnace is applicable to alloys of any zinc content, reduces metal losses, avoids crucibles, and gives good working conditions. The main drawback of this type of furnace is that the source of heat is not close to the melt and the heat must be reflected down from the roof. In order not to overheat the roof and cause its prompt failure, as well as to hold the resistor temperature within the limits that allow reasonable life of the resistor trough, the rate of power input is low compared to the size of the furnace and weight of charge. Hence the radiation losses from walls and roof form a large proportion of the total power. The furnace is at its best on 24-hour operation. When 10-hour operation is necessary, it is found that the furnace must be heated empty during all or part of the night in order to give satisfactory output in the daytime. Because of the high heat storage in the walls, a furnace of this type does not respond promptly to changes in power input, and accurate control of the temperature of the melt is difficult.

The Ajax-Wyatt furnace is a single-phase induction furnace in which the secondary ring is in the form of a loop below the level of the hearth proper, so that the hydraulic head of the metal in the hearth opposes the rupturing effect of the "pinch" force, thus avoiding the troubles that make horizontal-ring induction furnaces inapplicable to brass.

The metal heated in the secondary loop is constantly ejected at one part of each opening from loop to hearth, and colder molten metal drawn in at another part of the opening. These fountains of hot metal issuing from the resistor melt the charge in the hearth. The constant circulation of metal is a most desirable feature and gives a product of remarkably uniform chemical composition.

Because of the compactness of the furnace, the generation of heat within the metal itself, and the stirring action, vertical-ring-induction furnaces are extremely efficient as regards power consumption. The power factor, in the sizes so far built, is satisfactory.

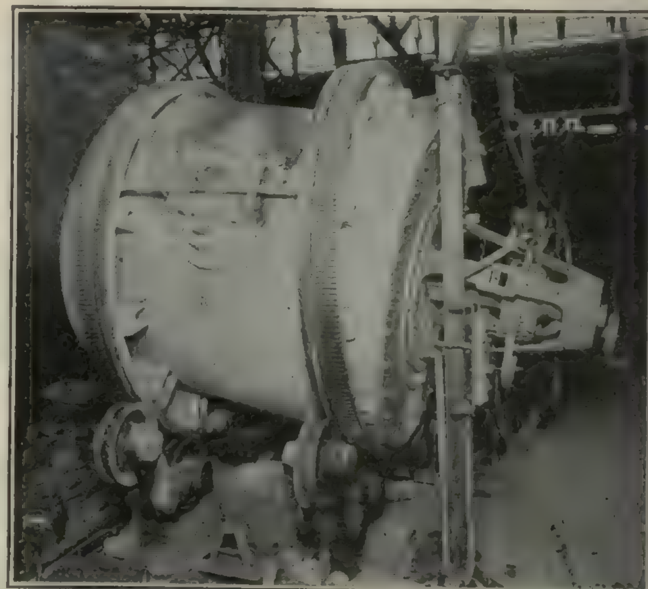


FIG. 2. ANOTHER VIEW OF THE REVOLVING ELECTRIC BRASS FURNACE

The furnace must be started with a charge of previously melted metal, and sufficient metal to fill the loop must be retained when pouring. The metal in the loop must never be allowed to solidify, or the lining will be ruined. These facts make it difficult to change from one alloy to another, and require that the furnace be run 24 hours a day, or else receive enough power at night to keep the metal in the loop fluid. Ramming up and drying the refractory lining of the loop is a job requiring care and experience, as the lining must be perfect or its life will be short. No lining has yet been found that will withstand alloys containing over 3 per cent of lead, and the furnace has been developed mainly for yellow brass.

The furnace is fitted for rolling mill use, where 24-hour operation on yellow brass is the rule, but is distinctly less suitable for 10-hour runs or for foundries making a variety of alloys.

Several of these furnaces are in use at the Ajax Metal Company, Philadelphia, two at the American Brass Company, Waterbury, Conn., and twenty-eight at the Bridgeport Brass Co., Bridgeport, Conn. The furnace saves zinc, avoids crucibles, and shows so low a power consumption on 24-hour operation that it can doubtless be used to advantage in rolling mill practice even under normal prices of fuel and crucibles.

Besides the four types mentioned above, each of which has found commercial use where conditions were suitable, there are four other furnaces that have reached a semi-commercial stage, but are still under experimental development.

The Bennett furnace at the Scovill Mfg. Co., Waterbury, Conn., is a three-phase furnace, probably of about 750-lb. capacity, and resembles a direct-arc furnace. However, the voltage between electrodes (which are automatically regulated) and bath is kept so low that there is no true arc and the heat is generated by a sort of contact resistance. This is said to give low metal losses and to show a reasonably low consumption of power.

The furnace has run mainly on yellow brass and is therefore probably applicable to all brasses and bronzes. The results of the work have so far been kept secret and no detailed data are available.

The Foley Furnace

The Foley furnace is a single-phase, vertical-ring induction furnace, similar in general design to the Ajax-Wyatt, although differing from it in many points. One such furnace of about 1000-lb. capacity has been in experimental operation at the Bristol Brass Company, Bristol, Conn., and three 3000-lb. furnaces are under construction. From the few data so far available on this furnace, its metal losses and power consumption will be about the same as in the Ajax-Wyatt; partly because of larger size its power factor is somewhat lower. It has the same disadvantages as regards starting, changing from one alloy to another, and the necessity for 24-hour operation, as that furnace.

The General Electric furnace is a smothered-arc, one or two-phase furnace, normally two of about 1500-lb. capacity, having four depending electrodes, two on each side of a hearth. Between the tips of each pair of electrodes is a carbon block to which arcs are drawn, the arcs being smothered by granular coke. The heat thus generated is reflected down onto the hearth by the roof. The electrodes are automatically regulated.

After being tested at the General Electric Company, Schenectady, N. Y., this furnace has been installed for further test at the Chicago plant of the Crane Company, but is not considered ready for general commercial use.

The heat transfer in this type is similar to that in the Baily, and the furnace seems theoretically capable of a performance of about the same order as the Baily with similar advantages and similar drawbacks. As the General Electric furnace takes a higher power input than the Baily, it may be slightly more efficient in power consumption, but the roof is subject to even more severe conditions and will require the use of high grade refractories to give a good life.

The Northrup furnace, being developed by Prof. E. F. Northrup and the Ajax Metal Company, is an induction furnace, heating the charge by means of eddy currents instead of making the charge, or part of it, the secondary of a transformer. Oscillating current of very high frequency is used instead of alternating current, and is obtained by the use of condensers or a special generator. A 60-kw. tapping-type furnace is being tried out. The Northrup furnace has a high power factor, and can take multiphase current. It is being developed in order to produce a furnace suitable for 10-hour operation and for facility in changing from one alloy to another.

Since the heat is generated within the charge itself, the eddy current furnace should be efficient in power consumption. This type is theoretically very promising, but its development has not yet gone far enough to show what, if any, mechanical limitations the type will have.

Many other types of furnaces have been suggested for brass melting, and a number have been tried out more or less thoroughly, but those mentioned above are the most prominent of the types in commercial use or under commercial development. Most of these are either limited in their application, or have some drawbacks, either inherent in the type of furnace, or not yet eliminated by long experience in their design and use, so that no one type or make of furnace is as yet definitely proved the best for any particular set of conditions, and still less will any one furnace meet all the different conditions found in the whole range of the brass and bronze industry.

In particular, none of these types seems quite fitted to that common set of conditions where a furnace may be called upon to melt successive heats of alloys differing widely in composition, to handle both alloys free from zinc and those high in zinc, and to operate cheaply on a 9 or 10-hour day.

Rocking Electric Brass Furnace

In its study of electric brass melting during the past five years, the Bureau of Mines has tried out a rocking-type of furnace, which may perhaps help to fill this gap.

In the ordinary indirect-arc type of furnace, the heat is applied above the melt and as hot metal is lighter than colder metal, there is little circulation in the bath. If the rate of heat input is at all rapid, as is necessary for thermal efficiency, heat conduction from the top of the melt downward does not keep pace with the heat supply. Before the melt as a whole reaches the proper pouring temperature, the surface is much superheated.

On an alloy high in zinc the surface will reach the boiling point of the zinc in that particular alloy while the bottom is scarcely melted. Such heating creates a high pressure of zinc vapor within the furnace so that if it is not tightly closed zinc is lost continually. If the furnace is sealed tight, the pressure may even blow out the roof or door. In case the furnace holds tight and the pressure is not relieved till the spout is opened for pouring a long hissing stream of zinc vapor then shoots out, burning in the air. This local overheating is the cause of the failure of the indirect-arc furnace to handle alloys high in zinc without large metal losses.

The obvious way to overcome this trouble is to stir the melt so vigorously that the temperature of the melt is practically uniform and the superheating of the surface prevented. The most practical way to stir the melt is by the principle of the cement-mixer, by turning the furnace bodily so as to stir the contents thoroughly while being heated. Constant rotation of a cylindrical furnace placed more or less horizontally, but preferably at a slight angle with the horizontal to produce endwise motion of the melt during rotation, with electrodes entering at the ends of the drum and an arc struck between the electrodes should not only stir the charge thoroughly, avoid surface over-heating and thus pre-

vent zinc losses, but should also give a well-mixed alloy. By washing the walls with metal the heat stored in the walls and roof should be largely taken up in the metal instead of passing out. The power consumption should therefore be low. As the walls are washed with metal their temperature can rise but little above the temperature of the metal, which should give a good life of lining.

Instead of rotating the furnace through a complete revolution which would involve difficulty in keeping the metal out of the joints between the door and the door opening, as this opening should be on the circumference of the drum rather than on the end—and in making brush contacts to the electrodes, it appears simpler to rock the furnace back and forth so that the molten charge just fails to reach the door at either end of its rocking angle.

Results of Laboratory Tests

A small furnace of this type was built and tried out. This was rocked back and forth by hand on tracks. It was cheaply constructed from materials at hand in the laboratory and was not expected to give very good results on power consumption, as the drum was too small to allow the refractory lining to be of desirable thickness.

The laboratory furnace held about 100 lb. of charge, and operated on 50 to 75 volts and 500 to 700 amperes at a power factor of 85 to 90. The usual power input was about 30 kw. Graphite electrodes 2 in. in diameter were used.

A number of different alloys were melted in the rocking furnace. In melting 1092.1 lb. of yellow brass, made up of 45 per cent ingot, 55 per cent copper and zinc, the calculated analysis being 65.6 per cent Cu, 34.4 per cent Zn, 1080.4 lb. of ingot was obtained, analyzing 65.9 per cent copper, 34.1 per cent zinc. The metal loss by weight was 1.06 per cent which includes both volatilization and mechanical loss by spatter in pouring. The average pouring temperature was 1080 deg. C.

On manganese-bronze chips (40 per cent zinc) the furnace gave a net metal loss of 3.0 per cent while the same lot of chips melted in oil-fired crucible furnaces in commercial practice gave 7.2 per cent loss.

Yellow brass chips (25 per cent zinc) gave 1.6 per cent net loss, red brass chips (10 per cent zinc) 1.0 per cent.

A fine concentrate (20-mesh) from brass-furnace ashes, obtained in the manufacture of an alloy of 80 per cent copper and 20 per cent zinc, analyzed 71.0 per cent copper and 14.3 per cent zinc, the balance being ash, etc. After melting in the furnace 99 per cent of the copper and 50 per cent of the zinc in the concentrate were recovered. This material is usually sent to the smelter and refined in a reverberatory furnace, not all of the copper and none of the zinc being recovered.

Yellow brass ingot (25 per cent zinc) was remelted with 0.5 per cent loss. Red brass (10 per cent zinc), made from red gates, scrap copper, yellow chips, lead and tin, was melted with 0.5 per cent loss.

Heavy German silver scrap (18 per cent nickel, 56 per cent copper, 26 per cent zinc) which gave 1.8 per cent loss on commercial melting in coke fires was melted with 1.2 per cent loss.

Sound copper castings were made from metal melted in the furnace.

Red brass of 81½ per cent copper, 8½ per cent zinc, 6 per cent lead, 4 per cent tin, made from red and yellow ingot and scrap copper, was melted in one series of tests with the following results, the furnace being cold at the start.

TABLE I.

Heat No.	Weight of Charge, Lb.	Time Arc Was On. Minutes	Pouring Temp., °C.	Kw.-Hr. Used	Kw.-Hr. per 100 Lb.
L 34	127.3	57	1,140	40	30⅓
L 35	127.75	50	1,180	30½	25
L 36	128.5	50	1,220	26½	20⅓
L 37	126.5	37	1,220	22½	17¾
L 38	129.5	36	1,220	19	14¾
Total	639.55	Av. 46	Av. 1,200	Total 138½	Av. 21¾

The total elapsed time for the five heats, including charging and pouring, was 5 hours; 630.9 lb. ingot poured and 7.45 lb. metal from spillings, etc., recovered, giving a gross metal loss of 1.35 per cent and a net loss of 0.2 per cent.

The power consumption, at the rate of 430 kw.-hr. per ton on a five-hour run, starting from the cold, and at the rate of 295 kw.-hr. per ton when the furnace is hot, with the metal heated to 1200 deg. C, is surprisingly low for so small a furnace.

The results above show that the rocking furnace is a type capable of giving low metal loss and low power consumption. When the furnace was not rocked while melting alloys high in zinc, pressure built up within the furnace and zinc losses were high.

Description of Commercial Furnace

The laboratory tests having demonstrated the probable usefulness of the type, a furnace of commercial size was designed.

The Detroit Edison Company had long been interested in electric brass furnaces as a possible outlet for electric power, and offered to co-operate by constructing a rocking furnace for commercial test without expense to the Bureau of Mines except for the salaries and expenses of its representatives while supervising the test.

Sketches of the furnace design were given the Detroit Edison Company, which refined the design, made the working drawings, constructed and erected the furnace. Two views of the furnace are shown in accompanying illustrations.

The drum is 5 feet in diameter by 5 feet long. The lining is 12 in. thick, and consists of Sil-o-cel brick on the outside, special heat-insulating brick in the middle layer and corundite brick (a very refractory firebrick high in Al_2O_3) in the actual hearth lining. The hearth is 3 feet long by 3 feet in diameter, taking charges of 1300 lb. and upwards. The electrodes are 4 in. diameter graphite, threaded for continuous feed, and are adjusted by screw-operated supports of the lathe-slide type. Single-phase, 60-cycle current, stepped down to 120 to 130 volts is used, 30 kva. being available. Electrode adjustment is by hand, and, to stabilize the arc an external reactance is used which brings the power factor of furnace plus reactance, measured at the furnace switchboard, to about 85. The open circuit voltage falls to about 106 to 116 volts under load. The current varies between 1000 and 2000 amperes, 1650 amperes being about the average. The power input can be varied by altering the length of the arc, and runs from 100 to 200 kw. averaging about 165 kw.

The flexible leads and the water hose for electrode cooling are given slack to allow rocking the furnace, as is clearly shown in Fig. 1.

The rocking of the furnace during melting is done automatically by means of a control device which can be set to give a "safe rock" of 80°, the limit of motion being such that the metal just does not run into the spout. After the charge has begun to melt, the "safe rock" is started. It is called the "safe" rock because the angle is such that solid charge will not fall on the electrodes and break them. A complete oscillation on safe rock takes 13½ seconds.

During the safe rock the solid metal is swashed about in the molten part of the charge and is tumbled over, so that fresh surfaces receive direct radiation from the arc. As melting goes on, the rocking angle is increased by turning the handle of the control device from time to time, until, when the metal is all melted, the furnace is on the "full rock" of about 200°. On full rock the metal washes the whole circumference of the hearth save the height of the charging door and a few inches above and below it, so that metal does not splash into the door joint. A complete oscillation takes 33½ seconds.

The reversal of the 5-hp. motor at either end of the rocking angle is done by contactors, operated by solenoids actuated by the contacts on the control device.

When it is desired to depress the spout past the limiting point of the automatic rock, for pouring, the control device is switched out and the solenoids are operated by a reversing switch.

Comparison with Coke-fired Furnaces

The furnace is installed at the plant of the Michigan Smelting and Refining Company, Detroit, Michigan, which makes brass ingot to customers' specifications from chips, scrap and junk of various kinds, by means of strict chemical control. As the firm makes no sand castings, but ingot only, no observations were possible on the comparative quality of metal melted in the electric furnace and in the coke fires. All the metal melted was poured into ingot which went into the regular output of the plant. As far as could be told by analysis and appearance, the electrically melted metal was of at least as good a quality as that from the coke fires. On alloys high in lead there was somewhat less segregation than in the metal melted in crucibles, and on charges high in zinc, the zinc content of the metal from the electric furnace was higher than that from the same charges melted in the coke fires.

As there is generally much oil on the borings and some non-metallic material in the other scrap, the true metallic content of the charge is seldom accurately known. Hence the net metal losses cannot be exactly determined.

The metal losses were therefore compared with those of the coke-fired crucible furnaces operating on the same charge.

From 102 tons of metal melted in strict comparison with the crucible furnaces, the rocking electric furnace produced 3626 lb., or 1.8 per cent more metal from the same charge than did the coke fires. The alloys melted ran from 90 per cent to 66 per cent copper, 1 per cent to 9 per cent tin, 1½ per cent to 26½ per cent lead, 0 to 30 per cent zinc.

The comparative metal losses on a few alloys in the electric and the coke fires are given in Table II.

The rocking furnace gave alloys that analyzed very close to the calculated analysis, especially if the difficulty of calculating the analysis of a scrap charge is considered. Characteristic analyses are given in Table III.

TABLE II.

Composition Per Cent				Weight Charged,	Per Cent Loss (Metal, Oil and Dirt) Coke	Per Cent Loss (Metal, Oil and Dirt) Electric
Cu	Sn	Pb	Zn	Lb.	Fires	Furnace
85	5	5	5	6,576	4.6	3.2
84	7	8	1	11,600	7.0	3.7
84	6	10	0	14,300	2.4	1.8
79	9	10	2	11,790	3.6	2.1
78	2	10	10	15,840	7.1	3.1
76	8	13	3	11,805	4.0	2.4
73	4	20	3	14,392	3.7	2.9
67½	4	26½	2	5,224	3.0	2.4
67	1	2	30	7,200	8.0	5.1

TABLE III.

Per Cent	Copper	Tin	Lead	Zinc
Sought	76.0	8.0	13.0	3.0
Electric	75.9	8.3	13.1	2.7
Sought	76.0	8.0	13.0	3.0
Electric	76.2	8.0	12.4	3.2
Sought	85.0	5.0	5.0	5.0
Electric	85.2	4.9	4.8	5.0
Sought	83.0	4.0	6.0	7.0
Electric	82.9	4.4	5.7	6.9
Sought	67.0	1.0	2.0	30.0
Electric	66.6	1.0	2.0	30.4
Coke	68.4	0.5	1.7	29.3
Sought	68.0	1.0	7.0	24.0
Electric	67.9	...	....	....
Coke	69.9	...	....	....

There was no difficulty in draining the metal completely from the hearth, and alloys of different composition could be made one after the other without contamination by metal remaining from the previous heat.

The power consumption on 10-hour operation, with no night heating is shown in Table IV, which gives a résumé of 5 days operation.

The power consumption on 24-hour operation is shown in Table V, for a 4-day run.

In the 24-hour tests tabulated in Table V and in a 10-hour run just preceding, in which the 75¼ Cu, 7½ Sn, 14¼ Pb. 3 Zn alloy was melted, the charge was as follows:

Ingot	25,200 lb.	
Red borings	11,200 lb.	2% oil = 224 lb. non-metallic
Medium brass	1,540 lb.	
Scrap Cu	10,987 lb.	
Ingot Cu	552 lb.	
Ingot Pb	3,906 lb.	
Yellow borings	1,400 lb.	3% oil = 42 lb. non-metallic
	54,805	266

For the 86 Cu, 6 Sn, 10 Pb alloy there was charged:

Ingot	16,000 lb.
Cu	4,704 lb.
Pb	96 lb.
	20,800 lb.
Total charge	75,605 lb.
	266 lb. non-metallic
	75,339 lb. metallic

There was obtained:
53,841 lb. good ingot 75¼ Cu
20,149 lb. good ingot 86 Cu

73,990 lb. total good ingot, 1,349 lb. gross loss, or 1.8 per cent.
63 lb. scrap 75¼ Cu
43 lb. scrap 86 Cu
300 lb. metallics in 569 lb. skimmings from 75¼ Cu } 53 per cent. metallic in
130 lb. metallics in 246 lb. skimmings from 86 Cu } all skimmings by assay
365 lb. metallics in 429 lb. ladle skulls from 86 Cu — 85 per cent. metallic

74,891 total metallic recovery—448 lb. net loss, or 0.6 per cent.

On the basis of power read on the high-tension side of the transformer, per ton of metal poured, 336 kw.-hr. per ton, on red brass poured at 1180 deg. C. average temperature. For 24-hr. operation the figure is about 260 kw.-hr. per ton for red brass.

The electrode consumption was 16.3 lb. while melting 21660 lb. of metal, or 1½ lb. per ton, equivalent to about

40 cents at present electrode prices. To this must be added the loss due to accidental breakage. There were nine breakages in melting 72 tons, four of which were due to the charge being so bulky that it fell against the electrodes when rocking started, and five to the electrodes being hit, while bulky material was being charged. The design of the furnace has now been altered so as to allow the electrode tips to be withdrawn into the walls during the charging of bulky material. When an electrode does break, if nipple joints are used, the breakage is usually of the nipple only.

Since the operation was experimental, it is not yet possible to give exact figures on the life of a lining, but as near as can be estimated the relining cost for labor and material should be well under 50 cents per ton with a corundite lining when melting red brass poured at 1150-1200 deg. C. If only yellow brass, poured at 1100 deg. C. is melted, the lining cost will be still lower. If very hot bronze is to be produced, say at 1300 deg. C., the roof and upper portions of the ends should be lined with zirkite bricks.

Accurate temperature control is very easy in the rocking furnace, since at the end of a heat, after the "full rock," the walls are no hotter than the metal, and there is no heating up of the charge from hotter roof and walls when the power is shut off, as is the case with those types of furnace where the heat is reflected downward from the roof. After cutting off the arc, the temperature falls very slowly, about 2 or 3 deg. C. per minute. By running the arc a minute or so every 10 or 15 minutes, a charge can be held at pouring temperature for an indefinite period.

One man can operate the furnace, with the aid of a helper while charging. Were automatic electrode con-

TABLE IV

Date	Heat No.	Alloys Cu	Sn	Pb	Zn	Nature of Charge	Pounds Charge	Elapsed Time	Sec. Kw.-Hr. Arc	Kw.Hr. Motor	Total Sec. Power	Pouring Temp.	Weight Poured	Primary Kw.-Hr.	Secondary Kw.-Hr. Cwt. Charged	Primary Kw.-Hr., Cwt. Poured	Remarks
Nov. 5	192	85	5	9	1	Average	1314	3:40	257	4	261	2000°F. 1095°C.	....	....	20.0	....	Furnace cooler than usual, not run previous two days. No. 192 includes 1 hr. 20 min., 100 kw.-hr. preheat
	193	85	5	9	1	Average	1314	1:50	219	3	222	2050°F. 1120°C.	....	....	17.0	....	
	194	79	9	10	2	Little bulkier than average	1304	1:35	196	2	198	2125°F. 1165°C.	....	....	15.0	....	
	195	79	9	10	2	Little bulkier than average	1304	1:30	190	2	192	2200°F. 1205°C.	....	....	14.5	....	
	196	79	9	10	2	....	1304	1:40	190	3	193	2200°F. 1205°C.	....	....	15.0	....	Time includes 20 min. charging heat 197
Day total, 5 heats							6540	10:15	1052	14	1066	2115°F. 1155°C.	6360	1162	16.3	18.3	
Nov. 6	197	79	9	10	2	Little bulkier than average	1304	1:45	235	3	238	2125°F. 1165°C.	....	....	18.5	....	
	198	79	9	10	2	Little bulkier than average	1304	1:30	199	3	202	2175°F. 1190°C.	....	....	15.5	....	
	199	79	9	10	2	Little bulkier than average	1304	1:40	186	2	188	2250°F. 1230°C.	....	....	14.5	....	
	200	79	9	10	2	Little bulkier than average	1304	1:40	176	2	178	2240°F. 1225°C.	....	....	13.5	....	
	201	79	9	10	2	Little bulkier than average	1304	1:30	162	2	164	2100°F. 1150°C.	....	....	12.5	....	
	202	79	9	10	2	Little bulkier than average	1304	1:45	160	2	162	2125°F. 1165°C.	....	....	12.5	....	Time includes 20 min. charging heat 203
Day total, 6 heats							7824	9:50	1118	14	1132	2185°F. 1195°C.	7571	1236	14.7	16.3	
Nov. 7	203	79	9	10	2	Little bulkier than average	1304	1:35	215	3	218	2125°F. 1165°C.	....	....	17.0	....	
	204	79	9	10	2	Little bulkier than average	1304	1:40	195	2	197	2165°F. 1185°C.	....	....	15.0	....	
	205	79	9	10	2	....	1304	1:30	180	2	182	2175°F. 1190°C.	....	....	14.0	....	
	206	79	9	10	2	....	1304	1:35	173	2	175	2140°F. 1170°C.	....	....	13.5	....	
	207	84	6	10	0	Very bulky	1304	1:40	165	2	167	2150°F. 1175°C.	....	....	13.0	....	
	208	87½	5	½	7	Very bulky	1304	2:30	178	3	181	1950°F. 1065°C.	....	....	14.0	...	Includes 50 minutes delay by broken electrode broken in charging bulky charge, also 20 minutes charging heat 209
Day total, 6 heats							7824	10:30	1106	14	1120	2120°F. 1160°C.	7583	1210	14.4	16.0	
Nov. 8	209	84	6	10	0	Very bulky	1300	3:00	246	2	248	2050°F. 1120°C.	....	....	19.0	....	Time includes 1 hr. 10 min. delay due to broken electrode due to bulky charge. Long delay due to nipple being over-size and requiring to be filed down
	210	84	6	10	0	Very bulky	1300	1:40	198	3	201	2175°F. 1190°C.	....	....	15.5	....	
	211	84	6	10	0	Very bulky	1300	2:05	188	2	190	2175°F. 1190°C.	....	....	14.5	....	Includes 25 min. adjusting electrode holder
	212	84	6	10	0	Very bulky	1300	1:30	169	3	172	2175°F. 1190°C.	....	....	13.5	....	
	213	84	6	10	0	Very bulky	1300	1:50	170	1	171	2175°F. 1190°C.	....	....	13.0	....	Includes 20 min. charging No. 214
Day total, 5 heats							6500	10:05	971	11	982	2150°F. 1175°C.	6341	1069	15.1	16.9	
Nov. 9	214	84	6	10	0	Very bulky	1300	1:45	223	4	227	2175°F. 1190°C.	....	....	17.5	....	
	215	84	6	10	0	Very bulky	1300	2:05	198	3	201	2200°F. 1205°C.	....	....	15.5	....	
	216	84	6	10	0	Very bulky	1300	1:00	195	2	197	2160°F. 1180°C.	....	....	15.0	....	
	217	84	6	10	0	Very bulky	1300	1:45	189	3	192	2250°F. 1235°C.	....	....	14.5	....	
	218	84	6	10	0	Very bulky	1300	1:25	165	2	167	2150°F. 1175°C.	....	....	13.0	....	
Day total, 5 heats							6500	8:50	970	14	984	2190°F. 1200°C.	6407	1073	15.2	16.7	

trol used, which could easily be done, one man could probably attend to two furnaces.

The output per man-hour was greater from the rocking furnace than from the coke fires. The working conditions are much less severe and more healthful with the electric furnace than with the coke fires, and a man of less rugged physique than is required for coke fires can readily operate the rocking furnace.

Various modifications and improvements in design were made during the tests, and others that could not well be made on the first furnace are being incorporated in other furnaces of this type now being built for Detroit firms. The electrodes were at first introduced into the furnace directly through the refractory walls. When making yellow brass from new materials so that addition of much spelter is required, the zinc, vaporized during the addition of the spelter to the molten charge, tended to condense in the clearance between the electrode and the hole through which it entered. This would then freeze, solder the electrode in place and cause breakage. Such trouble was later obviated by the use of graphite sleeves about the electrodes and by the proper arrangement and operation of the electrode coolers. It was also found feasible to charge the zinc with the rest of the charge instead of speltering at the end of the heat.

Comparing the cost of melting on a 10-hour schedule in the rocking electric furnace and in the coke fires of

TABLE V. POWER CONSUMPTION ON 24-HR. OPERATION

Date	Conseq. Heat No.	Day Heat No.	Weight of Charge Lb.	Alloy Per Cent Cu	Sn	Pb	Zn	Elapsed Time Hr.	Min.	Melting Time Hr.	Min.	Kw.-Hr. Arc Plus Rocking Motor Read on Secondary Side	Equiv. Kw.-Hr. on Primary Side	Pri. Kw.-Hr. per Ton Charged	Remarks
Apr. 30	261	1	1,305	75¼	7½	14¼	3	2	9	1	47	229	....	....	Started at 6:30 a.m. Furnace idle since 4:30 p.m., Apr. 29
	262	2	1,305	75¼	7½	14¼	3	1	53	1	28	192	....	....	
	263	3	1,305	75¼	7½	14¼	3	1	55	1	22	168	....	....	
	264	4	1,305	75¼	7½	14¼	3	1	44	1	15	152	....	....	
	265	5	1,305	75¼	7½	14¼	3	1	44	1	15	144	....	....	
	266	6	1,305	75¼	7½	14¼	3	2	12	1	2	141	....	....	30 min. (included in elapsed time), adding electrode sections and taking new grips
	267	7	1,305	75¼	7½	14¼	3	1	30	..	55	153	....	....	
	268	8	1,305	75¼	7½	14¼	3	1	35	..	58	156	....	....	
	269	9	1,305	75¼	7½	14¼	3	1	41	1	..	151	....	....	
Midnight	270	10	1,305	75¼	7½	14¼	3	1	33	1	2	146	....	....	
	271	11	1,305	75¼	7½	14¼	3	1	33	..	59	143	....	....	
	272	12	1,305	75¼	7½	14¼	3	1	47	1	6	149	....	....	
	273	13	1,305	75¼	7½	14¼	3	2	1	1	2	150	....	....	18 min. (included), replacing broken electrode nipple; heat ended 5.40 a.m.
Day total,			16,965					23	17	15	11	2,074	2,270	268	
May 1	274	1	1,305	75¼	7½	14¼	3	2	11	1	18	143	....	....	36 min. (included) wait for helpers to pour metal
	275	2	1,305	75¼	7½	14¼	3	1	49	1	12	147	....	....	
	276	3	1,305	75¼	7½	14¼	3	1	40	1	7	152	....	....	
	277	4	1,305	75¼	7½	14¼	3	1	35	..	55	147	....	....	
	278	5	1,305	75¼	7½	14¼	3	1	45	1	12	142	....	....	
	279	6	1,305	75¼	7½	14¼	3	3	..	1	20	160	....	....	1 hr. 10 min. (included), replacing broken electrode and altering cooling coil
	280	7	1,305	75¼	7½	14¼	3	1	32	1	2	151	....	....	
	281	8	1,305	75¼	7½	14¼	3	1	21	..	57	146	....	....	
	282	9	1,305	75¼	7½	14¼	3	1	19	..	53	145	....	....	
	283	10	1,305	75¼	7½	14¼	3	1	23	..	55	151	....	....	
Midnight	284	11	1,305	75¼	7½	14¼	3	1	31	..	56	152	....	....	
	285	12	1,305	75¼	7½	14¼	3	1	34	1	1	152	....	....	
	286	13	1,305	75¼	7½	14¼	3	1	20	..	48	141	....	....	
	287	14	1,305	75¼	7½	14¼	3	1	35	..	53	147	....	....	
Day total,			18,270					23	35	14	27	2,076	2,272	249	End of heat at 5:20 a.m.
May 2	288	1	1,305	75¼	7½	14¼	3	1	35	1	5	150	....	....	Heat started at 6:35 a.m. Furnace idle 1 hr. 25 min. between shifts
	289	2	1,305	75¼	7½	14¼	3	1	25	..	52	145	....	....	
	290	3	1,305	75¼	7½	14¼	3	1	25	..	57	143	....	....	
	291	4	1,305	75¼	7½	14¼	3	1	20	..	55	144	....	....	
	292	5	1,305	75¼	7½	14¼	3	1	35	1	2	144	....	....	
	293	6	1,305	75¼	7½	14¼	3	1	39	..	56	141	....	....	Much delay in pouring this heat—no helpers
	294	7	1,300	84	6	10	0	1	31	1	04	140	....	....	
	295	8	1,300	84	6	10	0	1	18	..	50	150	....	....	Furnace idle 45 min. at change of shifts, between 294 and 295
	296	9	1,300	84	6	10	0	1	48	..	59	158	....	....	
	297	10	1,300	84	6	10	0	1	22	..	52	151	....	....	
	298	11	1,300	84	6	10	0	2	13	1	5	156	....	....	39 min. (included), replacing broken electrode
Midnight	299	12	1,300	84	6	10	0	1	28	..	59	162	....	....	
	300	13	1,300	84	6	10	0	1	37	1	10	179	....	....	
	301	14	1,300	84	6	10	0	1	49	1	12	163	....	....	Heat ends 5:20 a.m.
Day total,			18,230					22	05	13	59	2,126	2,318	254	
May 3	302	1	1,300	84	6	10	0	1	43	1	14	167	....	....	Heat started 6:45, furnace idle 1 hr., 35 min. between shifts
	303	2	1,300	84	6	10	0	1	43	1	22	158	....	....	Furnace idle 1 hr. between 302 and 303; operator in conference
	304	3	1,300	84	6	10	0	1	55	1	9	158	....	....	Furnace idle 1½ hr. between 303 and 304. Broke electrode charging 304; none on hand; wait for one from machine shop
	305	4	1,300	84	6	10	0	1	44	1	17	159	....	....	
	306	5	1,300	84	6	10	0	1	50	1	16	166	....	....	25 min. patching electrode hole between 304 and 305
	307	6	1,300	84	6	10	0	1	35	1	10	162	....	....	
	308	7	1,300	84	6	10	0	1	23	1	10	162	....	....	
Midnight	309	8	1,300	84	6	10	0	2	15	1	5	165	....	....	42 min. (included) delay. Broke electrode nipples charging
	310	9	1,305	75¼	7½	14¼	3	1	19	..	55	152	....	....	
	311	10	1,305	75¼	7½	14¼	3	1	14	1	..	140	....	....	
	312	11	1,305	75¼	7½	14¼	3	1	21	..	50	142	....	....	
	313	12	1,305	75¼	7½	14¼	3	1	36	1	13	144	....	....	Last ladle poured 6:35 a.m.
Day total,			15,620					19	38	13	41	1,875	2,005	262	
4-day total,			69,085	...	..	..		..	..	..	..	....	8,865	257	

the plant at which the test was made, the sum of the cost per ton of charge for electric power, interest and depreciation, electrodes, linings, and for heating ladles, is just about one-half of the cost per ton of charge of the single item of crucibles at present prices and at present crucible life. The value of the metal saved by the electric furnace is about twice the cost of the coke used by the coke fires. Hence a huge saving is possible by electric melting under present conditions; and even at pre-war prices for crucibles, coke and metals, the rocking furnace will show a smaller, but still a distinct, saving. On 24-hour operation the balance in favor of electric melting is still more marked.

From data on hand on the power consumption of other types of electric furnaces, it appears that, when operated on the same alloy, heating it to the same temperature, and running the same number of hours per day, the rocking furnace is somewhat more efficient than the direct-arc and unrocked indirect-arc types, very much more efficient than electric furnaces of types in which heat is reflected onto the charge from the roof, and very little less so than the induction furnaces. These conclusions follow not only from the data at hand, but from the method of application of heat in the various types, those with the source of heat at a distance from the charge being less efficient than those where the heat is developed close to the charge; the induction furnaces in which the heat is developed in the charge itself should be the most efficient. On account of the washing of the walls with the metal, the rocking furnace should theoretically come next to the induction type in thermal efficiency.

Comparative Metal Losses

In magnitude of metal losses, the rocking furnace gives at least as good results as any other type of electric furnace. The only possible loss is from the stream of metal while pouring, as the furnace is sealed tight while running. Volatilization from the stream while pouring is of course about the same in all types of furnaces.

In closeness of control of the temperature of the melt the rocking furnace is superior to any save the induction type. In thorough mixing of the charge, the rocking type is about on the same plane as the induction type, and markedly superior to the other types, where, in large sizes, segregation in the bath may be a serious problem. For example, the following shows the analysis for copper of the first ingot from the first ladle and of the last ingot from the last ladle when melting 1200-lb. charges of 60 per cent Cu, 37 per cent Zn, 3 per cent Pb.

Heat	First Ingot, First Ladle	Last Ingot, Last Ladle
322	59.76% Cu	59.54% Cu
323	59.78% Cu	59.66% Cu

In ability to change from one alloy to another, it is superior to the vertical-ring induction type; and in ability to operate cheaply when used but 10 hours a day, without night heating, it is ahead of the vertical-ring induction type and of the reflected-heat types.

The rocking furnace can handle alloys of any zinc or lead content, being superior on this score to direct-arc, unrocked indirect-arc and induction types. The electrode cost compares favorably with other arc furnaces. With equal conditions of operation, and suitable refractories in each type, the cost of lining will probably be about the same as with most other types. Labor cost should be about the same in all hand-regulated arc furnaces. With automatic regulation, which can be applied if desired, the rocking type should show a labor cost about the same as that of any other type.

Load With Rocking Furnace Not So Steady As With Induction Type

From the electrical point of view, of desirability of a steady load, the rocking furnace does not have so steady a load, and hence, on this score, is not so desirable as the induction furnaces or granular resistor furnaces. It does not require special transformers, as the granular resistor type does. It lacks the electrical advantages of multiphase furnaces. In very large sizes, two arcs could be used in the rocking type, but in sizes up to one ton, single-phase operation is required, and in a plant so located that the power supply must be of limited capacity, a single-phase arc furnace, with its fluctuating loads, may not be satisfactory from the electrical point of view. Such fluctuation is no drawback in Detroit nor would it be in most cities or large manufacturing towns.

From the results on furnaces of 125 and 1300 lb. capacity, it appears that the rocking type can be built in a wide range of sizes without showing a great loss of efficiency in the smaller sizes. This type can doubtless be built in as large sizes as the brass industry could normally use.

In first cost, the rocking type should be no more expensive than other electric furnaces.

While further tests in different plants and under different conditions, which will, at least in part, be made in the near future, are neded to give accurate data on the complete performance of the rocking type of furnace, it would seem from the results so far that it may be of distinct value in the brass industry, especially under present conditions as to crucible prices and quality, fuel supply and prices, and metal prices.

At the conclusion of the tests conducted by the Bureau of Mines, which covered over 300 heats, the experimental furnace was put on regular production by the Michigan Smelting & Refining Co. Four one-ton rocking furnaces are being built for this company and two for the Electro Bronze Co.

Licenses to Make Furnace Granted by Bureau of Mines

The patents taken out by the Bureau of Mines on the rocking furnace have been assigned to the Secretary of the Interior as trustee, and free licenses to operate under them can be obtained by making application through the Director of the Bureau of Mines.

Grateful acknowledgement is made to Cornell University for use of the well-equipped Cornell electric furnace laboratory in the work on the laboratory furnace; to Dr. J. M. Lohr, formerly of the Bureau of Mines, for aid in the work on the laboratory furnace; to the Michigan Smelting and Refining Company for facilities for the test, and to the Detroit Edison Company, and particularly to Mr. E. L. Crosby of the latter firm, for never-failing co-operation.

A more detailed account of the tests of the rocking furnace will soon be published as Bulletin 171 of the Bureau of Mines.

SIDELIGHTS

EDITED BY E. C. PORTER

Two United States powder plants to cost $45,000,000 each are under construction.

* * *

The United States Ordnance Department manufactures about 100,000 parts. One type of gun with its carriage has 7990 parts, exclusive of accessories.

* * *

Exports of gold for the calendar year to Mar. 15 have amounted to $10,000,000 with imports of somewhat less than $8,000,000, leaving a balance of gold movement against us for the year of $2,137,000.

* * *

Shell borings and turnings in marketable quantities are beginning to appear as factors in scrap-steel quotations; 6000 tons were recently sold at $24 per ton. Sales of bars rolled from discarded shell steel are also noted.

* * *

The Government wishes to enlist every man, woman and child of the nation in war-saving service. When anyone buys war-savings stamps he enlists in the production division of the nation, thereby supporting and backing up the fighting divisions which are in France and on the seas.

* * *

The War Trade Board announces that arrangements have been consummated with the government of the Belgian Congo whereby a limited quantity of those commodities most needed by that colony will be licensed for export. Prospective importers in the Belgian Congo will be required to obtain the approval of the government of Belgian Congo for all orders.

* * *

A new use for thrift stamps has been found by a Chicago shirtwaist manufacturer. He employs several hundred girls, and has been greatly inconvenienced because such a large proportion of them were late at work every morning. He announced that he would pay every girl in his employ 5 per cent. additional wages, in thrift stamps, each week if she was not late more than a total of three minutes each week. Tardiness was completely eliminated the very first week of the experiment.

* * *

The steel collier *Tuckahoe* was launched from the Camden ways of the New York Shipbuilding Co. on Sunday, May 5, establishing a world's record in rapid ship construction. The record was 27 days, 2 hours and 50 min. This means that in that period a 5550-ton steel steamship was built from keel to truck and launched practically complete in every detail—boilers set, engines installed, masts stepped, funnel in place, propeller fitted, rudder hung, and only finishing touches to be put on. This ship was to have been delivered on June 15, but the company got her out 41 days ahead of time. The vessel is 330 ft. long with 50-ft. beam, and will have a speed of 10½ knots.

Last March the International Banking Corporation inaugurated a savings department, the first such institution in China under American auspices. Deposits were $3000 Mexican the first day and for 10 subsequent days they averaged $5000, the aggregate deposits at the end of 10 days exceeding $50,000. Much of this money was deposited by Chinese living outside the legation quarter. The International Banking Corporation pays 4 per cent. interest on these savings. Deposits made before the fifth of the month draw a full month's interest. There seems to be every reason to believe that the savings department will be increasingly patronized by natives, who have great confidence in American financial institutions.

* * *

The War Trade Board announces that until further notice licenses authorizing the exportation of postage stamps, revenue stamps and other stamps of similar character, either canceled or uncanceled, may be granted for the transmission only by registered or by first-class mails. The parcel containing the stamps shall bear plainly marked on the wrapper the license number, the description of contents and the name and address of the consignee, followed by the words, "In care of the Executive Postal Censorship Committee, 641 Washington St., New York City." The name and address of the consignor must also appear on the wrapper, and the postage must be fully prepaid to the country of final destination. Applications for licenses should be sent to the Bureau of Exports, War Trade Board, Washington, D. C., or any of the branch offices of the War Trade Board. Postage stamps appear on the export conservation list of Apr. 15, 1918, and since that date revenue stamps and other stamps of similar character, canceled and uncanceled, have been added to the conservation list.

* * *

To guard against the waste and serious loss resulting last winter from the shipment of dirty coal, which occupied car space and also seriously decreased industrial-plant efficiency, the Fuel Administration has organized a division of inspection with C. M. Means as manager. A chief inspector has been appointed in each of 21 representative districts, to whom the necessary assistant inspectors will be added. They will examine the coal in the mines, also when it is dumped from mine to tipple, watch the picking tables, and again inspect the coal as it is loaded in cars for shipment. Standards will be established for insuring proper preparation according to use, so that all coal shipped will be of the quality required for its particular purpose. By condemning coal at the mine a great improvement in the transportation situation should result in that the railroads will in effect be hauling heat units, not ash. Miners who get out dirty coal will be penalized and a bonus system is being developed. Mines that cannot supply properly prepared coal will not be allowed to ship by rail.

The Worcester Spring Meeting of the A S M E

The following extracts are taken from among a number of interesting papers read at the spring meeting of the American Society of Mechanical Engineers held at Worcester, Mass., June 4 to 7. Other details will be given later.

"Efficiency of Gear Drives" was the subject allotted to C. M. Allen of Worcester, Mass., a member of the society, and F. W. Roys, a non-member. The paper showed that the usual method employed in determining the efficiency of a gear drive is one in which the power loss is obtained by measuring the input and output and subtracting the latter from the former. In good drives, however, the efficiency is high and the input and output are very nearly equal, and any error in their measurement will result in a large percentage of error in their difference, or the power loss. It is therefore evident that a method by which the power loss may be directly measured will be much more accurate. The authors described such a method developed recently in the mechanical engineering laboratories of the Worcester Polytechnic Institute. In the apparatus used an electric motor is so suspended in a cradle that both its armature and field are free to turn. The armature shaft is connected directly to the pinion gearshaft and the driven shaft directly to an Alden absorption dynamometer. The reaction of the motor field is balanced by the action of the dynamometer through a simple lever, the arms of which are accurately proportioned to the ratio of the gears. Results of tests on bevel-gear and worm-gear drives are given in tables and charts, and from the form of the curves presented and the consistency of the data the authors conclude that the method described is apparently the best yet devised for testing gear drives of all types.

F. Hymans of New York, a member of the society, spoke on "Stresses in Machines When Starting or Stopping," in which he said that for the intelligent determination of the dimensions of machine parts it is necessary that the forces acting thereon be known. The calculation of these forces follows at present one of two methods. The first assumes a state of equilibrium for the machine, which, however, exists only when the machine runs at constant speed or is at rest. In the second the machine is considered to consist of rigid parts, but their acceleration at start or stop is considered. Neither of these methods leads to even approximately correct results. A new method for the correct evaluation of the forces acting on machine parts during start or stop is developed and illustrated by application to a vertical-geared hydraulic hoisting machine. It is shown that the stresses during start or stop depend on the inertia and elasticity of the parts, their distribution throughout the system and on the magnitude and nature of the accelerating force. Vibrations of start or stop always occur, but whether they are pronounced and give rise to dangerous stresses depends to a very great extent on the character of the accelerating force.

"A Self-Adjusting Spring Thrust Bearing" was the title of a paper read by H. G. Reist, Schenectady, N. Y., another member of the society, and is as follows:

It has been shown that the pressure on the babbitted surface of an ordinary journal bearing varies greatly in different parts of the circumference of the bearing, being greater at the center line of the resultant load than toward the sides and varying approximately inversely with the thickness of the oil film. Whether the greater part of this variation in pressure is due to the difference in thickness of the film or to the dragging of the oil by the shaft to a point from which it cannot readily escape is hard to determine. The thickness of the film depends apparently on the load per unit area, the viscosity of the oil and the surface speed of the shaft. Several investigators have shown that with ordinary loads of 100 lb. average pressure per square inch the thickness of the oil film at the bottom of the bearing is about 0.0002 to 0.0003 in. With this in mind it will readily be understood why the surfaces of the bearing have to be fitted closely to the shaft, why the supporting shell must be made rigid and, finally, why a soft metal which conforms to the shaft is much better for a bearing surface than a hard one. In spite of all the care that may be taken only a small part of the surface usually fits the shaft to within the aforesaid dimensions, and the load is borne on a restricted area with a pressure many times the average and often many times the pressure at the bottom of a perfectly fitting bearing. On large bearings it is difficult to prevent the metals from touching, a small part sometimes taking sufficient load to cause wiping of the babbitt at starting. "Wiping the babbitt" tends to fit the bearing to the shaft under the loaded condition, and may occur only at starting and not repeat the process afterward, due to a larger bearing surface thus being established. It is better, however, to avoid this, as the particles of loosened babbitt metal may injure or destroy the good part of the bearing surface, and there is also danger of scoring the shaft.

Bearing Failures

In the absence of dirt or grit, bearing failures are due to the squeezing out of the oil film. The pressure necessary to accomplish this is much greater than is generally known. In one case that came to my attention a pressure of 5000 lb. per square inch was carried for several hours and the babbitted surface was absolutely free from damage. In another case a pressure of 2000 lb. per square inch at a rubbing speed of 4500 ft. per minute was successfully carried. The consideration of such experience led to the conclusion that damage to properly lubricated bearings was due to failure of the oil film on so small a part of the total surface that the unit pressures on these surfaces exceeded the values just mentioned.

In order to maintain a film of oil of fairly uniform thickness in bearings of the constructions now in use it is necessary that the parts which form the bearing surface should be exceedingly rigid so that the deflection of the bearing surface shall be very small. With this precaution and with very accurate fitting it is theoretically possible to maintain over the whole surface of the bearing or a large area thereof a film of oil sufficiently thin to support a fair pressure per inch of bearing. It is for this reason that the shells of ordinary bearings are made quite stiff so that they will do some supporting even at the ends. The ideal condition would be to have the deflection of the bearing and shaft the same, but in practice this cannot be accomplished.

The bearing that is to be described departs altogether from these principles, and is based on the idea of a bearing surface which is so yielding, flexible and elastic that it may follow the irregularities of the rotating surface with-

out creating at any point a pressure per square inch sufficient to destroy the oil film.

Many of the problems found in the construction of journal bearings are met with in the design of thrust bearings. Small bearings, up to perhaps 10 in. in diameter, may be readily fitted so that at ordinary speeds the surfaces are sufficiently accurate to allow a film thin enough to support the load without danger of dragging the babbitt. The parts must be made quite rigid and the seat is usually supported on a spherical surface to correct for slight inaccuracies of alignment.

Thrust Bearings

Thrust bearings for supporting the heavy loads of waterwheels and the electric generators driven by them are now very widely used. The difficulties in the fitting and use of plate bearings are much aggravated as the weight is increased, on account of the large over-all dimensions of the supporting plate. It is true that the surfaces can be fitted quite accurately by machining, but I have known cases where the surfaces were turned slightly conical so that they touched hard on the inner or the outer edge. The deflection of the supporting collar on the shaft may allow the runner to be slightly dished, or there may be a deflection of the supporting surface, thereby dishing the babbitted seat or causing one side to be lower than the other. The self-adjusting spherical seat provided to correct some of these difficulties is of doubtful value on large bearings on account of the great frictional resistance which must be overcome to make it shift.

Thrust-bearing surfaces are usually scraped to each other or to a surface plate to avoid dangerously high spots; but since the oil film is of the order of 0.0002 in. to 0.0003 in. in thickness the difference in level must be smaller than these values. This work must usually be done without load, and no matter how carefully done, when the bearing is loaded the parts will probably not fit each other, due to deflection.

A careful study of the above difficulties led me to design a flexible bearing surface pressed against the runner by springs. It seemed that this would prevent the possibility of undue pressure at any point, and compel each element of the surface to carry its share of the load and, on trial, this solution proved satisfactory.

Thrust Bearings for Vertical-Shaft Machines

A typical design of a spring thrust bearing for vertical-shaft machines which I designed and tested consists of a runner of a special grade of cast iron resting on a thin steel ring with a babbitted surface. The babbitted stationary ring in turn rests on short helical springs and is held against rotation by dowel pins. A saw cut through one side eliminates any tendency of the ring to dish with a change of temperature. A high base ring, on which the springs stand, is used in connection with a deep housing to increase the amount of oil in a surrounding bath. A tube in the center forms a retaining wall around the shaft for the oil. The springs ordinarily used are wound of ½-in. round wire and have an outside diameter of 2 in. and a free length of 1½ in. Under load the springs close about $\frac{3}{16}$ in., and the total pressure is well distributed. By this means it is possible to avoid excessive pressures at any point. Thus it is safe to run with a much higher average pressure than when there is no definite limit to the pressure which may occur over a small area.

It will be seen that this type of bearing differs from the solid-ring thrust bearing in that one of the bearing surfaces is made to yield at any point by using a comparatively thin plate supported by a large number of springs. While solid bearings may be used successfully for small loads, a bearing which thus automatically adjusts itself to faults in finish and in alignment is preferable for carrying very heavy weights.

Oil grooves are provided in one of the members and sometimes in both. In order to insure proper circulation of the oil for cooling purposes, in the case of bearings operating at low speed it is necessary to have grooves in the rotor. On high speeds these grooves may sometimes be omitted, relying for circulation only on the friction of the rotor on the oil while passing the grooves in the stator. In many cases we have had very satisfactory results by placing radial grooves in both the rotating and the stationary surface. It is our practice to have different numbers of grooves in the two plates; for instance, six and eight. With grooves in each of the surfaces we have a continuous flooding of oil on all the bearing surfaces and a very effective means of cooling. Much of the heat would otherwise have to be transmitted through the metal of the stationary part of the bearing.

The pressure usually allowed on these bearings is from 300 to 400 lb. per square inch, the design permitting a very thin oil film without metallic contact. It is necessary to have the runner very smooth and free from scratches, especially any at an angle to the direction of rotation, as these might cause injury to the babbitt. The babbitted surface does not need to be scraped, but is turned with a tool as smooth as is convenient. Wearing sometimes occurs in minute spots all over the plates. When this happens there is no risk of dragging the metal. The bright spots that show themselves are produced while starting and slowing down before a pressure film is formed. When in operation the weight is apparently entirely supported on the oil film.

Bearings at High Pressure

It is desirable to run bearings at a high pressure if they can be designed to do this safely, as the parts then are smaller, the rubbing speed is less and the friction very much reduced. With this design of bearing the tendency to excessive pressure at one point is automatically relieved by the springs yielding, and while there will be some uneven distribution a variation in pressure of two or three times the average is comparatively unimportant and does not cause bearing failures; it is pressures of 20 or more times the average that cause injury. These excessive pressures are prevented by the construction just described. For this reason it is safer to operate this bearing with high pressures than a more rigid bearing at lower pressures.

The loss of alignment due to settling of foundations or other causes does not affect the bearing adversely. In one waterwheel-driven alternator installation the striking of the field against the armature led to the discovery that the coupling between the two units had loosened, which allowed the shaft to "run out." The bearing operated without injury with over 0.03 in. vertical movement of the outer edge of the rubbing surface. This caused an uneven distribution of load on the bearing to the extent of reducing the load on one side of the bearing about 16 per cent. and increasing the pressure a similar percentage on the extreme opposite side.

An advantage of increased pressure in the reduction of friction is shown by the following table of comparison:

Bearing number	1	2
Revolution per minute	200	200
Total load, pounds	300,000	300,000
Outside diameter of bearing, inches	35	46
Inside diameter of bearing, inches	17.5	17.5
Net area, square inch	600	1200
Pressure, pound per square inch	500	250
Average rubbing speed, foot per minute	1370	1670
Coefficient of friction	0.0018	0.0033
Kilowatt loss	16.7	38
Horsepower loss	22.5	51

The Vertical Clearance

In some designs the vertical clearance between the waterwheel and the casing is very small, so that the displacement caused by a free spring under the variation of hydraulic suction is objectionable. In such cases an initial compression equal to full load, or to an overload, is put on the springs. The load will still distribute, since an overload at any point will cause the spring to close beyond the initial compression. However, this bearing was designed to replace a roller bearing, and was so made that the parts of the waterwheel would occupy the same relative positions as before. The principles used in the construction of these thrust bearings are applicable also to journal bearings and to bearing surfaces having a reciprocating motion, like the crosshead of a steam or gas engine.


The Message of the Flag

TOMORROW is Flag Day—and never before in the history of our country was Flag Day half so important as now. Never before did the Stars and Stripes mean so much to the world, standing as it does as the last bulwark against all autocracy.

※ ※

The flag today carries two messages. To us it carries the appeal for higher and greater service that it may truly symbolize the ideals of democracy. To the people of the devastated regions of Europe it carries the message of hope and the faith that their wrongs may be righted. To us it calls for our best energies and sacrifice—to them it is the inspiration which enables them to suffer yet a little longer.

※ ※

But we must remember that the flag is of itself only a symbol and that on us rests the task of making this great country of ours all that the flag implies. Justice and liberty do not come of themselves nor do they remain of their own accord. They demand constant vigilance and constant service. And unless the flag brings to our mind the necessity for this service, we have failed to grasp its full meaning and its full beauty.

※ ※

Over there in France the sight of Old Glory is putting fresh courage into the hearts of tired but gallant fighting men and their

women and children. Hundreds of thousands of our best youths are over there carrying that flag, and with it the hope of the world. To them it is the symbol of home, of duty and, above all, the symbol of service, even to the death. To us it should mean the call for greater effort in every walk of life.

It appeals for more production, for greater efficiency, for steady work, that our boys in France may have all that they need to win the war. Unless the sight of the flag inspires us to more vigorous action, to greater service, we have failed to read its message. Let us display the flag freely—but let the sight of it be an inspiration to duty. Let us remember and be thrilled by the knowledge that the flag has never known defeat. But let us also remember that on us rests the responsibility not only of backing up our boys in France, but of making the Stars and Stripes truly symbolical of the best in government and in life.

We are far from the firing line, but if we are doing our share that flag will thrill us to the core just as it does the people of war-torn France. But we must make it OUR flag in reality as well as in name.

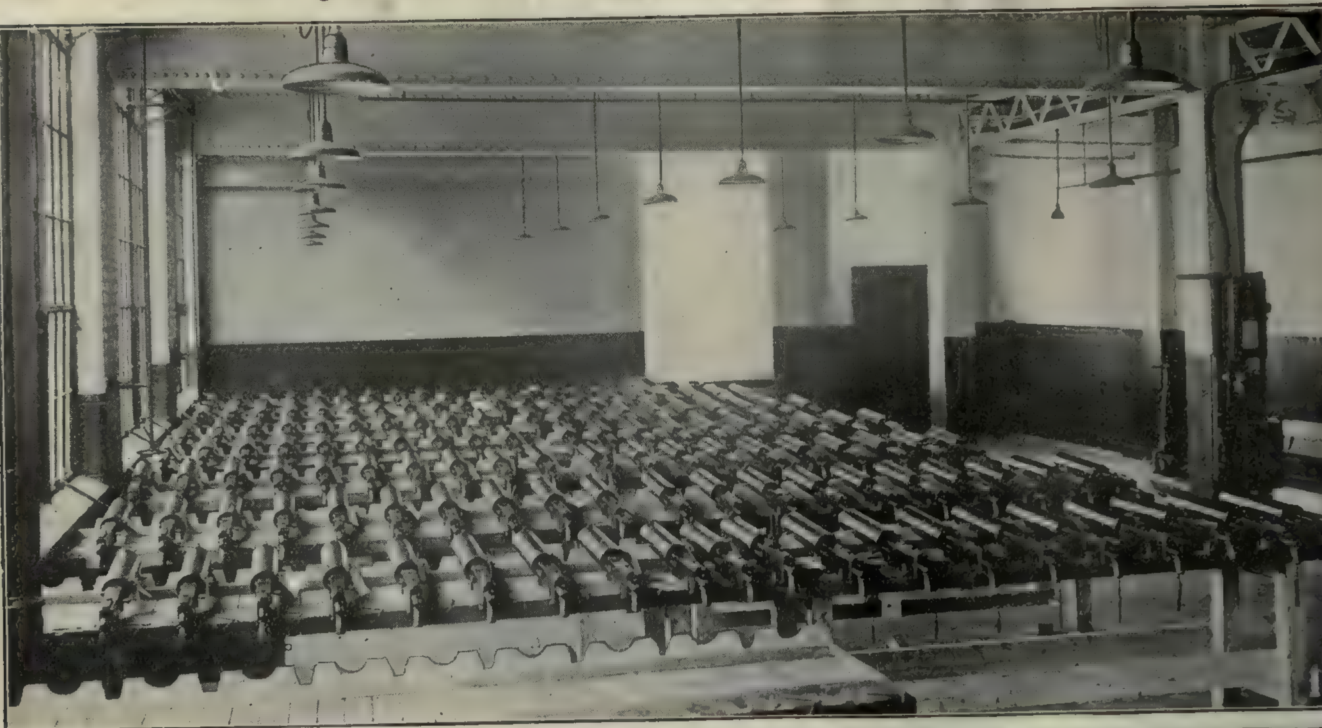
Then too we have another duty. The war has shown us our shortcomings in our failure to Americanize the alien who has cast his lot among us. We have failed in too many cases to so treat him and his family that the flag means to him all that it should. We have failed to extend the human sympathy which so often means much more than anything else. We have left him to shift for himself, to gather into groups and colonies, to continue the old ideas and practices, instead of trying to show him the real meaning of our ideals of democracy and of justice. But in spite of our neglect there are many of our foreign-born citizens who can teach us much in loyalty and in real adoration of our flag—to them it is truly the flag of liberty, of freedom from the oppression of the autocracies of the old world.

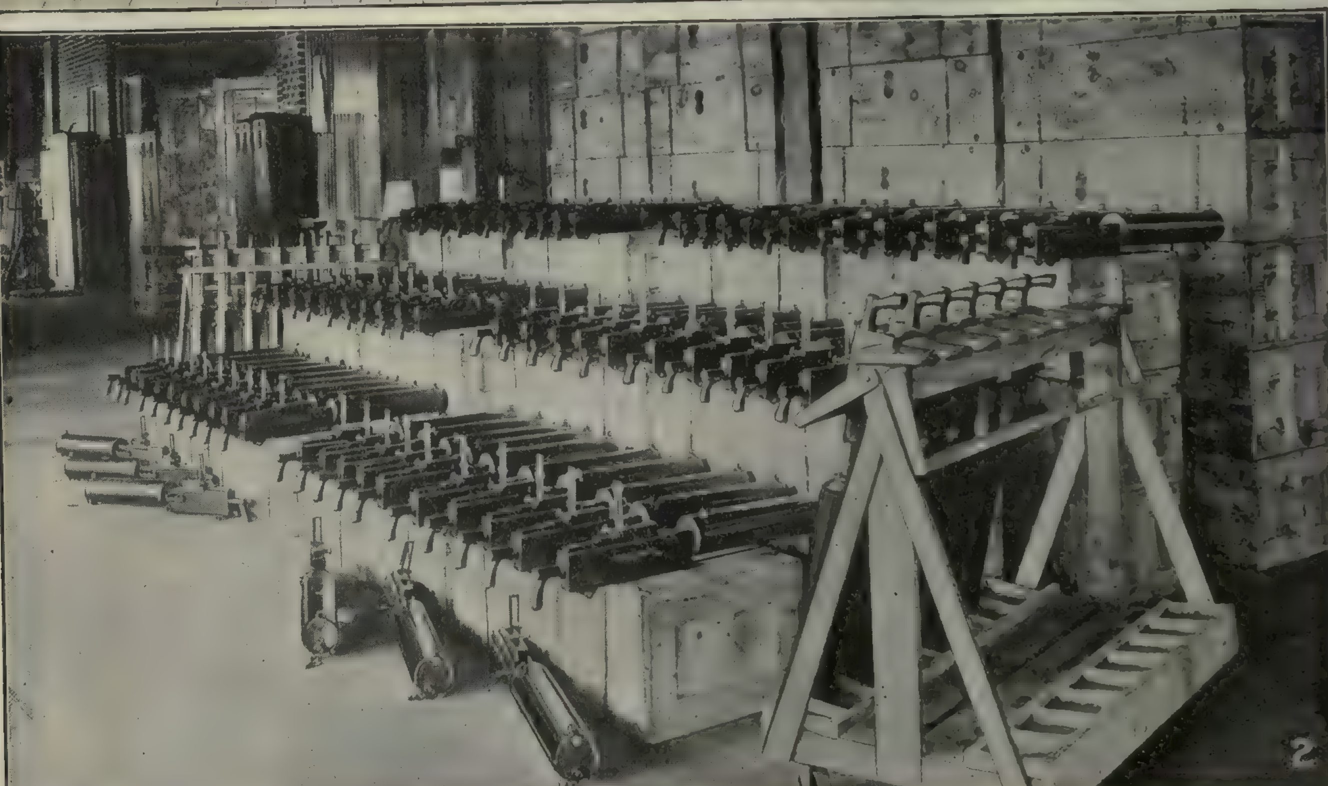
To those few to whom the flag means merely a cloak for trade, the possibility of exploitation in foreign markets or the protection of ill-gotten gains, this should be a period of regeneration. They dishonor our flag, or any flag. To our boys in France it signifies duty, and service, and sacrifice. Unless it means the same to us we have missed the spirit of Old Glory.

Tomorrow is Flag Day. Let us celebrate it as we should, joyously and with the firm determination that it shall continue to be victorious as in the past. Let us catch some of the fire and the enthusiasm of the marching troops; let us pledge ourselves to do our full share not only in the winning of the war, but in the maintaining of our ideals after the struggle is over.

Let us realize that honoring the flag does not end in cheering and loud demonstration, but that it means doing our utmost in whatever work we are engaged—in working as best we may, with the one thought of giving the greatest service to the country and to the flag.

Heavy Browning-Gun Production





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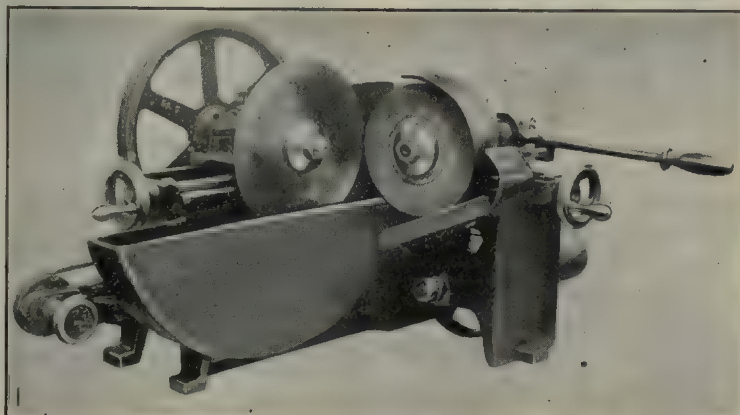
MANY people are in doubt as to whether we are actually producing the new Browning automatic machine guns on a quantity basis. The manufacture of the light, air-cooled type of Browning gun is a simpler problem than the making of the heavy type, which is water-cooled. However, we are now turning out the heavy type at a very satisfactory rate, and the output is improving daily. The light type is of course far ahead in numbers produced and will continue to be.

The illustrations show some of the heavy-type Browning guns which have been proof-fired and inspected and are ready to be packed and shipped. The tripods and ammunition cases are shipped separately. The guns shown were photographed May 10. One hundred forty, shown in Fig. 1, were taken at the plant of the Remington Arms and Ammunition Co., Bridgeport, Conn., and 80, shown in Fig. 2, was taken in the factory of the New England Westinghouse Co., Springfield, Mass. They were all manufactured by machine processes on a quantity basis.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist"

Machinery Co.'s Slitting Saw and Circular Knife-Grinding Machines

The illustrations show two of the recent developments of the Machinery Co. of America, Grand Rapids, Mich. Figs. 1 and 2 are two views of a bevel grinding machine for circular knives, cutters, etc., from 3 to 20 in. in diameter. This device is suitable for grinding or sharpening the circular cutters, or knives, commonly used for cutting meat, paper, cork, cloth, or similar substances. A hand adjustment is provided for centering the cutter, according to its diameter, for proper contact with the grinding wheel, and a handwheel adjustment feeds the grinding wheel to or from the cutter during the grinding process, while a hand lever gives the lateral movement of the grinding wheel across the surface of the cutter. The machine is equipped with a water tank, the grinding being done wet in order to prevent undue heating. An adjustable stock or back rest of fiber is mounted behind the cutter opposite the grinding wheel to support the cutter rigidly and prevent chatter or vibration. A guard incloses the grinding wheel to prevent the throwing of water or dust. The angle or degree of bevel ground is adjustable, the device for obtaining this adjustment being clearly shown in the upper left part of Fig. 2. Fig. 3 shows the No. 10 automatic sharpener for slitting or milling saws. This is for the purpose of regrinding or recutting slitting or milling saws from 2 to 10 in. in diameter and is particularly adapted to reclaiming thin slitting saws with fine tooth spacings. It is claimed that the grinding of the teeth is uniform and that the teeth are correctly spaced. The device is fully automatic in operation and is mounted on a pedestal that brings it up to a convenient height for the operator. All essential working parts are inclosed in the body and protected from dust, dirt or other foreign material. All moving parts are provided with adjustment for taking up wear, and any standard shape or spacing of tooth may be obtained by handwheel adjustments. The approximate shipping weight is about 225 lb.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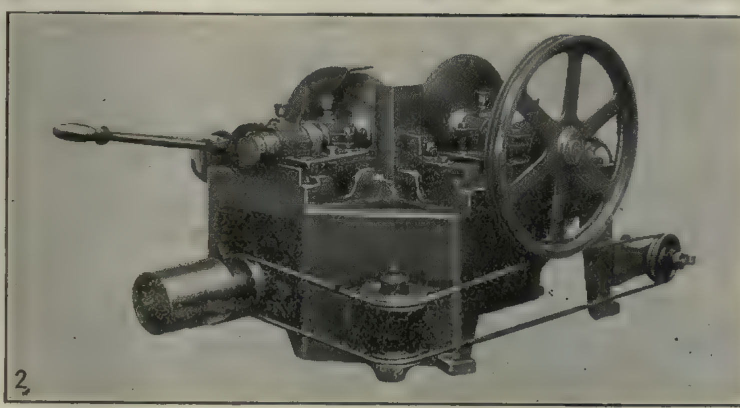
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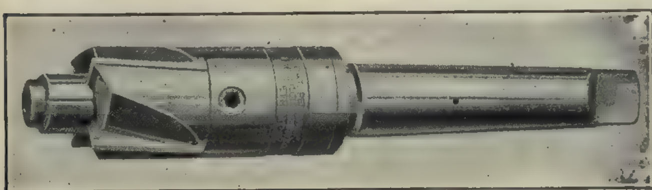
FIGS. 1 TO 3. BEVEL KNIFE-GRINDING MACHINE AND SLITTING SAW SHARPENER

Figs. 1 and 2—Bevel grinder for 3 to 20 in. circular knives and cutters. Diameter of tight and loose pulleys, 4 in.; width of belt, 2 in.; diameter of grinding wheel, 8 in.; width of grinding wheel, $\frac{3}{8}$ to $\frac{3}{4}$ in.; floor space, 30 x 36 in.; height, 20 in.; width of zone ground, up to $1\frac{1}{2}$ in.; weight crated, 275 lb. Fig. 3—Sharpening machine for milling and slitting saws

"Utility" Interchangeable Counterboring and Spot-Facing Tools

The illustration shows one of a new line of interchangeable counterboring and spot-facing tools that has been placed on the market by the J. C. Glenzer Co., Detroit, Mich. The counterbores are made up of four parts—the holder, the cutter, the pilot bushing and the pilot pin. The holders are made in four sizes which cover a range of work from $\frac{3}{8}$ to 3 in. They are provided with Morse taper shanks varying in size from No. 1 to No. 4. The cutters are made of high-speed steel and are provided with a slot across their upper surface which insures a positive drive. The interchangeable pilot bushings are pack hardened and ground 0.008 in. under the drill-hole sizes and are driven by the teeth of the cutter which fit into notches in the upper surface. This method of drive is claimed to remove from the pilot pin considerable of the stress which is generally present. The pilot pin simply serves to hold the assembled tool together and is held in place

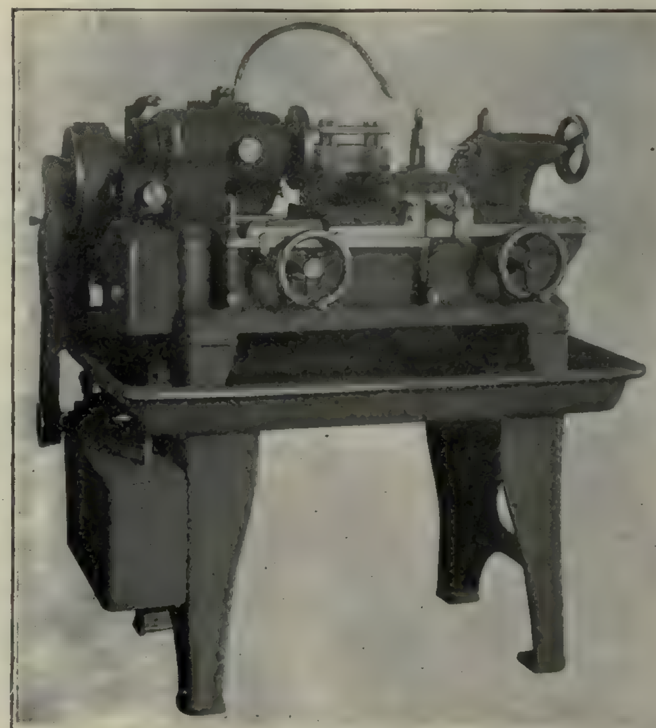


UTILITY INTERCHANGEABLE COUNTERBORE

by means of a headless setscrew placed in the side of the holder. The cutters are made in sizes varying by sixteenths of an inch from $\frac{3}{8}$ to 3 in., while the pilot bushings are made in sizes varying by sixty-fourths of an inch. Holders with special tapers or straight shanks can be made on special order if desired.

Rockford "Sundstrand" 9-In. Manufacturing Lathe

The illustration shows a 9-in. manufacturing lathe that is now being marketed by the Rockford Tool Co., Harrison Ave. and 11th St., Rockford, Ill. This machine is known under the trade name of "Sundstrand," and is intended primarily for a plain high-power lathe for the rapid production of duplicate parts in large quantities. The work handled to best advantage is short pieces of comparatively small diameter. The bed is ribbed and has separate ways for tool carriage and tailstock so arranged that the carriage can travel to the end of the bed in front of the tailstock. The advantage of this is that the tailstock can be set up close to the work and the overhang of the tailstock center is greatly eliminated. The headstock is of the all-geared type and is operated by a friction clutch upon which is mounted the driving pulley. The lever which operates the clutch automatically engages a friction brake which stops the spindle. The spindle and other principal bearings are fitted with SKF self-aligning ball bearings. Three spindle speeds can be obtained by means of a lever located on top of the headstock, while additional speeds are obtained in series of threes by changing two auxiliary gears on the end of the headstock. Four auxiliary gears are furnished which give 12 spindle speeds. The gears in the headstock run in a bath of oil, and the spindle is adapted for draw-in collets. The carriage has a long bearing surface on the ways and is operated by a screw located between the ways and directly beneath the tool, this construction, it is claimed, eliminating twisting tendencies. Automatic stops are provided and they are adjustable. The carriage is regularly equipped with a plain rest, which has a toolpost slot. The rear toolholders are of the multiple-tool type for facing, grooving, etc., and can be mounted on the rear ways entirely separate from the carriage. The cross-feed of the rear toolholders is operated by a handwheel located at the front of the bed, and both front and back



SUNDSTRAND MANUFACTURING LATHE

Swing over bed $9\frac{1}{2}$ in.; swing over plain rest, 7 in.; distance between centers, 12 in.; diameter of hole through spindle, $1\frac{3}{8}$ in.; largest collet capacity, 1 in.; spindle nose, $2\frac{1}{8}$ in. diameter, 10 thread; taper of centers, Morse No. 2; size of cutting tool. $\frac{5}{8}$ x $1\frac{3}{8}$ in.; length of carriage on bed, 18 in.; diameter of drive pulley, $8\frac{1}{4}$ in.; width of drive belt, $2\frac{3}{8}$ in.; speed of drive pulley, 350 r.p.m.; number of spindle speeds, 12; number of feeds, 4; floor space, 45 x 24 in.; weight, crated, 1050 lb.

tools are equipped with positive stops. The lathe is regularly furnished with oil-pan bed, plain rest, wrenches, etc., and back rest, taper attachment, draw-in attachment, collets, oil pump, piping, etc., can be furnished at additional cost.

Foster Turret Lathe

The Foster Machine Co., Elkhart, Ind., is placing on the market a new universal turret lathe which is known as the company's No 2-B machine. It is for both bar and chucking work. This machine, it is claimed, will handle bar work up to $3\frac{1}{4}$ in. in diameter and 30 in. in length, and chucking work 13 in. in diameter. It is capable, however, due to the larger swing over the ends of the carriage, to handle lighter chucking work up to 20 in. in diameter. It is claimed that this machine is the most universal of any on the market, this feature being due to several peculiar features of construction, such as wide and well-balanced speed and feed ranges

and numerous standard, semistandard and special tools and attachments with which the machine can be equipped. It is claimed that these make the machine capable of handling economically work of widely different nature and quantity, covering a range from small lots up to work in large quantities.

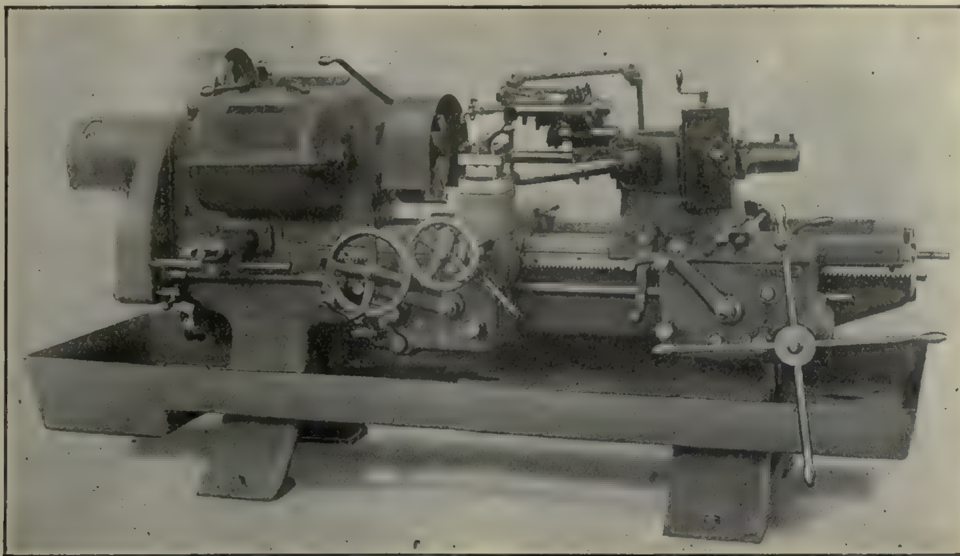


FIG. 1. FOSTER NO. 2-B UNIVERSAL TURRET LATHE WITH CHUCKING EQUIPMENT

Capacity, bar work up to $3\frac{1}{4}$ in. in diameter and 30 in. in length and chucking work up to 13 in. in diameter; capacity for light chucking work, up to 20 in. diameter; speed changes twelve, 12 to 325 r. p. m.; width of belt, 4 in.; diameter of driving pulley, 15 in.; speed of pulley for high-speed cutting tool, 500 r.p.m.; speed of pulley stellite cutting tools, 750 r.p.m.; longitudinal feeds, twelve, 0.0055 to 0.150 in. per spindle revolution; cross-feeds, twelve, 0.0029 to 0.080 in. per spindle revolution; weight, complete with automatic chuck and bar feed but without standard tools, 5200 lb.

Twelve speed changes ranging from 12 to 325 r.p.m. are obtainable by means of sliding gears, the operating levers being mounted on top of the head cover, as shown in Fig. 1, which is a general view of the machine. The start, stop and reverse friction clutch is mounted on the back gear shaft and operated by the lever shown directly over the front spindle bar. All gears used are carbonized and heat treated and the teeth are of the Fellows stub-tooth standard style. They run in an oil bath and the bearings throughout the head are automatically lubricated by means of the splash from the gears. The bed is claimed to be very liberally ribbed internally, which makes it capable of carrying heavy cutting without spring or vibration. The carriage moves on two V-ways and the rear end of the cross-slide is built in the shape of the table, on which standard or special toolholders can be mounted. The square turret mounted on the cross-slide is indexed and bound by means of the lever handle mounted at the top, the lock-bolt being of the cylindrical, vertically mounted type, located directly beneath the working position of the cutting tool. For longitudinal gaging and duplicating of the work the carriage apron is equipped with six independently adjustable stop screws mounted in an indexable stop spool and abutting against a slidable stop rod mounted in a bracket secured to the bed. When a stop screw comes in contact with the stop rod a drop-off lever drops and disengages the feed friction. The advantage claimed for the drop-out feed friction over that of a drop-out worm is that the engagement is instantaneous.

For duplicating and gaging diameters of work a large dial is mounted on the cross-feed screw and adjustable observation stops are provided. The cross-feed is disengaged by means of a short lever shown at the right of the apron. Twelve feed changes are provided for both longitudinal and cross-feeds, six of these being obtainable by means of sliding gears in the apron, these being doubled by two changes obtainable in the gear box at the head end of the bed which gives two speeds to the feed rod. The main turret, which is of a hollow-hexagonal type, is shown in Fig. 2 with box tools in place. The turret saddle is equipped with an apron very similar in design to that described for the carriage. The drop-out feed friction is controlled by stops adjustably mounted on a long stop roll located between the ways of the bed, this stop roll being long enough to take care of work up to the maximum length capacity of the machine. The saddle is equipped with rapid traverse which is operated by means of a lever mounted on the front side of the saddle. The mechanism itself is more clearly illustrated in Fig. 3, which is a rear view of the machine. The device consists of a right- and left-hand screw with nuts which are intermittently locked by means of a double friction controlled by the lever at the front previously mentioned. A rod adjustably mounted in a bracket secured to the rear end of the bed automatically disengages the rapid traverse and limits the movement of the saddle. The rapid traverse screw is protected from chips and dirt by means of a telescopic tube and is driven by means of a belt from the main driving pulley.

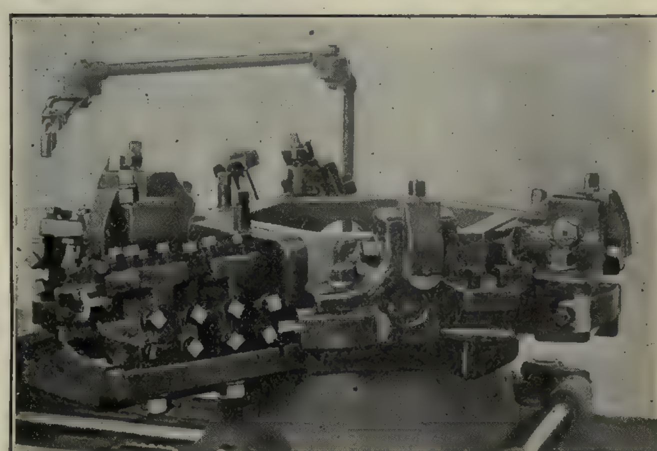


FIG. 2. HEXAGON TURRET WITH BOX TOOLS

Fig. 3 also shows the machine equipped with automatic chucks of the standard collet construction. It is claimed that the construction is such that the collet chuck has a very short overhang beyond the front-spindle bearing. A lever action for operating the chuck wedge has been incorporated, which it is claimed greatly

facilitates the ease of operating and greatly increases the gripping power. The bar-feed head travels on two parallel bars, the outer ends of which are supported in a rigid stand as shown.

The machine can be equipped for screw-cutting and taper attachments, the screw-cutting attachment being

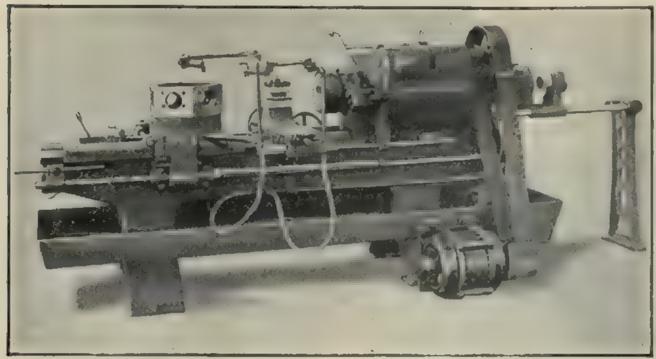


FIG. 3. REAR VIEW OF THE UNIVERSAL TURRET LATHES WITH AUTOMATIC CHUCK AND MOTOR DRIVE

of the leader and follower type, as shown in Fig. 4. The leader is mounted on the main feed rod, and is capable of cutting two pitches of threads in the multiples of one and four of that of the pitch of the leader. The follower is mounted in a lever in a projection of the carriage apron. Fig. 4 also shows quite clearly the arrangement of the carriage stops and the left side of the apron. The taper attachment is mounted at the rear of the carriage and operates directly on the cross-feed nut. It can be seen in Fig. 3. A complete system for circulating cutting lubricant is supplied and a pan of gen-

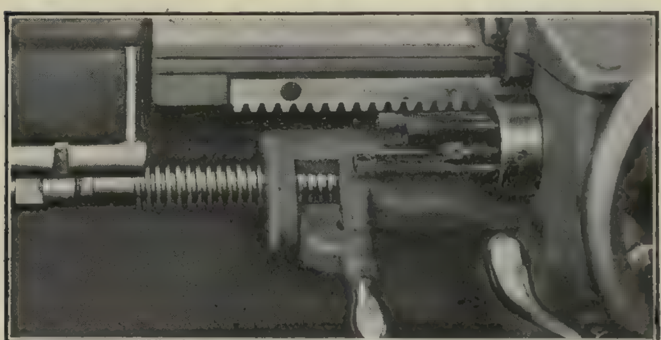


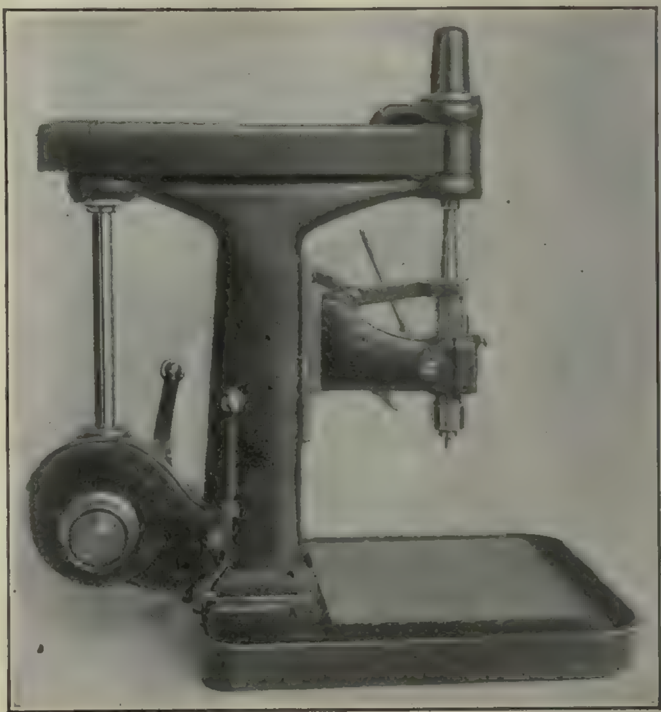
FIG. 4. VIEW SHOWING SCREW-CUTTING ATTACHMENT AND CARRIAGE STOPS

erous size is incorporated in the machine. The piping system and pump are shown in Fig. 3, which also shows the motor-drive arrangement.

The machine is also furnished if desired for belt drive from the countershaft. It is claimed that a very extensive and complete tool equipment can be supplied for various classes of work for which the machine is adapted.

Mason High-Speed Drilling Machine

The quick-change, high-speed drilling machine shown in the illustration is the latest product of the A. C. Mason Co., Inc., Paterson, N. J. It is at present being manufactured in the bench type only with single or multiple spindle as desired. Unit construction has been used to permit accessibility and ease of adjustment, and replacements in case of wear are readily made. Ball bearings are used throughout and moving parts are carefully guarded. The construction is such that all speed changes may be made without stopping the machine, two belt speeds being arranged for. The belt drives horizontally from a plain rear pulley to a cone pulley on the spindle, this pulley being of special fabric composition to reduce belt slippage and tension to a minimum. A spring idler is incorporated. The rear vertical shaft is fully inclosed and is driven by a two-speed gear drive. These speeds are obtained by the semiautomatic clutch operated by a handle near the collet. There are no sliding yokes or parts subject to friction wear, and it is claimed no adjustments are needed



HIGH-SPEED BENCH DRILLING MACHINE

or provided for, the adjustment at the factory being sufficient for all time. Four spindle speeds are available, varying in geometrical progression from 3000 to 10,000 r.p.m., with the back shaft running at 1800 r.p.m. The horizontal back shaft together with the gears form one unit, the vertical shaft a second unit and the spindle pulley together with its top and bottom bearing a third unit. Each of these units is removable without disturbing other parts of the machine. The spindle is of semihardened steel and is a complete unit with its own bearings and is removable from the spindle sleeve without taking the spindle or spindle pulley from its fastenings. An oil system is provided which insures continuous lubrication of all spindle bearings. A balanced chuck capable of holding drills up to ¼ in. in diameter is provided and the spindle feed is 6½ in. at one setting of the bracket. An oil or chip channel is provided around the working surface of the base, which is of generous size. The spindle feed pivot may be operated from any position and is quickly adjustable to take up backlash between the spindle sleeve and the pinion. To insure drilling to the proper depth an adjustable gage is provided.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., June 8, 1918.—As has been pointed out before, there is an urgent need for machinery with which the big guns must be made. We have pointed out the need for a machine-tool program to handle this work, but until the statement submitted by Col. H. W. Reed to the Machine Tool Builders at Atlantic City last month was made it was impossible to get any definite idea as to the machines needed. And when we are still a long way from getting the machines with which to build the guns it is a bit premature to talk of our gun program as being satisfactory.

The smaller guns are coming along better, but the comments of some of those who are actually building or trying to build big guns are not nearly so optimistic as those by Mr. Caldwell. With changing designs and delayed forgings, they are having troubles of their own. They are overcoming them, however, one by one, and when real, honest-to-goodness production gets really started we shall see guns and guns and more guns in a never-ending procession.

Those who can be of assistance in providing the machines for the big-gun program want to know just who to communicate with in regard to the matter. These inquiries, I am informed, should be addressed to Captain Pierrong, Miscellaneous Section, Procurement Division, Ordnance Building, Sixth and B Sts., Washington, D. C.

About Priorities

There seems to be some misunderstanding as to priority orders on steel, nearly all of which are now needed in war work. The method of procedure is as follows:

The concern wanting steel should go to its regular dealer or source of supply and place its order, subject to obtaining the necessary priority. If the dealer or steel company will accept the order, providing priority is secured, an application covering this order must be made to the Priorities Committee. If an order has actually been accepted priority may be granted thereon, the rating being governed by the actual need of the steel covered for war work or other work of exceptional importance. With almost no exceptions priority will not be granted for the replacement or maintenance of stock unless it can be clearly shown that this is necessary for a continuance of war work. And in this case the application must cover specific cases, as a blanket certificate will in no case be issued.

The allocation of steel is only undertaken with reference to orders placed directly by the Government.

This Priorities Board consists of the chairman of the War Industries Board, the Priorities Commissioner, a member of the Railroad Administration, a member of the United States Shipping Board and Emergency Fleet Corporation, a member of the War Trade Board, a member of the Food Administration, a member of the Fuel Administration, a representative of the War Department, a representative of the Navy Department and a member of the Allied Purchasing Commission.

To Secure Coördination

This makes a board of 10 members, each representing a different group so as to secure a real coördination of resources and needs. They are all authorized representatives of governmental agencies concerned with war industries and supplies and are in a position to secure "common, consistent and concerted action" as pointed out by the President in this connection.

The preferential treatment follows the following list:

Ships—Including destroyers and submarine chasers.

Munitions, military and naval supplies and operations—Building construction for Government needs; equipment for same.

Fuel—Domestic consumption. Manufacturing necessities named herein.

Food and Collateral Industries—Foodstuffs for human consumption, and plants handling same. Feeding stuffs for domestic fowls and animals, and plants handling same. All tools, utensils, implements, machinery and equipment required for production, harvesting and distribution, milling, preparing, canning and refining foods and feeds, such as seeds of foods and feeds, binder twine, etc. Products of collateral industries, such as fertilizer, fertilizer ingredients, insecticides and fungicides, containers for foods and feeds, collateral products. Materials and equipment for preservation of foods and feeds, such as ammonia and other refrigeration supplies, including ice.

Clothing—For civilian population.

Railroad—Or other necessary transportation equipment, including water transportation.

Public Utilities—Serving war industries, army, navy and civilian population.

This includes all necessary raw materials, partly manufactured parts and supplies for the completion of products. Further preference lists will be issued from time to time as conditions change.

The War Industries Board earnestly urges each nonwar industry to look the whole situation squarely in the face *now* and to plan accordingly, instead of waiting as

long as possible before making any changes. By curtailing now and planning in accordance with the real needs of the war, the essential industries will be helped and less damage will be done to industry as a whole. The erection of new plants which are not for direct war work is discouraged and no priorities will be granted for materials of any kind. War work should have first consideration and nothing allowed to hinder it. It is desired to disturb all legitimate business as little as possible, but this is a note of warning to those who do not seem to appreciate the vital necessity of devoting every ounce of the nation's energy to the one great object of winning the war.

Delay in Releasing Cars for Duty

The question of car shortage continues to attract attention and all are urged to avoid delays in loading and unloading material of all kinds. The present weather hardly reminds us of the rigors of last winter, but it all has its bearing on the coal supply and we should do nothing that may in any way delay the handling of coal or other commodities.

It is very noticeable, however, that the railroads themselves are the worst sinners in this respect. Coal cars are held for days on days on sidetracks, loaded with ashes or coal or empty, as the case may be. They can be seen in almost any railroad yard in almost every large city. With the shortage in cars for coal and other commodities this would seem to be one of the things to be looked into very carefully by the railroad officials.

The Control of Labor and Wages

Every manufacturer has realized the futility of the constant bidding against each other for labor, and many and loud have been the complaints against the firms with cost-plus contracts who have offered and paid unheard-of wages. One of the latest examples is a Liberty motor contractor coming to New York and offering $1.10 an hour for gage and tool makers. This naturally demoralized the gage makers in New York to some extent, and as many of them are on war work it makes it unfortunate all around.

We sometimes fail to realize just what this sort of thing does to the country as a whole. It takes men from the kind of work with which they have become very familiar; it congests the railroads with unnecessary travel; it disturbs housing conditions in both places, and it makes men uneasy in all lines of industry. It is difficult to talk about the patriotic duty of a man sticking on his job when we offer some other man a big advance in wages to go somewhere else on work that is equally important.

The result of all this has been the formation of a plan, which is scheduled for adoption as soon as the details can be arranged, for a standardizing of wages and the distribution of labor by means of the newly organized Public Service Employment Service. Just how the wage question will be handled has not been announced, but the matter is under careful consideration and is likely to be announced in the near future. The impression is that wage rates will be arranged according to districts so as to cover certain conditions, and that maximums instead of minimums will be designated. Some compensation must also be considered for men who must travel several miles a day to get to their work.

It must also be remembered that no arrangement which only includes the shopman is going to be satisfactory. The same principle must apply to executives, and one firm must not be able to offer a superintendent an enormous salary in order to get him away from some other shop. Mr. McAdoo has given us a good precedent in this respect by limiting the salary of railroad presidents or managers to $15,000 a year. The man in the shop is sure to feel that he is discriminated against if his superintendent can be hired away at a huge salary while he must accept the standard wage and stick on the job.

The placing of all men through the United States Employment Service is going to be a terrific problem, but all can see the advantages of having labor handled through a central organization. This can be made a great advantage, but it must be remembered that thoroughly competent employment managers are hard to find, largely because we have paid too little attention to this important subject for so many years. We have been content to put the whole thing in the hands of a $15-a-week clerk and have not realized how important the problem was.

Such a plan is sure to develop many flaws in its actual working out, due in most part to the human element which we have to encounter in every enterprise. There are sure to be charges of preference in the supplying of certain plants with men and some of these charges are pretty sure to be justified. But we all realize that something of this kind is absolutely necessary if we are to get the best results from our available manpower, and we must do all we can to help it rather than to hinder it by useless criticisms and objections. Helpful criticisms should be made freely and will, I am sure, be welcome, for the Labor Policies Board is headed by a remarkably able man, Felix Frankfurter, and he is gathering a group of coworkers who give promise of doing all that is humanly possible. But let us be sure that we do not expect the impossible.

Naval Architecture Course

A special short course in naval architecture of not less than six weeks is offered by six coeducational universities and technical schools in the United States. The course is given at the suggestion of the United States Civil Service Commission in order to increase the supply of ship draftsmen so needed by the Government at the present time. It is open to senior students in technical courses or graduates of technical schools. After six weeks of intensive training the graduates will be eligible for the lowest grade of ship-drafting position under the Navy Department. The plan is to develop them in the Government drafting rooms. Universities and schools are urged by the commission to open this course to women, since it is largely to the women that the Government must look to supply the increasing demand for ship draftsmen. The schools which now offer such a course in naval architecture are: Massachusetts Institute of Technology, University of Michigan, Pennsylvania State College, University of California, University of Washington and University of Texas.

Personals

Philip T. King, assistant sales manager of J. N. Kinney, 30 Church St., New York, locomotive and traveling cranes, has joined the national service.

S. H. Reck, formerly with the Greaves-Klushman Tool Co., Cincinnati, Ohio, is taking up Y. M. C. A. work in France. Mr. Reck has two sons in active army service.

John Parker, formerly efficiency engineer of the Cincinnati-Bickford Tool Co., has accepted a position with the Spencer-Smith Machine Co., Howell, Mich., as factory manager.

William A. Viall of the Brown & Sharpe Manufacturing Co., Providence, R. I., had the degree of Master of Arts conferred upon him by Brown University at the commencement exercises May 29, 1918.

A. W. Milligan has resigned as general foreman of Section B of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, to accept a position with the Canadian Westinghouse Co., Ltd.

W. N. Dickinson, president of the Standard Plunger Elevator Co., Worcester, Mass., has resigned to join the progress section of the control bureau, Ordnance Department, U. S. A., Sixth and B Sts., Washington.

V. F. Signorelli, formerly secretary and assistant treasurer of the Southwark Foundry and Machine Co., Philadelphia, is now office manager and auditor of the Foundation Co.-Carpenter-Watkins, Inc., Brunswick, Ga.

C. H. Froelich, for several years in charge of designing field artillery at the Bethlehem, Penn., plant of the Bethlehem Steel Corporation, has been commissioned a major in the Ordnance Reserve Corps of the United States Army.

George W. Agerter, formerly with the Hunter Saw and Machine Co., later with the Pittsburgh Saw and Manufacturing Co., is now connected with the Ludlum Steel Co. Watervliet, N. Y., and will represent the company in the Pittsburgh district in the sale of its tool steels.

W. P. F. Ayer, vice president of the Walworth Manufacturing Co., Boston, was one of the speakers at the annual meeting of the National Pipe and Supplies Association at Cleveland May 13 and 14. His address covered present conditions in the fittings and valve industry.

Thomas R. Brown, engineer, Pittsburgh, Penn., was recently appointed administrative engineer for the Fuel Administration. **C. P. Billings** was made special staff assistant. These appointments are in connection with the program for fuel conservation through economies in operation methods.

Charles A. McCune has resigned his position as chief engineer of the Commercial Acetylene Co. to become sales engineer with the Page Steel and Wire Co., 30 Church St., New York, where his efforts will be devoted to sales and service in connection with Armco welding rods.

August Mertes, for a number of years superintendent of the works of the Pittsburgh Machine Tool Co., Braddock, Penn., has resigned his position to accept a similar one with the Bradney Machine Co., Middletown, N. Y., builder of locomotive cranes, elevating machinery and machine-shop tools. **James Weeks,** formerly with the Union Switch and Signal Co., has been appointed to succeed Mr. Mertes.

Charles A. Adams has recently completed 50 years' service with the John B. Varick Co., Manchester, N. H. For 43 years he has been manager of this hardware jobbing house. He has been presented by Thomas Rice Varick and Richard Varick in commemoration of this business record with a solid-silver service of five pieces, with a kettle to match and a solid-silver server. He was also the recipient of a gold watch and chain from the New England Iron and Hardware Association, of which he has been president for the past two years. Mr. Adams is also president of the Elliot Manufacturing Co., Manchester.

M. C. Robbins has resigned as general manager and director of the "Iron Age" and has secured control of the "Gas Age" and "Brown's Directory of American Gas Companies" through the purchase of the stock of the Progressive Age Publishing Co., New York, of which he will be president and treasurer. **E. C. Brown** will continue as editor of the "Gas Age." Mr. Robbins is a civil engineer by education and served eight years on the staff of the "Engineering News" as manager of the western office in Chicago. He joined the "Iron Age" seven and one-half years ago.

M. C. Turpin, formerly assistant to the manager of the Westinghouse department of publicity, Pittsburgh, has resigned to enter federal service as assistant to the manager of the technical publicity bureau, Ordnance Department. His work is to disseminate information from the War Department among manufacturers through the medium of the trade press. He is a graduate of the Alabama Polytechnic Institute and of Cornell University. After several years' experience in the construction and operation of central-station plants he entered the Westinghouse department of publicity in 1909. He is an associate member of the American Institute of Electrical Engineers and the National Electric Lamp Association, and a member of the Pittsburgh Press Club, the Pittsburgh Ad Club and the Illuminating Engineering Society.

Obituary

Albert W. Gifford, 82 years old, vice president of the Standard Screw Manufacturing Co., Worcester, Mass., died at his home in Worcester last week.

Ralph W. Wight, treasurer of the Chapman Valve Manufacturing Co., Indian Orchard, Mass., died of pneumonia May 20 in a New York hospital. He was a prominent citizen of Springfield, Mass., having served as president of both branches of the City Council and having been active in the work of commercial and civic associations.

Larz Worthington Anderson, former president of the Cincinnati Shaper Co., died May 27 as the result of a throat operation. He was 51 years old. Since retiring from business he had devoted most of his time to patriotic work, taking great interest in the Y. M. C. A. He was a great grandson of the first Nicholas Longworth, and was a graduate of Stevens Institute of Technology, Hoboken.

Business Items

The Dale-Brewster Co., of Chicago, has leased for a long term of years the ground floor and basement at Clinton St. and Washington Blvd. (Machinery Hall), for machinery sales and display room.

The Curtiss Airplane and Motors Corporation, Buffalo, N. Y., recently held its annual meeting and elected the following officers and directors: Glenn H. Curtiss, chairman of the board of directors; John North Willys, president; James E. Kepperley, vice president and general manager; C. M. Keys, vice president; E. C. Morse, vice president; W. W. Moss, vice president and comptroller; B. A. Guy, secretary and assistant general manager; J. F. Prince, treasurer; H. M. Root, assistant comptroller; J. J. Donahue, assistant treasurer; J. F. Weber, assistant secretary. The board of directors consists of Glenn H. Curtiss, C. H. Conners, Harry Evers, B. A. Guy, C. M. Keys, James E. Kepperley, W. A. Morgan, W. W. Moss, F. H. Russell, J. Allan Smith, G. C. Taylor, J. N. Willys, Rodman Wanamaker, W. B. Stratton and J. A. D. McCurdy.

Catalogs Wanted

The Wright Martin Aircraft, tool designing department, Long Island City, desires catalogs from various machine-tool companies.

Parr Terminal Co., Wilfred N. Ball, engineer, 225 First National Bank, Oakland, Calif., wants catalogs and other data from manufacturers of materials or equipment used in the construction of piers, warehouses, industrial buildings, belt-line railway and street work and cargo-handling equipment; coal bunkering and handling equipment; floating-drydock and marine-railway equipment; general shipyard machinery and equipment.

Trade Catalogs

Buffalo Forges. Buffalo Forge Co., Buffalo, N. Y. Catalog, Section 100. Pp. 112; 5 x 7½ in. It illustrates, describes and gives the weight and prices of forges, blowers and tuyere irons.

Stewart Furnaces. Chicago Flexible Shaft Co., 56th Ave. and 12th St., Chicago, Ill. Circular illustrating and describing various furnaces, forges and rivet heaters manufactured by this concern.

The D. & H. Universal Grinder. The Draper & Hall Co., Middletown, Conn. Circular. Pp. 6; 5¾ x 9 in. Halftone illustrations are given showing the grinding machine, also the work done and attachments used.

Satisfaction or ———. Armstrong Cork and Insulation Co., Pittsburgh, Penn. Folder. Pp. 4; 3½ x 6½. This folder deals with the subject of industrial drinking water systems and will be supplied free of charge upon request.

New Departure Ball Bearings. New Departure Manufacturing Co., Bristol, Conn. Data sheets. Pp. 12; 8½ x 11 in. This is an issue of the monthly-bulletin service and contains a revision of descriptive and dimensional data. They are to replace sheets Nos. VII, IX, XI, XIII, and XV.

System in Trucking. The Stuebling Truck Co., Cincinnati, Ohio. Catalog. Pp. 32; 7¾ x 9¾ in. This work illustrates how modern factory trucking is done. Every page contains a description of the Stuebling lift truck, and its construction and appointment to factory production and handling.

Wetmore Cutting Tools for Shell Manufacture. Wetmore Mechanical Laboratory Co., Milwaukee, Wis. Leaflet. Pp. 6; 8½ x 11 in.; illustrated. The products covered in this leaflet are special hand-sized taps for United States and British shells, expanding reamers for finish-sizing fuse holes of shells, and special lathe and boring tools.

Imperial Welding, Cutting, Carbon-Burning and Head-Burning Equipment. The Imperial Brass Manufacturing Co., 1200 West Harrison St., Chicago, Ill. Catalog No. 142. Pp. 36; 6¾ x 10 in. This catalog describes the oxyacetylene and oxyhydrogen process and shows various outfits, torches regulators, accessories, etc.

Melting Points of Chemical Elements and Heat Color Scale. The Brown Instrument Co., Philadelphia, Penn. A very interesting chart showing the melting points of chemical elements, together with a heat color scale. This includes 50 elements, from nitrogen to carbon, and should be found useful in various kinds of heat-treating work.

Hilo Military Enamels. Moller & Schuman Co., Marcy and Flushing Aves., Brooklyn, N. Y. Bulletin No. 5. Pp. 6; size 5 x 8 in. This bulletin shows a number of standard shades of enamel used in particular work such as ordnance, airplane, automotive precision instruments, etc. A shade of gun finish and military bronze is also shown.

Red (E) Tools. The Ready Tool Co., Bridgeport, Conn. Quick Reference Catalog No. 16. Pp. 32; 4 x 6 in. This catalog illustrates and describes toolholders for various machines and uses also lathe, milling, grinding, hold-back and brass-faced dogs, belt sticks, vise hold-downs and high-speed cutters. It will be sent upon request to anyone interested.

Standardized Boston Gears. Boston Gear Works, Norfolk Downs (Quincy), Mass. Catalog F-8. Pp. 96; 3½ x 6 in. This catalog describes and gives prices of the various standard forms of gears manufactured by this company. It also describes gear gages, pinion wire racks, worms, wormwheels, chain, sprockets, universal joints, ball bearings and pulleys. A number of useful formulas and tables are included.

Lakewood Industrial Haulage-Trackless System. The Lakewood Engineering Co., Cleveland, Ohio. Bulletin No. 25. Pp. 24; size 8½ x 11 in. Illustrating and describing Lakewood-Galion tractor, storage-battery trucks, factory trucks and trailers for factories, railway terminals and industrial enterprises. Bulletin No. 32, pp. 8, same size, illustrating and describing the Lakewood Universal mixer, is also ready for distribution.

The Helix. Greenfield Tap and Die Corporation, Greenfield, Mass. This is the first number of the company's new factory magazine issued for the benefit of its employees and will be published monthly. It is 16 pages and contains many interesting shop notes, view of the factory, news from the boys at the front and personals of many of the employees. This magazine is in charge of J. T. Sellers, secretary of the corporation and head of the welfare department.

The Tilted Turret. Wood Turret Machine Co., Brazil, Ind. Catalog. Pp. 40; $8\frac{1}{2}$ x $11\frac{1}{2}$ in. This is a catalog of a full line of the tilted-turret screw machines, turret lathes, brass-working machinery and extra-capacity automatic chucking turret lathes. Illustrations and specifications of various types of screw machines and turret lathes are shown as well as cuts detailing construction. Part of the catalog is given to tooling equipment and various other equipments that can be furnished with or applied to the tilted turret.

New Publications

Pocket Signal Chart and Booklet of Signaling Instructions—Published by Army and Navy Signal Publishers. Boston, Mass. Price 15c.

This is a pocket signal chart which is accompanied by a booklet of Signaling Instructions, including the semaphore and the international Morse code, in accordance with the United States Army and Navy system. It is a convenient method of learning signaling and should be particularly useful to those who are about to enter the service. The same company also published United States Navy and Merchant Marine Service Chart, covering the use of flags, and also the two-arm semaphore code. This sells for 25c., and in combination with the one previously mentioned should enable one to readily learn the foundation of all signaling.

Advertising—By E. H. Kastor. Three hundred seventeen $5\frac{3}{8}$ x $8\frac{1}{4}$ in. pages; 52 illustrations; limp leather binding. Published by LaSalle Extension University, Chicago, Ill.

This is an attractive, well-arranged book, intended primarily for the average busy man who has to do more or less with advertising and who wants to know something about the various phases of the subject. It contains the kind of information that such a person will find helpful and profitable to know, especially in planning and placing his advertising. The expert advertiser may also find in it a number of very helpful suggestions and sidelights. The author has been in the advertising business for 20 years, and has gone through all the positions from copy man to layout man, idea man, plan man and campaign man. His advertising knowledge is backed by wide experience as traveling salesman, merchandising man and sales manager. Commencing with the simpler forms the book is packed full of examples of successful advertising that will fit almost any occasion. The problems are viewed from every angle, and directions given for their solution. An attractive feature of the book is the space devoted to descriptions of the process of making the various kinds of cuts used in advertising. Altogether the book seems to fulfill its mission in an unusually satisfactory manner.

The Modern Gasoline Automobile—By Victor W. Page. One thousand thirty-two $5\frac{1}{2}$ x $8\frac{1}{2}$ in. pages, 725 illustrations and nine large plates or charts. Published by Norman W. Henley Publishing Co., 2 West 45th St., New York City. Price, \$3.

This is a new and revised edition to which considerable matter valuable for reference, has been added. Among the new or elaborated subjects are those relating to ignition, the action of generators and the basic principles on which they operate, tractors in the three- and four-wheel types, cycle cars, agricultural tractors or automobile plows, combination gasoline-electric drive, front-wheel and four-wheel drive and steering systems, and many other important developments in power-propelled vehicles. The discussion of power-transmission methods has been augmented by consideration of the skew-bevel gear and two-speed, direct-drive, rear axle, as well as several forms of worm-gear drive. The subject of electrical motor starting systems is dealt with, and the leading systems and their components described. A discussion on ball and roller bearings, their installation and maintenance has also been included. Other interesting matter has been included regarding the latest types of gasoline and kerosene carburetors, cycle-car power plants, the Fischer slide-valve motor, detachable wire wheels and the like. As a reference book for libraries, the engineer, the up-to-date mechanic, the designer, and all others interested in the subject, the book is invaluable. It is also considered to be of value as a textbook on elementary automobile engineering for classes in technical or automobile schools.

Aircraft Mechanics' Handbook—By Fred H. Colvin. 402 pages; 5 x 7 inches; 193 illustrations. Published by the McGraw-Hill Book Co., New York. Price \$3 net.

This is a collection of such information in regard to airplanes, their construction and repair as is believed to be of real service to the thousands of mechanics whose duty it is to keep them in first-class flying condition in the training camps and in the flying fields of France. This information has been carefully gathered from various sources, such as the experience of the Royal Flying Corps of Great Britain, the airplane motor factories and the various articles which have appeared in the "American Machinist" and other technical publications during the past year. The data include the principles of the airplane construction, points out the essential features of the airplane motor, shows how it is constructed, overhauled and kept in repair. The book contains a large number of special illustrations and articles, such as those showing how the Gnome and other motors are assembled, overhauled and put together again for further use. The experience of airplane-motor builders has been largely drawn upon, and the personal observations of the writer in the different factories and the flying fields are also included in the book. The information is written in such a way as to be readily understood by the average mechanic, and it is difficult to see how any one connected with airplane construction or repair could fail to find much of interest and value in this volume.

Plane Trigonometry—By Eugene Henry Barker, head of the department of mathematics, Polytechnic High School, Los Angeles, Calif. One hundred and seventy-two 6 x 9 in. pages; 86 illustrations; cloth. Published by P. Blakiston's Son & Co., 1012 Walnut St., Philadelphia, Penn. Price \$1.

This book is for the use of students and others beginning the study of trigonometry, and sets forth clearly and simply the various laws and principles involved. Where illustrative examples are used all of the necessary steps in the solution are presented, which is often a great help to the elementary student. Quite a number of exercises are included and practical problems have been used. Answers to all exercises are placed together near the back of the book. Logarithms are rather fully described, and five-place tables of logarithms of numbers from 100 to 1000 and logarithmic functions in steps varying by minutes are included. Four-place tables of natural sines, cosines, tangents and cotangents are also given. These are in steps varying by one minute. Another handy feature of the book is a collection of formulas for use in algebraic trigonometry.

The chapter headings are as follows: I, The trigonometric functions—definitions—notation; II, Solution of right triangles—applications; III, Functions in terms of other functions; IV, Angles in general; V, Functions of sum—difference—double and half angles—sums and differences of functions; VI, Oblique triangles—laws of sine, cosine, tangent, etc.: VII, Solution of oblique triangles—applications; VIII, Areas of triangles; IX, Algebraic trigonometry—radian, circular measurement—inverse functions—transformations—trigonometric equations; X, Tables—explanations—applications.

Finding and Stopping Waste in Modern Boiler Rooms—By Engineers of the Harrison Safety Boiler Works, Philadelphia, Pa.; limp cloth; 9 x 7 in.; 276 pages; 213 illustrations. Price, \$1.

The saving of coal is the purpose of this little handbook, which is addressed to power-plant owners, managers, engineers and firemen. The preface says that the statements, tables, charts, etc., used were carefully selected and are supported by experiments and tests, references being given wherever possible to the original authorities.

The work is divided into five sections, the first of which is about fuels, under which are considered the coals of the United States and their classifications, size of coal, coal sampling, proximate analysis, ultimate analysis, heating value of coal, ash and clinker, value of coal for steaming purposes, purchase of coal under specification, washing of coal, storage and weathering of coal, coal measurement, oil fuels and gaseous fuels.

The second section is on combustion, taking up the chemistry of combustion, air theoretically required, grates and grate surface, hand-firing methods, thickness of fire, mechanical stokers and their operation, furnace temperature, furnace gases, clinker draft, flue and stack proportions, draft required by stokers, mechanical stokers, draft gages, dampers, flue-gas temperatures, flue-gas analyses, CO_2 recorders, what CO_2 indicates, what CO indicates, air requirements and supply, prevention of excess air, smoke and smoke prevention, burning oil fuel, burning gaseous fuels and burning powdered coal.

The third section treats of heat absorption, including heat transmission by conduction, convection and radiation, heat transfer from a fluid in a channel, heat transfer in economizers, air heaters and superheaters, improving heat absorption, relation between heating surface and boiler capacity, boiler setting, refractories and fire brick, soot, scale, softening feed water and feed-water heating.

The fourth section on boiler efficiency and boiler testing covers heat balance, heat absorbed by boiler, heat losses due to moisture in the coal, hydrogen, chimney gases, CO, combustible in the ash, moisture in the air and unaccounted for loss, efficiencies, efficiencies with different coals, boiler capacity and efficiency and boiler trials.

The fifth section on boiler-plant proportioning and management discusses various arrangements of auxiliaries with regard to their effect upon feed heating, and also describes the Polakov functional system of boiler room management.

Forthcoming Meetings

The annual convention of the American Drop Forge Association will be held at 10 a.m. on June 20, 1918, at the reserve hall of the Iroquois Hotel, Buffalo, N. Y. E. B. Home, 1516 Helen Ave., Detroit, Mich., is the secretary.

American Society of Mechanical Engineers. Monthly meeting, second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

The American Society for Testing Materials will hold its twenty-first annual meeting at Atlantic City, N. J., June 25-28, with headquarters at the Hotel Traymore. The permanent headquarters of the secretary-treasurer are under the name of the society, Philadelphia, Penn.

Boston Branch National Metal Trades' Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers, 29 West 39th St., New York. Summer meeting to be held at Dayton, Ohio, June 17-18. Complete war program, at least half of it being devoted to the actual demonstration of war apparatus. All meetings will be held at Triangle Park, a dinner being served Monday evening and luncheons each noon. Reservations may be secured at hotels Miami, Holden, Algonquin, Phillips and Bechel, or by writing the Dayton S. A. E. Committee, 137 North Ludlow St., Dayton, Ohio.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

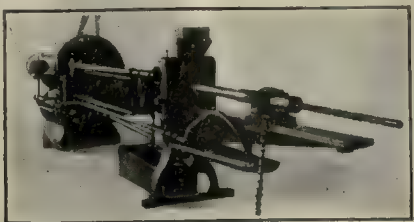
Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Broaching Machine for Gun Barrels
J. B. Lapointe Co., New London, Conn.



"American Machinist," May 30, 1918

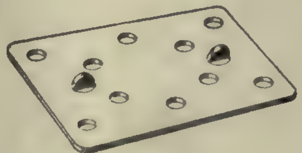
For broaching the rifling in one-lb. gun barrels, the work being accomplished in two operations, roughing and finishing. The work is 44 in. long and there are 12 helical grooves approximately 0.015 in. deep with a right-hand twist of one turn and 40 in. A master bar is used which operates through a spiraling block, causing the broach to rotate, the gun barrel being held rigid. A large supply of lubricant is used to wash away the chips and insured smooth cutting.

Tractor, Electric
Industrial Truck Co., Holyoke, Mass.
"American Machinist," May 30, 1918

This truck is made with either two- or four-wheel drive and with either end or center control. Length over bumpers, 87 in.; width over all, 40¾ in.; wheelbase, 40 in.; tread, 30 in.; height of platform, 26 in.; ground clearance, 4¼ in.; gearing, single reduction; tires, 20 x 3½ in.; steer, four wheel; turning radius of outside wheel, 56⅞ in.; turning radius of outside corner, 63¾ in.; speeds, four forward and four reverse, five miles per hour with a trailer load of 20,000 lb. and seven miles per hour with empty trailers; motor, 5 hp.; springs, coil type, four in number; weight without battery, 2400 lb.

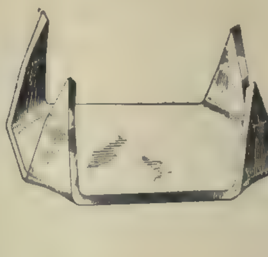
Belt Fastener, "Ideal"
W. O. & M. W. Talcott, 91 Savin St., Providence, R. I.
"American Machinist," May 30, 1918

The "Ideal" belt fastener that is used for rubber canvas, balta and textile belts. It is used either between the layers of the belt or on the side of the belt away from the pulley. When used on the outside of the belt the fasteners are curved somewhat to conform to the pulley. These fasteners are secured to the belt by means of rivets, and two small lips shown prevent the fastener from moving out of place.



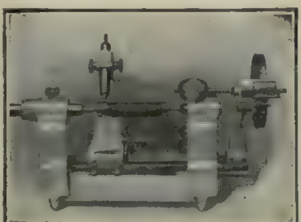
Belt Hooks, "Acme"
W. P. & M. W. Talcott, 91 Savin St., Providence, R. I.
"American Machinist," May 30, 1918

The illustration shows one of the "Acme" steel belt hooks, which are for leather, rubber or canvas belt. The construction is such that when the hooks are driven into the belt the edges are drawn tightly together, after which the points are bent over with a hammer. Both styles of belt fasteners are made in a number of sizes to meet various conditions and sizes of belts.



Thread-Lead-Testing Machine
West & Dodge Co., 167 Olive St., Boston, Mass.
"American Machinist," May 30, 1918

To test the lead of threads the contact point is placed in position in one of the threads and the micrometer spindle adjusted so that the dial indicator points to zero. The point is then moved along a number of threads and micrometer readings taken. Drunken threads are detected by turning the gage partway around and again measuring. The dial indicator is not used for obtaining the actual measurements, but only to show the correct amount of pressure to apply on the micrometer spindle. The large graduated wheel gives readings to 0.0001 in. if desired and a solid plug can be used in place of the indicator spindle and Johansson blocks used between contact points on the base.

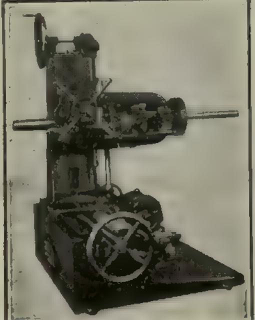


Starter, Automatic for Direct-Current Motors
Westinghouse Manufacturing Co., East Pittsburgh, Penn.
"American Machinist," May 30, 1918

Especially adapted for starting direct-current motors of 10 hp. and under. The complete mechanism is inclosed in a dust-proof case approximately 15 in. high, 17 in. long and 10 in. deep, which may be locked to prevent tampering. The line switch, which is of the knife type, is operated from the outside of the case by a crank handle extending through one end, and the switch may be locked in either off or on position. The counter em.f. method of acceleration is used. For ordinary work two points of acceleration are maintained, but where exceptionally heavy loads are carried, three points are used. Provision is made for protection against failure of power, and may be so arranged that the motor will be restarted when the power returns or so that this will require the services of an operator. Built with or without provision for dynamic breaking or field rheostat for adjustable-speed service.

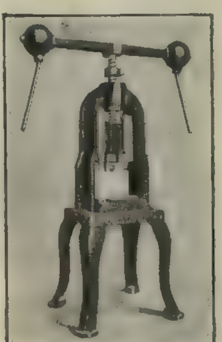
Drilling, Boring and Tapping Machine
Rockford Drilling Machine Co., Rockford, Ill.
"American Machinist," May 30, 1918

Diameter of spindle, 2$\frac{1}{16}$ in.; spindle travel, 25 in.; diameter of spindle sleeve, 3⅜ in.; feeds per revolution of spindle, seven, 0.005, 0.007, 0.010, 0.014, 0.020, 0.030 and 0.040 in.; hole in spindle, No. 5 Morse taper; drive slot in end of spindle, ⅝ x ⅝ in.; spindle speeds with three- or four-step cone, 9 to 245 r.p.m.; spindle speeds with two-step cone, 30 to 185 r.p.m.; spindle speeds with gear box, 30 to 250 r.p.m. Can be made in other sizes on special order if desired.



Press, Screw No. 2
Moore & Co., Grand Ave. and Franklin St., Chicago, Ill.
"American Machinist," May 30, 1918

Weight, 1978 lb.; standard opening in bed, 8 x 8 in.; width between uprights, 16 in.; width between gibs, 7½ in.; distance from bed to slide without bolster plate and with slide up, 12 in.; maximum movement of crosshead, 8¾ in.; face of crosshead, 7 x 8 in.; square hole in slide for punch shanks, 2 in.; top of bolster plate, 15½ x 15½ in.; thickness of bolster plate, 2 in.; diameter of steel screw, 3 in.; pitch of thread on screw, 1 in.; length of operating lever, 60 in.; weight of lever with two balls, 325 lb.; height of press with slide up, 84 in.; floor space of legs, 30 x 35 in.



Patent Applied For

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	$.....
No. 2X, New York	34.25	.....	47.00
No. 2 Northern Foundry, Chicago	33.00	37.00	50.00
*Bessemer, Pittsburgh	36.15	37.25	55.95
*Basic, Pittsburgh	32.00	33.95	50.00
No. 2X, Philadelphia	34.25	33.75	46.75
*No. 2, Valley	33.00	33.95	50.00
No. 2 Southern Cincinnati	35.90	35.90	42.90
Basic, Eastern Pennsylvania	32.75	33.75	42.50

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.195	$4.195	$5.00	$4.20	$5.00	$4.20	$5.00
Soft steel bars	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Soft steel bar shapes	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Soft steel bands	4.945	.....	....	....	....	....	....
Plates, ¼ to 1 in. thick	4.445	4.445	8.00	4.20	7.00	4.45	8.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.25
Warehouse, New York	4.70	4.60
Warehouse, Cleveland	4.10	4.45
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
*No. 28 black	5.00	6.445	6.445	9.50	6.385	8.25	6.45	8.50
*No. 26 black	4.90	6.345	6.345	9.40	6.285	8.15	6.35	8.40
*Nos. 22 and 24 black	4.85	6.295	6.295	9.35	6.235	8.10	6.30	8.35
Nos. 18 and 20 black	4.80	6.245	6.245	9.30	6.185	8.05	6.25	8.30
No. 16 blue annealed	4.45	5.645	5.645	9.20	5.585	7.95	5.65	8.70
No. 14 blue annealed	4.35	5.545	5.545	9.10	5.485	7.85	5.55	8.60
No 10 blue annealed	4.25	5.445	5.445	9.00	5.385	7.75	5.45	8.50
*No. 28 galvanized	6.25	7.695	7.695	12.00	7.695	10.00	7.70	10.50
*No. 26 galvanized	5.95	7.395	7.395	11.70	7.335	9.75	7.40	10.20
No. 24 galvanized	5.80	7.245	7.245	11.55	7.185	9.55	7.40	10.05

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 10%	List plus 25%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	30%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Current	One Year Ago
New York	$15.50–19	$20.00
Cleveland	15.00	12.30
Chicago	17.00	12.00

In coils an advance of 50c. usually is cha

Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	22.10 to 33.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

*Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.00
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel (heavy)	7.50	8.00	7.50
Spring steel (light)	11.00	11.25	11.00
Coppered bessemer rods	9.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel	8.50	8.25	8.50
Floor plates	6.19½	6.00	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	41.9%	26.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	37.9%	23.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	34.00
Tin, in 5-ton lots	91.00	85.00	61.00
Lead	7.25	7.25	12.00
Spelter	7.50	7.50	9.25

*Government price.

ST. LOUIS

Lead	7.10	7.10	12.00
Spelter	7.25	7.25	9.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper sheets, base	32.50-33.00	32.00	42.00	34.00	42.00	32.50	42.50
Copper wire (carload lots)	31.00	32.00	39.50	34.00	39.00	32.00	40.00
Brass sheets	31.75	30.75	45.00	30.00	41.00	30.00	43.50
Brass pipe base	36.50	36.50	47.50	41.00	48.00	40.00	47.50
Solder ½ and ½ (case lots)	62.00	62.00	39.75	62.00	39.50	70.00	39.50

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	38.00
Chicago	28.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 15.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	18.75	21.00	18.40	21.50
New York	16.50	23.00	17.00	23.25
Chicago	21.00	22.50	21 50	23.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	12.50	30.00
Chicago	13.50	28.00
Cleveland	15.00	27.50


THEY CALL THEM DEVIL-HOUNDS
BUT THEY ARE SIMPLY
HOUNDING
THE DEVIL
OUR MARINES
Victor Gerard

Training Men Instead of Stealing Them

BY FRED H. COLVIN

The shortage of skilled labor will never be successfully overcome until a foresighted policy has been adopted by those depending upon labor—which means all manufacturers. One of the concerns to recognize what this shortage really means is the Norton Grinding Co., Worcester, Mass., which through John C. Spence, its superintendent, has established a training shop to develop skilled mechanics in a modern way.

IN ALL the agitation regarding labor turnover and amid all the accusations regarding the stealing of men by competing employers we hear very little about efforts to increase the supply of labor. The reaction from the old apprenticeship days still exists in most places, and too many manufacturers are still perfectly willing to let the other fellow train his men, depending upon inducing them to leave later. There are of course several notable exceptions to this, but they have not been sufficiently numerous to greatly increase our supply of skilled mechanics and they have altogether failed to keep pace with the new demands. The sudden expansion of the automobile industry inaugurated the first great labor-stealing drive, and the demands of the past three years have added fresh laurels to the record of unstable labor. But in spite of all the present needs comparatively few seem to be seriously considering the training of new men instead of devising ways and means of getting them away from some other manufacturer. Needless to say this does not add to the productive capacity of the country, but actually decreases it, besides adding to transportation and housing difficulties.

Among those who are attacking the problem from its proper end and who see the necessity and the advisability of building up a working force of their own is John C. Spence, superintendent of the Norton Grinding Co., Worcester, Mass. Realizing the scarcity of skilled mechanics throughout the country and the necessity of increasing the supply in the shortest time, Mr. Spence some time ago—December, 1915, to be exact—organized a shop training school with an eight-weeks' course, and it has proved so successful that he is contemplating enlarging it as quickly as possible.

Realizing that the foreman in the modern busy shop has little time for instructing green help he started a separate training school, or shop, comprising over 6000 sq.ft. in the gallery of one of the buildings. It has its own toolroom, washrooms and toilets, is entirely separate from the rest of the shop and contains the following equipment:

17 lathes	3 upright drilling machines
2 vertical milling machines	2 sensitive drilling machines
3 horizontal milling machines	1 floor grinding machine
1 hand-milling machine	2 arbor presses
3 universal grinding machines	1 straightening press
1 shaping machine	1 gas furnace
130 ft. of benches	

This equipment handles 40 men, with the necessary instructors, and is now graduating about five men a week into regular shop work. This has been so successful that over half of the men so trained have been hired by other local firms, which is one of the best proofs of their desirability. Several of the boys with only four months' training have been accepted in the navy as second-class machinists. Another product of the school shop is now foreman of the toolmakers on the night shift and is one of the best toolmakers in the shop. The interesting part is that prior to December, 1915, he had no shop training whatever.

As fast as the men are sufficiently trained they are placed in positions that are open in the shop, each foreman keeping the school informed as to his needs. This does not mean that every student serves a given length of time in the school, as this depends upon the natural aptitude of the man or boy and of course upon the kind

of work to which he is best adapted. In some instances a few days have sufficed to give the necessary start, while on the other hand some have been kept in the school for several months.

The wages paid are attractive enough to secure a good class of learners, and run from 17c. to 20c. an hour for boys of no previous experience to 35c. an hour for men who have been in other lines of work, such as driving grocery teams or shipping work. Few men have been found who did not earn up to their day rating after they got out into the shop and the average has been about 10c. an hour over this rating. This is looked after very closely to know how the cost of training works out and also to keep tabs on the efficiency of the training itself. As each man goes from the school into the shop notification is sent to the cost department, which starts a special record. This is maintained for six months in order to find out the exact earnings of these men and to see how they compare with skilled men of long training when working at regular shop work and at piece prices which have long been established. The fact that Mr. Spence is seeking to enlarge his school speaks volumes for the results he has secured.

The success of this plan depends very largely in obtaining the right kind of teachers and in securing co-operation with the shop. The foreman must be shown that his work is not being taken away, but rather that he is being relieved of a part of his duties so that he will have more time for that which will make him more valuable to the company—the purely executive side of the job. Then too the student must be made to feel that the school is not simply a mill to grind out as many men as possible for the sole benefit of the shop, but he must be shown how it makes him much more valuable to himself and to the community. To prevent the student becoming discouraged after getting out into the shop the chief instructor still continues to keep in touch with him frequently for several weeks. To the new man this is a source of encouragement when things do not go exactly as he would like.

The Points To Be Remembered

Mr. Spence sums up the situation in the following pithy paragraphs:

1. Few men have the faculty to teach. Often the best workmen is the poorest teacher. Hence, it is easier to find one teacher and let him do the bulk of this work.

2. The press of output prevents a foreman from giving proper attention to beginners even if the foreman happens to be a good teacher.

3. It does not pay to have a high-class executive foreman spend time on a beginner any more than a professor of mathematics in a college could afford to put his time into first-grade work. In fact, in most cases he would probably lack the real qualifications for first-grade work, i.e., patience and human insight.

4. Unless the schooling is centralized the corporation cannot readily carry out a fixed policy with regard to teachings other than mechanical, i.e., questions pertaining to honesty of product, citizenship, etc.

5. The influence on the future attitude of these men toward each other and toward industry depends largely on the impression made on them at the start. This should be controlled as far as possible.

6. In a school the beginner is sure of a variety of work, whereas the tendency in the shop is to give the beginner such a dose of whatever simple work he can do that he will not disturb the foreman again for some time, or as the boys say, enough to "hold him for a while."

7. The training probably costs less in the school than in the shop. Although apparently not, as the true cost in the shop is almost always buried in departmental expense, it is there just the same.

As there is nothing like ocular demonstration we are very glad to present a number of illustrations from the training school in this shop. The headpiece shows a class taken not long ago, the ages of the students ranging from 16 to 60 years, and the occupations previously followed vary in about the same proportion as the ages of the students vary. Some of the occupations are shown in detail in the illustrations.

The businesslike appearance of the school shop is shown in Figs. 1 and 2, the latter showing assembling work of various kinds. Six weeks before this was taken the last man at the bench was running his own butcher shop, but the uncertainty of the business in these times led him to leave it for a chance to get into shop work.

Some Visible Proofs of Success

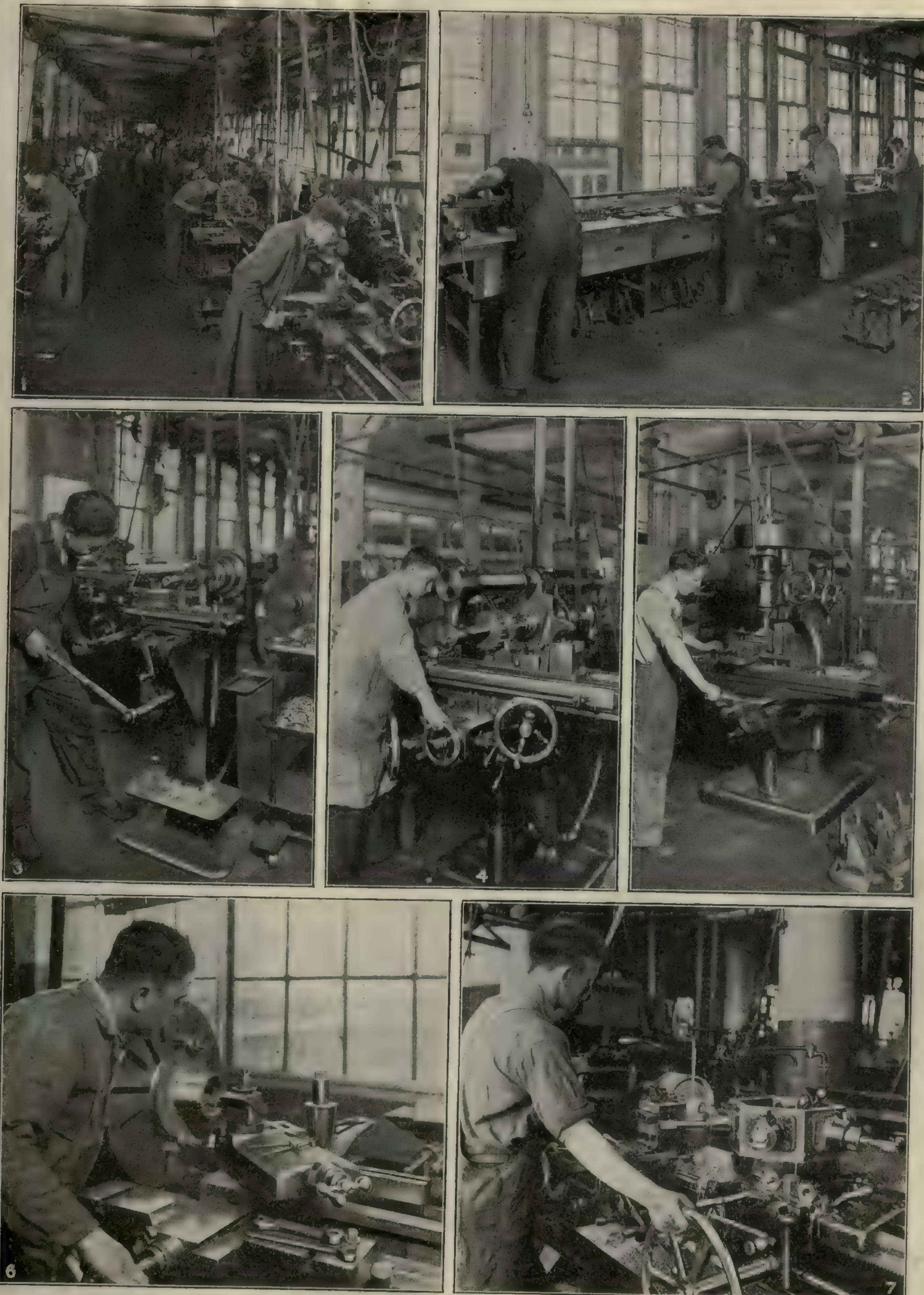
In Fig. 3 is a 16-year-old boy who after spending nine weeks in the shop school can handle very creditably any simple machine operation. He had no previous experience. Another bright boy is seen in Fig. 4. This lad is 17 years old and spent eight weeks in the school, with the result that he can now make such tools as taper reamers from start to finish. Fig. 5 shows a man with no previous machine experience, who had worked at plumbing and had driven a team. With two weeks' training in the school shop he is milling a grinding machine back-rest body and can handle any similar work.

A more complicated job is shown in Fig. 6. The man doing this work was formerly a crane operator and spent five weeks in the school. He can do many kinds of lathe work, and after a total experience of 10 weeks he is earning about 45c. an hour. A similar case is shown in Fig. 7. This man has developed into a good turret-lathe operator after eight weeks in the school and earns about the same as the man previously mentioned.

The next three illustrations, Figs. 8 to 10, show three different types of work and men. The first of these men was a shipping clerk who had spent four weeks in the school; the next a boilermaker who was in the school for seven weeks, and the third had run a turret lathe on shell work, but had never handled anything else. He only required two weeks at the school.

The last two views, Figs. 11 and 12, show men on grinding operations. The first had no previous instruction and has spent five months in the school. He has however acted as assistant instructor, but now operates a Norton plain grinding machine on production work. Perhaps the greatest contrast is shown in Fig. 12. As will be seen, the man is operating a Brown & Sharpe universal grinding machine, and this after a previous experience as a corset designer and with only five weeks at the school.

The notable feature of this school as compared with most other short-term schools is that it does not attempt to make specialists or operators of one type of

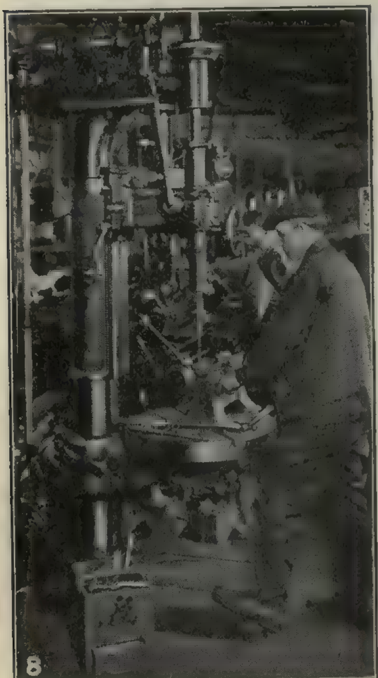
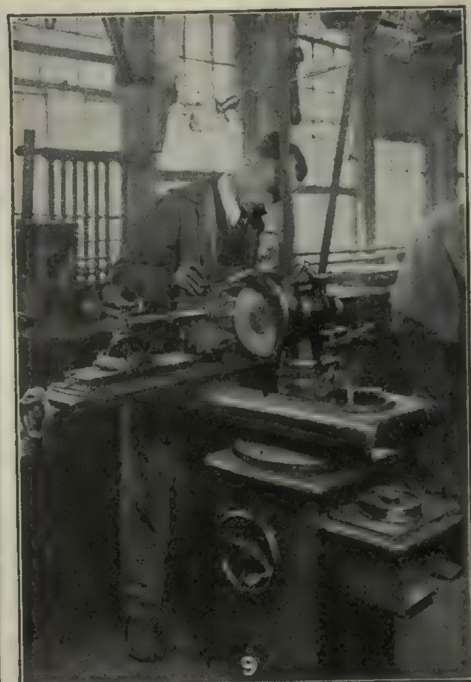


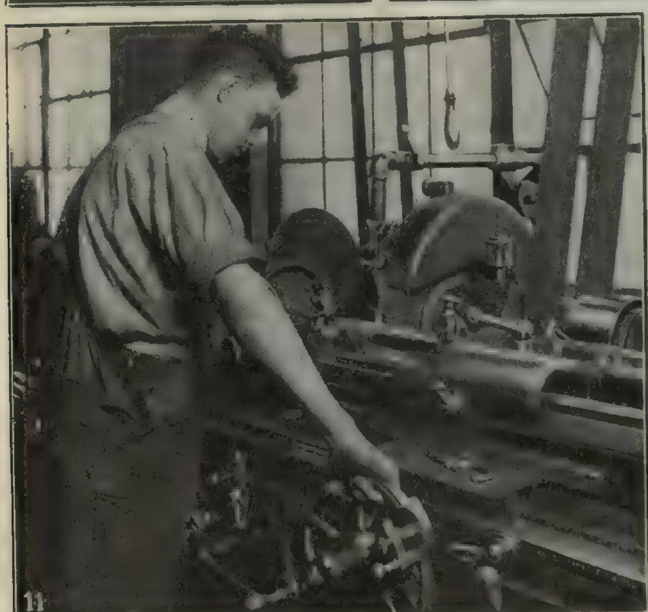
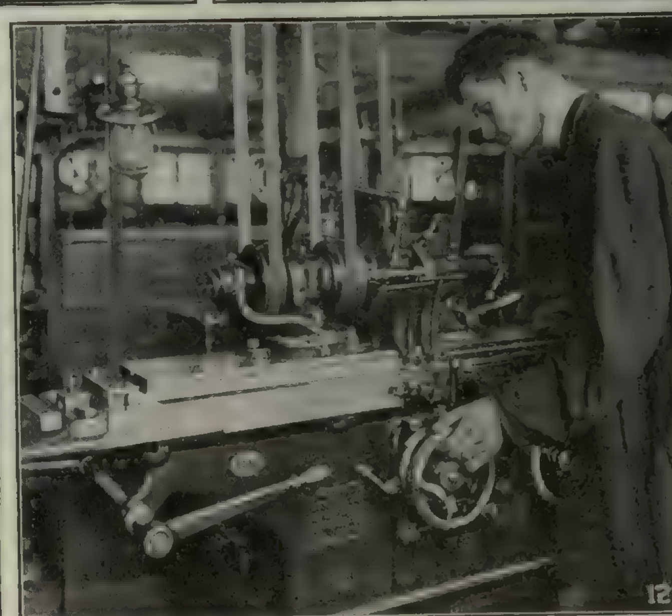
FIGS. 1 TO 7. SHOP VIEWS AND STUDENTS ON VARIOUS KINDS OF WORK

Fig. 1—One end of the school shop. Fig. 2—Assembling and bench work. Fig. 3—A 16-year-old graduate. Fig. 4—Another lad who can make reamers. Fig. 5—Formerly a plumber and teamster. Fig. 6—A crane operator handles the lathe. Fig. 7—On the turret lathe

machine, but gives the foundation of an all-around course. It does not give the practice that the old-fashioned apprenticeship gave in four to five years, but it does give enough of the fundamental knowledge of the different types of machines to enable a fairly bright man or boy to grasp the machine operations much more readily when he gets out into the shop. It also has the advantage to the Norton Grinding Co. of giving it a supply of men which it can use in different departments as occasion demands.

The time has gone by when this very important subject can be longer neglected, and the stealing of men from other factories is likely to be the subject of drastic action in the very near future. It has become absolutely necessary to train men and women—to increase the supply rather than to waste time in devising ways and means of luring them away from someone else. And the time is probably not far distant when training will be made compulsory as it now is in Great Britain. There it has now reached the point where every firm (with a very few exceptions) employing 300 or more workers must organize a portion of the shop as a training school for improving the skill or unskilled workers. Smaller factories are exempted, but arrangements are made with neighborhood technical schools for carrying on the work. This training must be done whether the shop has a sufficient number of trained men or not, so as to maintain the supply of skilled labor in the kingdom. This arrangement includes the paying of the worker during training on the same basis as that earned before the training period. France has also made training compulsory in all shops, which emphasizes the need for us to follow suit so as to have a supply of workers.

FIGS. 8 TO 12. WORK OF MEN WITH NO PREVIOUS MACHINE TRAINING

Fig. 8—A former shipping clerk. Fig. 9—A boilermaker grinds tools. Fig. 10—A former shell-shop worker. Fig. 11—A worker and instructor. Fig. 12—From corsets to grinding.

At present numerous cities are taking an active inter-

est in this matter and so are a number of companies. The Curtiss Airplane Co., Buffalo, is devoting 30,000 sq.ft. to this work and, it is reported, it is turning out about 150 workers a week. The Wright-Martin Co., New Brunswick, N. J., the Bethlehem Steel Co., with its 40,000 employees, and others are lined up for this work.

The Lincoln Motor Co., Detroit, is training women in a special school so as to make them familiar with the work when they go into the shop. It has secured a high class of workers, giving preference to those between 28 and 35 years old and who have relatives at the front. They are taking hold in splendid shape. Many other instances might be cited, but these will suffice not only to show the need of this work but the fact that it can be done with a little persistent effort. And its effect will be evident long after the war is over. It is time to begin the work now in every section of the country where manufacturing is carried on.

The Lubricating Problem

BY RAYMOND FRANCIS YATES
Associate Editor Everyday Engineering

The lubricating problem is of more importance than most manufacturers seem to recognize. It is just as much a problem in the small shop as in the large one, and yet it is generally overlooked in both places. The average shop superintendent is not fully aware of the great waste of power that may result from unscientific lubrication. In view of our efforts to conserve power as a wartime necessity it becomes the patriotic duty of every shop manager and superintendent to see that none of this valuable energy is wasted.

MANY manufacturing establishments have come under my observation where only one grade of lubricating oil was used throughout. Large boring mills were lubricated with the same oil that was used for small, delicate bench drills, and the same oil was used for big turret lathes as was used on speed lathes. No shop can be lubricated in this manner without an enormous waste of power. The heavy, viscid oil that is necessary to lubricate a boring mill cannot be employed successfully on a small drill press, nor can

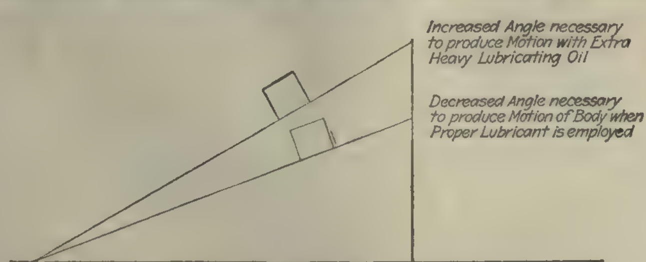


FIG. 1. EFFICIENCY INCREASED BY PROPER LUBRICANT

the oil used on a large turret lathe be employed to efficiently lubricate a speed lathe. To lubricate properly and with a minimum of loss in transmitted power it is necessary to use the "right oil in the right place."

To make the relation between friction and lubrication clear, consider a body at rest upon an inclined plane. The angle of the plane is such that the static friction will just prevent the body from sliding down. The friction between the body and the plane will entirely depend on three factors, i.e., the weight or pressure of the body, the angle of the plane and the condition of the contacting surfaces. If a suitable lubricant were interposed between the surfaces it will be found that the body on the inclined plane will gain motion at a decreased angle, as indicated in Fig. 1. Before the lubricant was introduced the tiny indentations and depressions in the surface of the body and the plane interlocked with one another and had a tendency to overcome the gravitational force that would otherwise have caused the body to gain motion and slide down the plane. If a viscid or heavy oil were introduced between the surfaces it would tend to retard motion rather than assist it. Whether or not the oil was too viscid would depend entirely upon the pressure or weight of the body. If the weight of the body was small a very fluid or light oil would be necessary to produce a maximum motion of the body sliding down the plane. For a given angle of the plane it will be found that a lubricant with specific characteristics is necessary to obtain maximum efficiency. The proper lubricant used when the weight of the body is 20 lb. and the inclined plane at 30 deg. could not be successfully employed with a body pos-

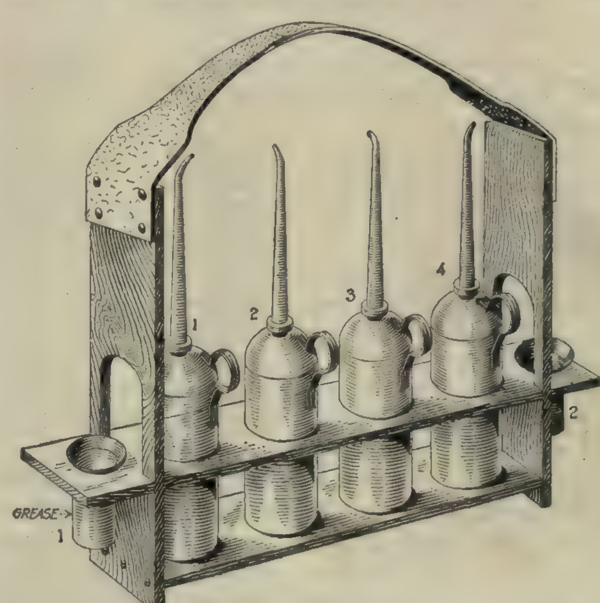


FIG. 2. OIL AND GREASE HOLDER

sessing a weight of only 10 lb. and the angle of the plane at 25 degrees.

When oil is interposed between the contacting surfaces of the body and the inclined plane, friction no longer takes place between the surface of the plane and body, but between the surface of the plane and the lubricant and the surface of the body and the lubricant. Added to this friction is the internal or molecular friction of the lubricant itself. The internal friction of a lubricant or oil depends entirely upon its viscosity or

fluidity. The internal friction of a light oil is very small, and vice versa. It will be seen that the more viscid an oil is the more closely it approaches the solid state of matter and will therefore possess great internal or molecular friction.

The universal use of one grade of lubricating oil in a shop is due to ignorance rather than to a desire to economize. No shop maintaining such a system of lubrication can exist without a serious loss in power. In order to show the difference when special lubricants are used for special purposes I have in mind a shop which required 37 hp. to operate it when only one grade of oil was employed, but when four different lubricants were used, each in its proper place, only 28 hp. was needed.

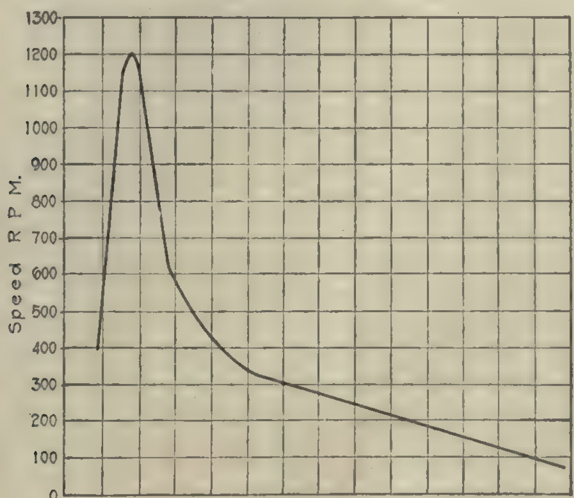


FIG. 3. RESULT OF INCREASE OF SPEED

This was a saving of 9 hp. in a small shop, which in dollars and cents per operating year would run well into three figures.

To introduce scientific lubrication in a shop the bearings should all be classified as follows: (1) High-speed low-pressure bearings; (2) medium-speed, medium-pressure bearings; (3) low-speed low-pressure bearings, and (4) special bearings.

A separate oil will be needed for the bearings in each class. Class 1 will require a light oil with high operating temperature; Class 2 will need a medium heavy oil, and Class 3 a viscid oil capable of withstanding great pressures. Special bearings, referred to as Class 4, are those that operate under abnormal conditions, such as excessive heat or cold, etc. Excessive heat causes oil to become less viscid, and when a bearing becomes excessively hot in many cases the oil will reach such a high degree of fluidity that it will be entirely squeezed out of the bearing. On the other hand when oil becomes chilled its fluidity decreases and it becomes more viscid. This is proved when an accident happens to the heating apparatus overnight in cold weather. It will then generally be found that the driving motor is unable to move because the lubricant has congealed in the bearings and line-shaft hangers.

Just as the oil-lubricated bearings are classified so should the grease-lubricated surfaces also be classified. Sliding surfaces should be classified just as revolving surfaces are, i.e., according to velocity and weight. In most shops only two different grades of grease are necessary—a good, heavy grease and a light one.

It is possible for a shop to be lubricated scientifically and still be within practical limits. The workman who takes care of the lubrication (sometimes called the "oiler") should be educated in the proper use and application of lubricants. If approached in the proper manner he will manifest an interest in the subject and will be willing to learn all he can concerning the subject of lubrication and apply his knowledge to the shop he is working in. This is especially so with ambitious young men if they are given enough freedom to exercise their initiative and make them realize the importance of their task. After displaying sufficient knowledge of the subject acquired through a little study the oiler should be permitted to systematize completely the lubrication of the shops according to scientific standards.

There should be four barrels containing different grades of oil, and each should have a card on it explaining the kind of oil and what kind of bearings it should be applied to. To simplify matters the barrels may be numbered 1, 2, 3 and 4, and should be arranged progressively—barrel 1 containing a very light oil, barrel 2 a more heavy oil and barrel 3 a very heavy oil. The fourth barrel should contain the special oil. There should also be four different oil cans and they should be numbered to correspond with the barrels. To make the cans portable a wooden carrier, Fig. 2, can easily be made as shown in the sketch. Accommodations are made at each end of the carrier for two grease cans.

Care and Repair of Bearings

The oiler should not only be taught how to apply the oil, but he should also be given several practical lessons in the care and repair of injured bearings. This is important, though if a shop is properly lubricated little trouble should be caused by hot bearings.

The importance of using the proper lubricant in a bearing having a certain speed and weight cannot be overestimated. If a bearing with 250-lb. pressure is making 300 r.p.m. and a grade of oil used to lubricate it is giving maximum efficiency the same oil could not be successfully employed if the speed of the bearing was increased to 1000 r.p.m. The result of such an increase in speed is shown graphically in Fig. 3. Up to a certain critical point friction decreases, but beyond this it increases very rapidly. The decrease in friction is due to the fact that the greater speed causes a higher temperature, which in turn decreases the viscosity of the oil. This decrease in viscosity, or fluidity, will permit the bearing to revolve more freely up to a certain point, after which it becomes so fluid that the pressure begins to squeeze it from between bearings. This does not happen suddenly, but is a gradual process. At first only certain parts or spots of the oil film between the bearings will be ruptured, and this will permit the contracting surfaces to come in direct contact, which in turn raises the temperature and further decreases the viscosity of the oil until a very hot bearing results and practically no lubricant remains between the surfaces.

From the foregoing explanation it will be seen that it is almost impossible to expect maximum efficiency in a shop unless the proper method of lubrication is used. All considered it actually costs less to use several lubricants than only one; that is, aside from the increased power realized.

Making Accurate Squares for Gagemakers

BY JOHN TECKEER

The modern gagemaker requires a square of greater accuracy than can usually be purchased commercially. In this article the writer describes a few methods by which a gagemaker with sufficient time can produce his own squares having a good degree of accuracy.

SQUARES bought commercially are rarely of the degree of accuracy required of such tools by gagemakers. It is not intended to present ways of making these accurate tools on a commercial basis, but rather to give suitable methods whereby a gagemaker

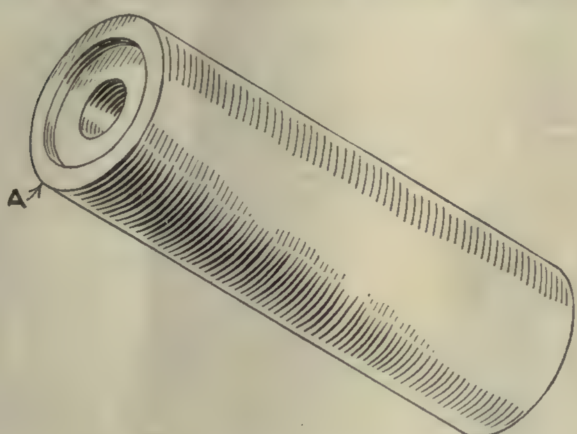


FIG. 1. PRECISION CYLINDER

can produce these tools with the equipment he has at hand. For this work a cylinder such as illustrated in Fig. 1 and a square block, Fig. 2, are required. The material for the parts can be of almost any grade of

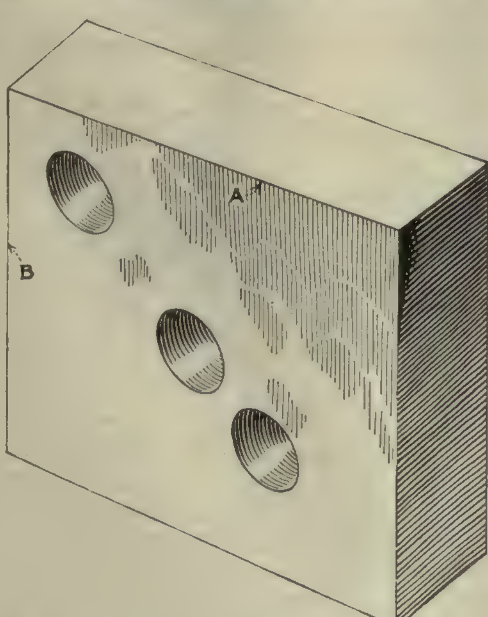


FIG. 2. SQUARE STEEL BLOCK

tool steel or of reliable machine steel. Personally I prefer a low-carbon machine steel, which must be free from seams. A low-carbon steel, from my experience, carbonizes more evenly and the surfaces can be lapped, leaving a fine finish, free from soft spots and checks, and I believe that a low-carbon machine steel is not so subject to change due to aging.

When the cylinder, Fig. 1, is hardened and ready to grind, the hole through the center is lapped round and fairly straight; it is then mounted on an arbor.

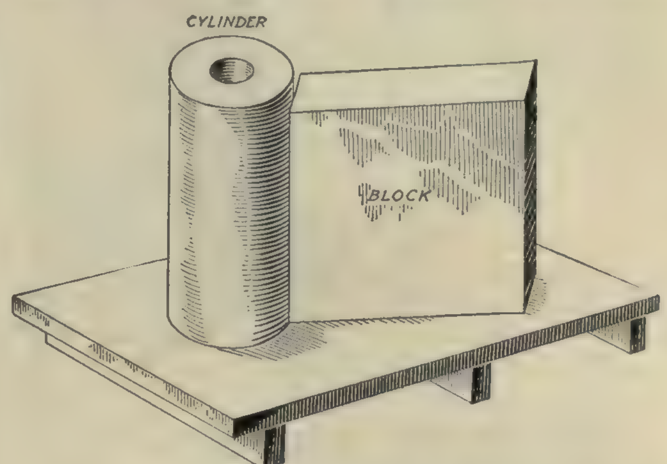


FIG. 3. CHECKING SQUARENESS OF THE BLOCK

The outside is ground as nearly perfect as possible for its entire length and the end *A* is ground in the same setting, thus insuring a perfectly square base. The cylinder is then lapped for finish and to insure its being parallel, and should be well within 0.00005 in. variation in diameter. Judgment must be exercised in pressing in the arbor, as it is possible to expand a piece resulting in faulty work, as seen when the arbor is removed. Too much care cannot be taken with this first standard. The second standard is the square block, Fig. 2, and this must be developed with care and gaged by the aid of our now perfect cylinder. This block must be exactly square on at least two sides *A* and *B*, and should be square on all sides. To develop this block, after machining it, it is hardened and then rough ground all over. The first sides are then ground straight and parallel, using a free cutting wheel to avoid heating; I use a Norton 38-46 H wheel, which is efficient for this class of work.

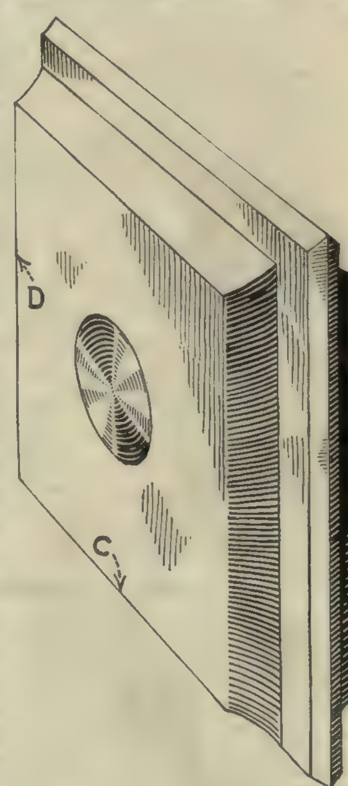


FIG. 4. SQUARE READY FOR GRINDING

The edges are ground with the block bolted against an angle iron. The cylinder is used as a check for squareness by standing it on a surface plate, as shown in Fig. 3. By thus checking a wide surface against a cylinder a line contact is obtained, and an error of

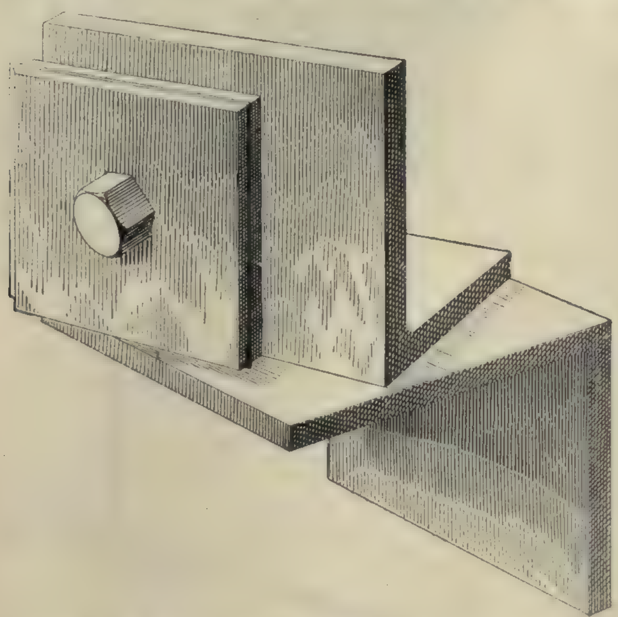


FIG. 5. SET-UP FOR GRINDING KNIFE EDGES

0.00005 in. can be detected by the light which shows blue through the space. A careful man can develop a master block square within less than 0.0001 in.

The making of squares is much simplified by the use of this square block and cylinder. Assume the

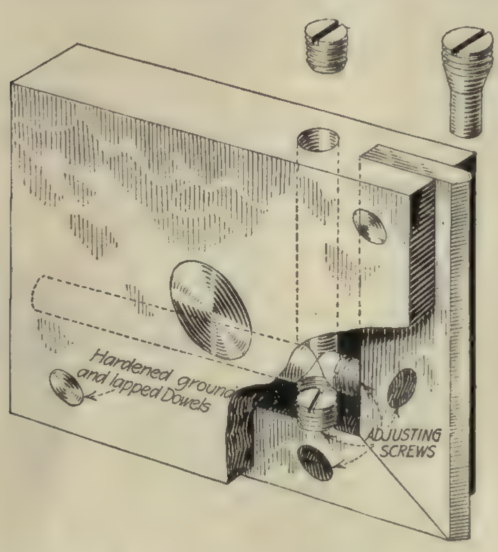


FIG. 6. BUILT-UP SQUARE

square shown in Fig. 4 is hardened, then grind the flat sides straight and parallel. Attach it to the master square block by a ½-in. cap screw having the two wide edges C and D project over the block. The block, Fig. 2, is placed on a magnetic chuck first on side A, then side B, and the two wide sides of our square are accurately ground. The square can then be removed and the steps of the two knife edges cleaned by placing the square unmounted on its ground edges.

To grind the angles clamp two angle irons and set up, as shown in Fig. 5. Having ground the angles to a sharp edge, take a good wheel and clean off the knife edge, making a flat of about 0.003 in.

These operations will give a square which will shut out light on your master square block on the knife edges, and will shut out light against the cylinder on its wide surfaces C and D, Fig. 4. Lapping the square will improve its value both in finish and length of life and is advisable.

The square in Fig. 6 is a built-up type, its only advantage being that the blades may be removed, reground and lapped and returned, or a damaged blade can be replaced, adjusting it by the screws to a master block. This advantage is a questionable one. In the construction of this square the slots must be milled carefully so they may be easily stoned smooth after hardening. The blade is doweled on one end with a hardened, ground and lapped pin; the loose end is adjusted by two screws, as shown. The binding screw on the side has the factor of holding the blade tightly against the adjusting screw, and thus both screws are locked. The square may be ground before assembling, or ground as in the case of the square in Fig. 3.

The square in Fig. 7 is essentially an inspection square and will stand very little abuse. I have one that has been in constant use for years. The beam is held by one screw only and rests on only three points on the base for ease in lapping. This square can be ground on the block, Fig. 2, each piece separately, with the assurance of all surfaces being at 90 deg. with each other, and the V can be ground on the previously described angle iron set up, and lapped if desired before assembling.

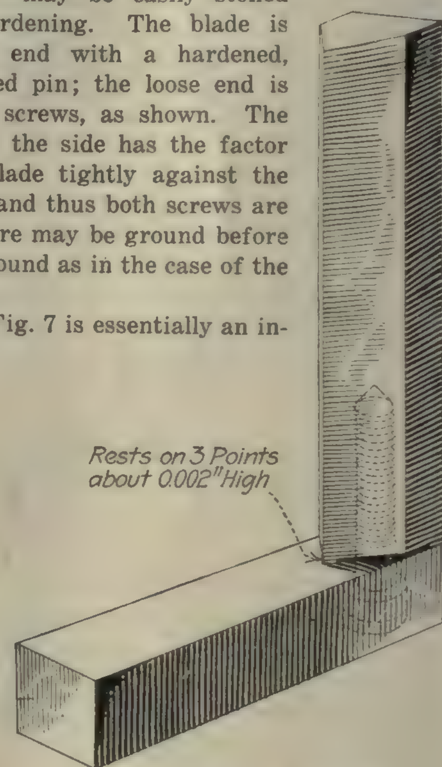


FIG. 7. INSPECTION SQUARE

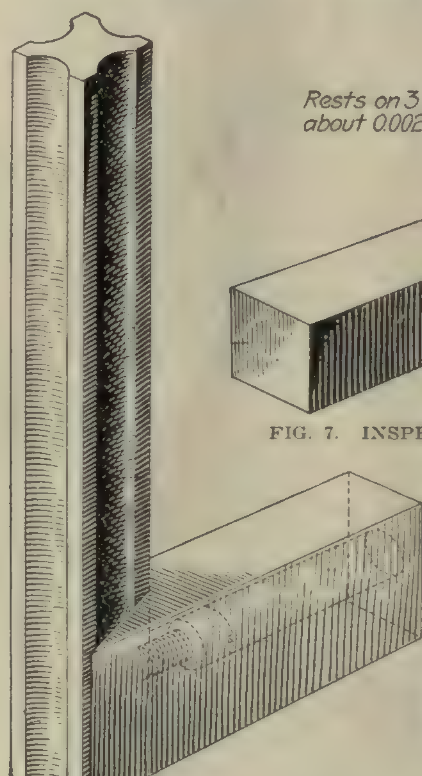


FIG. 8. SUBSTANTIAL SQUARE

A similar but more substantial square is shown in Fig. 8. The slots are milled in the beam to improve the appearance of the square. The beam is ground square on the rough grinding; later finish grinding two opposite sides straight and parallel. Then, clamp-

ing the finished side to the block, Fig. 2, grind the 90-deg. face and finish grind the opposite side from this. The base will be ground in the same manner. To grind the V in the base, set an angle iron on the block, Fig. 2, at 45 deg., using a sine bar for accuracy similar to the manner shown in Fig. 5. Use the face of the wheel and grind one side of the V; then the other. Do not use the side of the wheel nor try grinding both faces in one setting. After assembling it can be checked on the block, Fig. 2.

A serviceable tool, and perhaps the best of any for the labor required to make it, is that illustrated in Fig. 9. The construction is simple, a milled slot and a large-sized hardened, ground and lapped dowel make the assembly and are adjusted by two screws hardened on the ends. As will be observed the knife edge does not extend in the base of the square, but a flat surface is presented to the ends of the screws. The previous explanations cover the grinding of the base; but to grind the blade first rough grind all over; then finish straight and parallel the two flat sides. The angles are then ground on the set up shown in Fig. 5 and the edges touched up as shown in Fig. 10. This is done by attaching to a cast-iron block shaped up and ground parallel on the two opposite edges. Assemble and adjust to the block, Fig. 2.

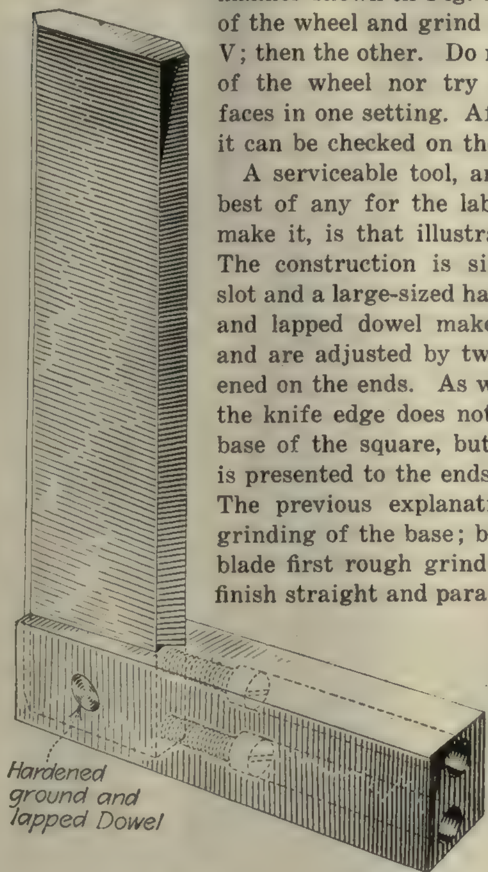


FIG. 9. SERVICEABLE SQUARE

There are many little details omitted perhaps, but to the man who needs these tools the methods mentioned will be sufficient to enable him either to build the tools as here shown or devise a way of his own.

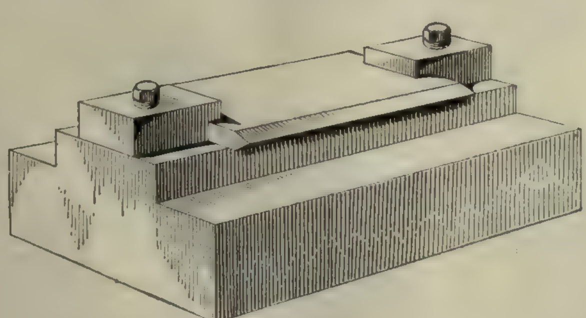


FIG. 10. SET-UP FOR GRINDING ANGLES ON SERVICEABLE SQUARE

Invention Section Created for Inventors

All inventions that are of a mechanical, electrical or chemical nature submitted to the War Department for inspection, test or sale are now considered by an "Invention Section" recently created as an agency within the General Staff. This new bureau was created in order to secure prompt and thorough investigation of inventions by technical experts.

Inventions may be sent to the Invention Section, General Staff, Army War College, Washington, D. C., by mail or they may be submitted in person, accompanied by written descriptions or drawings. They are then sent to an examining board having technical knowledge of the classes of inventions they handle, whose investigation determines whether the inventions have merit. Those with merit are referred to the Advisory Board, which determines in each case whether it should be put in the hands of some of the numerous testing and developing agencies or whether it should go to one of the staff or supply departments for test and consideration of its adoption and final acquirement of title if such action is desirable.

Submitting an Invention

Any person desiring to submit an invention for consideration, test, sale or development should do so by letter, giving in order the following information: Name and object of the invention; any claim for superiority or novelty; any results obtained by actual experiment; whether the invention is patented; whether remuneration is expected; whether the invention has been before any other agency; whether the writer is owner or agent; the number of inclousres with letter; a written description and sketches or drawings of sufficient detail to afford a full understanding of the cases should be submitted. Should the invention be an explosive or other chemical combination the ingredients and processes of mixtures should be stated.

The Invention Section will not bear the expense of preparation of drawings and descriptions nor advance funds for personal or traveling expenses of inventors. The inventor will be notified of each step taken during the investigation of his invention.

The Advisory Board

Composing the Advisory Board at present are the following: D. W. Brunton, member Naval Consulting Board and chairman War Committee of Technical Societies; Dr. Graham Edgar, member National Research Council; Col. James W. Furlow, Quartermaster Department, chief of Motors Division; Col. J. A. Hornsby, M.C., chief of Hospital Division, Surgeon General's Office; Lieut.-Col. Morgan L. Brett, Ordnance Department, Engineering Branch; Lieut.-Col. Robert A. Millikan, S.C., chief of Science and Research Division; Lieut.-Col. N. H. Slaughter, S.C., chief of Radio Development Section; Major Joseph A. Mauborgne, S.C., chief of Electrical Engineering Section.

When completed the board will have 12 to 15 members to cover fully all of the various technical problems which may come before it.

In testing and developing inventions and in considering problems presented by staff departments the Advisory Board works in connection with a number of agencies. Among them are the following: Research Council; Bureau of Standards; War Committee of National Technical Societies (this committee consists of two members detailed from each of the 10 important

technical societies in the United States); laboratories and shops of the staff and supply departments of the army; Patent Office; Aircraft Production Board; all army service schools; C. L. Norton, Massachusetts Institute of Technology, Cambridge, Mass.; Dr. Charles P. Steinmetz, General Electric Co., Schenectady, N. Y.; A. H. Beyer, chairman committee on testing laboratory, Columbia University, Broadway and 117th St., New York; R. R. Abbott, metallurgist, Peerless Motor Car Co., Cleveland, Ohio; Dr. John A. Matthews, president Halcomb Steel Co., Syracuse, N. Y.; Knox Taylor, president Taylor-Wharton Iron and Steel Co., High Bridge, N. J.; Howard D. Colman, Barber-Colman Co., Rockford, Ill.; Preston S. Miller, Electrical Testing Laboratories, 80th St. and East End Ave., New York; Herbert Fisher Moore, University of Illinois, Urbana, Ill.; L. F. Miller, metallurgist, Mitchell Moore Co., 1832 Asylum Ave., Racine, Wis.; E. J. Okey, the Timken Roller Bearing Co., Canton, Ohio; Dr. Ales Hrdlicka, curator division of physical anthropology, United States National Museum, Washington, D. C.

The Economics of the Machine-Tool Business

By G. R. Woods
Allied Machinery Co. of America

The equipment used for producing raw materials is made by machine tools and the change from raw products to the finished article is made by machine tools. Likewise, all appliances for creating power and furnishing transportation are made by machine tools. The sources of machine-tool business are classified and tabulated as will be seen in Chart I.

CHART I. THREE PRINCIPAL SOURCES OF THE MACHINE-TOOL BUSINESS

I. Machine tools make possible every industry. They are used directly in every trade and industry which uses power-driven machinery.*

II. Machine tools are required to maintain and repair mechanical equipment of every kind and wherever used.

III. Machine tools last an average of 15 years before discarding either for obsolescence or deterioration.

I. (1) Sales are primarily dependent on: (a) Extension or expansion of existing industries, all of which must use machine tools; (b) creation of new industries whose fundamentals must rest on machine tools. Corollary—General business must be active and capital available.

II. (1) Sales are dependent on: (a) Prosperous condition or extension of existing mechanical industries; (b) new industries requiring machine tools for creation and maintenance.

III. (1) Sales for replacement purposes are limited because: (a) Long life of good tools ranging from 10 to 30 years; (b) obsolescenec is confined principally to industries requiring high production or fine accuracy.

*Six industries in the United States, each producing over one billion dollars a year purchase 90 per cent. of our machine tools. These great machine-tool users and the production in 1914 are as follows: Mechanical products, \$5,134,657,000; grain and bakery products, \$1,391,912,000; lumber and wood products, \$2,127,114,000; structural and wire products, \$1,108,911,000; meats and canned goods, \$3,097,959,000; common ore smelting, \$1,026,695,000. In addition there is our great clothing industry, which is based on the use of machinery made by machine tools. Another interesting fact is that the sawmill and woodworking industries of the United States alone require 5,000,000 hp. to keep their machinery in motion.

Reducing Production Costs

With intensified competition in every field of endeavor there will be an increasing necessity for reduced production costs. More highly developed mechanical equipment must be utilized and machine tools will be required to produce this perfected machinery. Thus the machine-tool business depends on the further development of existing industries and the placing of old industries on a more modern mechanical basis. With large-scale production in every industry the need for machine tools will be continuous and increasing.

A classification of the leading industrial groups using machine tools is shown in Chart II. This threefold division is made for convenience in determining the economic development of a market. A large self-contained and developed industrial country, such as the United States, is the ideal machine-tool market because every kind of machine-tool user is within our borders. In many other markets, however, industries are not so diversified and machine-tool users will be confined principally to the miscellaneous-manufacturing group and the general-manufacturing group.

CHART II. THREE GENERAL CLASSES OF MACHINE-TOOL USERS

Miscellaneous Manufacturing and Maintenance	General Manufacturing of Large Units—Specialization by Industries	High-Production Manufacturing—Specialization by Small Units
(a) Railroad shops.	(a) Prime movers.	(a) Automobiles and internal combustion engines.
(b) Shipyards.	(b) Locomotives and cars.	(b) Specialties, such as sewing machines, cash registers, phonographs, instruments, etc.
(c) General repairs.	(c) Ordnance.	(c) Small arms (arsenal work).
(d) Small scale manufacturing.	(d) Mining, rolling mill, pumping machinery, etc.	(d) Special machinery, such as printing presses, textile machinery, shoe machinery, etc.
	Purchase Factors in Order of Importance	
(a) Universality.	(a) Strength.	(a) High production.
(b) Strength.	(b) Universality.	(b) Durability.
(c) Simplicity.	(c) Simplicity.	(c) Simplicity.

Considering that the average life of a machine tool should rate at 15 years a brisk and heavy demand for machine tools means expansion in manufacturing fields. Expansion means outlay of capital, and speaking generally machine-tool business is good when a nation's business is good. When industries are not expanding and machine-tool purchases are confined principally to replacements and when business is very poor even the orders for replacement purposes are small. The history of the machine-tool business shows that it is the first industry to feel a coming depression and the last industry to experience the benefits of an increase in business. When industrial conditions improve there is no immediate need for machine tools until the existing shop capacity is used and then comes the demand for more machine tools.

CHART III. WORLD MARKETS FOR MACHINE TOOLS

Europe	Asia	Africa	Australia	Central and South America
	Developed Industrial Countries			
United Kingdom	Japan	None	None	Chile
Germany				
France				
Belgium				
Switzerland				
Italy				
Sweden				
	General Manufacturing Countries			
Norway	None	South Africa	New So. Wales	Argentine
Spain and Portugal			Victoria	Brazil
Austria-Hungary				
Denmark				
Holland				
	Pastoral Countries, Sporadically Industrial			
Russia	India	Other Africa	Other Australia and remaining Australasia	Other South and Central America
Balkans	China			
	Siam, etc.			
	Straits Settlements			

Chart II shows the principal classes of machine-tool users, and to supplement that chart I have prepared Chart III, where the countries of the world are grouped according to the classifications on Chart II, giving the three classes of machine-tool users.

Gaging Screws

By H. J. BINGHAM POWELL

There is a maxim to the effect that a "go gage must gage simultaneously all the elements concerned in order to insure their proper correlation," but on account of the numerous existing standards there is a great deal of conflict where interchangeability of parts is desired. In this article the author has endeavored to show how these difficulties may be overcome.

IT IS now generally agreed both in the United States and England that screws should bear only on the slopes and therefore that the roots of the male and female threads ought to be "cleared" to attain this. A close fit on the slopes, or a low tolerance on the pitch (effective) diameter, which is the corollary to this condition, is particularly essential in screws subjected to longitudinal vibratory stresses, such as the turnbuckles of airplanes, bolts, studs and screws of airplane engines, etc., because any slackness of fit augments the vibration in the screw and so increases the tendency for such parts to fail by "fatigue" or crystallization of the steel. But the fact that the roots of the product should be cleared does not imply that the screw gages for checking the product can be equally cleared, as is now the common practice in the United States, for such procedure does not guarantee interchangeability of the product, which is the very object of gaging. It is true that for the male product a no-go plain ring is used to check the size of the outside diameter, and likewise for the female product a no-go plain plug is employed to control the root diameter; but these additional gages do not give security of interchangeability since they are used separately from the go screw gages. The considerations given below will demonstrate this.

Obtaining Interchangeability

It is a maxim that to obtain interchangeability of parts the go gage must gage simultaneously all the elements concerned in order to insure their proper correlation. This axiom was first expounded by the well-known authority on screws and screw gaging (probably the leading authority in England), W. W. Taylor, who is a member of the subcommittee on screw threads for all purposes and their gaging of the British Engineering Standards Committee and who has devoted many years to writing and lecturing on the subject. Mr. Taylor, in a recent discussion at an important meeting of the Society of Automobile Engineers of Great Britain, in which the principal authorities on screws and screw gaging took part, gave a very apt analogy to illustrate this maxim, as follows:

"Take the case of a 5 x 4-in. photographic plate. It is not sufficient for interchangeability that the plate nowwhere exceeds in length 5 in. or in width 4 in. We must also control its squareness. If we passed such plates with separate go gages for length and width we might pass diamond-shaped plates. The go gage must include both elements and their correlation, which in this case is the squareness of the plate." Equally, in the case of screws, it is essential to not only check the pitch diameter but simultaneously (and therefore not by separate ring gages) the root and outside diameters. If this is not done the outside diameter of a bolt or the root diameter of a nut may be passed even if eccentric to the pitch diameter, and the latter is the very thing that happens most commonly in practice, since a tap or die often does not center itself correctly and so causes such eccentric threads.

Recently a consignment of bolts and nuts was sent to the gage laboratory of the British Ministry of Munitions in the United States to be carefully measured on all the dimensions of the screw thread (U.S.S. form) and also to obtain information on the form of thread. The latter was obtained by use of a "projection apparatus," which throws an exact image of the screw, enlarged 50 times, onto a screen. These nuts and bolts were made by one of the best-known and largest firms in the United States, and were not in any way especially selected, but on the contrary care was taken to draw them haphazardly from stock in order to obtain results truly representative of ordinary commercial workmanship.

The Various Sizes Used

The sizes dealt with were $\frac{1}{4}$ in., $\frac{5}{16}$ in., $\frac{3}{8}$ in., $\frac{7}{16}$ in., $\frac{5}{8}$ in. and $\frac{1}{2}$ in. in diameter. The threads were tap or die cut, the material being ordinary machine steel. Lard oil is used as lubricant by this firm to reduce to a minimum the abrasion and wear of the screw-cutting tools. The eccentricity of the outside diameter in relation to the pitch diameter of the nuts was carefully calculated from the enlarged image given by the projection apparatus. Only one bolt was correct in this respect; all the others had an eccentricity ranging from 0.001 in. to 0.003 in., the average eccentricity being 0.0015 in. It was not possible to obtain the corresponding figures for the relation of the core diameter to the pitch diameter of the nuts as we were not able to take sufficient number of casts of the nuts to find where the eccentricity was greatest also the nuts being of ordinary workmanship they were too rough to take from them the numerous delicate casts required for this investigation.

In my opinion and in that of others with whom I have discussed the point the present usual method of gaging in the United States and described above cannot secure interchangeabilty of parts because it violates the maxim laid down. It is therefore of little value to keep the gage makers to such fine limits on the pitch diameter as is now demanded if the system of gaging does not give interchangeability. On the other hand the clearing of the roots of the go screw gages is not adopted from choice, but almost from necessity, because it is practically impossible to obtain the correct square form root to the right diameter, and so practical requirements demand that the roots be cut almost to a sharp V and so to an incorrect diameter.

I have been considering how these practical objections can be overcome and still obtain a true go screw ring gage or one which "checks all the elements of the thread

simultaneously," and the following is suggested. To retain the sharp roots is a practical necessity, and so the gage in that part will be as now made, but in passing it must be represented that the length of thread must be the same as the length of thread gaged in the product; otherwise there is no control over the lead of the product, which is considered today of equal and greater importance to the pitch diameter because of the excessive lead errors in taps and dies as commercially made, often amounting to 0.002 or even 0.003 in. or more per inch of length.

If now on the bottom of the screw gage a plain part is attached by screws and dowels to be truly concentric with the pitch diameter of the screw and of an internal diameter equal to the high limit of the outside diameter of the product, a bolt screwed through the threaded portion and which also passes through the plain cylindrical part will have all its elements gaged simultaneously, and so the root, pitch and full diameters will be concentric within the variation permitted by the relative high and low limits of each respectively.

The Split-Ring Screw Gage

In the case of a split-ring screw gage, the plain cylindrical part can also be split and the portions fixed separately on either side of the split. Also three projecting heavy pins ground and lapped to the correct included diameter could be used. This gage seems to me a practical solution to the problem of obtaining a true go screw gage with sharp roots.

For a go screw gage the plain part would be of the low limit of the root diameter of the product, and it would be placed at the back of the threaded portion of the gage.

Of course it is often maintained that as there is clearance between the V-root and the square crest of the complementary part the pieces will assemble whether there is eccentricity or not. But this is only true if the root remains a sharp V, which of course is not the case. The sharp crests of the cutting taps and dies soon wear round, and experience shows that this rounding does not reach a more or less permanent form until the radius is about that of the standard Whitworth thread. Thus the clearance soon disappears, and any eccentricity will prevent assembling of the pieces.

The bolts and nuts previously referred to as having been sent to the gage laboratory of the British Ministry of Munitions in the United States were examined for the amount of rounding at their roots, with the following results:

The roots were nearly all rounded, and even the best had the nominal flat rounded at the corners. But the majority had circular roots, and the lengths of the radii of these in terms of the pitches (leads) of the screws were: Where P = pitch, minimum = 0.100 P, maximum = 0.131 P, average = 0.118 P for the bolts, and minimum = 0.100 P, maximum = 0.133 P, average = 0.115 P for the nuts. The crests of the threads were also somewhat torn at the corners, and some of them were even torn to a circular form, the average of the radii of the latter being 0.119 P.

These results confirm the experience of many years in England, which is that the crests of taps and dies soon wear to a more or less stable circular form, that form having about the radius of the Whitworth thread which is = 0.137 P. Thus whether we set out to obtain the Whitworth shape of thread or the United States form of thread we obtain in ordinary commercial practice with taps and dies the rounding at the roots of the former.

The firm that supplied the bolts and nuts assured us that they do not use their taps and dies until they are much worn. This is no doubt true, so we must consider why the crests of their taps and dies so soon take a rounded form. The reason probably is that the lubricant does not properly get into the roots of the product, and so the corners of the flat crests of the taps and dies become overheated and fall away until the rounded form is reached.

An Example

Regarding no-go screw gages, in direct opposition to what is necessary for the go screw gages, it is essential that only one element of the screw be gaged at a time. A little consideration will show that this condition must be true, for if a no-go gage bears on more than one element at a time one is not able to judge which of the elements is at fault in a defective product. An example of a useless no-go screw gage is one where the three diameters—root, pitch and outside—are all on the high limit. If such a gage accepts the product that is no proof that the latter is correct since the gage may be bearing on the product on any element or at any place, and so the fact that it acts as a no-go does not show that the product is right. As the correctness of the pitch diameter is the essential thing the no-go screw gage should be made to bear only on the slopes of the product. This can be done by cutting the roots to a sharp V and the crests very flat. Such a gage shows that the pitch diameter of the product is not too small in the case of a bolt or too large in case of a nut, and therefore that the threads of the screw are not thin. On the other hand the go screw gage with cleared roots shows that the threads are not too coarse; thus with these two gages there is assurance that the form of thread is correct.

Heavy Browning Machine Guns

Heavy Browning machine guns sufficient to equip the machine-gun units of one army division have been manufactured and are being shipped to Camp Meade, Md. More than half of the guns have arrived at that camp. The Liberty division, as the Camp Meade unit is known, thus becomes the first to be equipped completely and trained with heavy Brownings. Light Browning rifles sufficient to equip the machine-gun units of four and one-half army divisions have been manufactured. Overseas shipment of one-half of these has begun. The other half of the output goes to army divisions in this country. Camp Meade will be the first division completely equipped with light Brownings. Camp Meade now has approximately half her complement of this light type. Enough heavy Brownings for instruction purposes have been shipped to every National Guard training camp and National Army cantonment in this country where troops are in training. They have arrived at as distant a point as Camp Lewis, American Lake, Wash. Heavy Brownings for overseas training have been shipped.

Effect of Changes in Foreign Tariffs on the American Machine-Tool Industry

BY L. W. SCHMIDT

With the prospective cancellation by France of her commercial treaties the United States, as a great manufacturing country, will also have to reconsider her commercial relationships not only in respect to France but to other countries as well. Now that foreign competitors are challenging the high efficiency and quality of American-built tools it is of the utmost importance that special trade agreements be entered into which will at least place American industry on an equal commercial plane with foreign products.

FROM France comes the information that that country intends to terminate all her commercial treaties containing the so-called most-favored-nation and the tariff-consolidation clauses. Also notice will be given of the termination of all treaties concerning commercial navigation, custom regulations, status of commercial travelers, exercise of commerce and industry, etc. By this step France will divest herself of all the encumbrances which may be in the way of her regulating foreign commercial relations after the war. Following France's initiative Italy and several other countries have taken similar steps, and as a result the United States will have to see how its economic interests will fit into the general reorganization of international commerce and industry after the war.

THE MACHINE-BUILDING INDUSTRY

The machine-building industry of the nation is vitally interested in the outcome of the changes that are now taking place. American machinery is sold all over the world, and the machine builder therefore has reason to ask himself whether his interests can be sufficiently taken care of under the present commercial treaties between the United States and other countries.

As an important manufacturing nation we have shown a deplorable lack of interest in the commercial policies of the world. While other nations have been active in making commercial treaties and often securing many advantages we have been satisfied with our old general treaties which at the best give us little else but the so-called most-favored-nation advantages. The fault is ours and not that of the other nations that have been only too ready to treat with us, and the result has been that prior to the war we found ourselves on the outside of a powerful ring of nations bound to each other for their common benefit and of whom we could demand very little by right of treaty. This condition had not affected our industrial life very much before the war because we were busy among ourselves. Our industries were rapidly growing and our machine-building industry had to take care of a large home demand. Most of the machines we exported were needed by our customers and therefore had to be bought independently of any interference with custom barriers in the country of the buyer. This certainly has been one of the principal reasons why the American machine-tool industry has not greatly felt the disadvantage of inadequate protection in its foreign dealings.

In the early days of American machine-tool exportation the American machine-tool industry, as an international industry, stood in a class by itself. The machine tools exported in most cases were built only in this country. They therefore met with little competition abroad, and they could well be admitted in those countries on the most reasonable terms. Often the buyer was willing to pay the high import duties as a compensation for owning a machine possessing the qualities of the American-made article. For several years, however, this enviable position has been assailed by certain European competitors, and has led to a stricter treatment of the American machines by the countries concerned. Great Britain with its free-trade policy has always permitted American machine tools to enter free, withwithstanding the fact that British machine-tool builders were turning out first-class tools in increasing numbers. But in Germany and France the conditions were becoming more difficult. Germany, which has followed a policy of national industrial protection, has been building several machine tools in imitation of those built in the United States, with the result that before the war American machine tools were not selling so freely in Germany and some types had practically disappeared from the sales list. This was caused principally by the working of the tariff which made it impossible for the American machine-tool maker to compete in Germany.

SALE OF AMERICAN MACHINE TOOLS

The machine-tool market has grown with the years and the industry in America has been able to stand the loss of some foreign trade. But German machine-tool builders have made more progress in European markets than have American, owing to the special tariff treaties arranged between most of the European nations, though in several instances the United States had most-favored-nation arrangements with many of these countries. The influence of treaties of this sort on commercial relationships as a rule is very insignificant, as they lack the necessary commercial basis. The German treaties with some countries provide for special treatment in the exchange of goods in which both countries are specially interested. It is natural that such understandings must lead to closer commercial relationship than any general arrangement and that the two countries will be benefited by every article so traded whether it is specifically included in the arrangement or not. For instance there is little inducement for the Russian manufacturer to buy machinery in the United States when he can buy it in Germany, with which there existed a regular commerce based on treaties securing material profit to both.

The principal disadvantage of the American situation today is that the ordinary most-favored-nation agreements in use are all dependent for their continuance upon the actions of foreign countries other than those with which the United States may at the time be dealing. Take, for instance, the case of the German-Italian commercial treaty giving Germany certain rights which are also enjoyed under the most-favored-nation treatment clause by the manufacturers of the United States. This treaty is now inoperative owing to the war. But suppose the war had not come and that ordinary commercial differences had made necessary the dissolution of the Italian-German pact, all the clauses benefiting United States commerce with Italy would have been canceled. As a result the American exporter would have lost his favorable import rate in Italy through no fault of his own. This in fact is the present situation in regard to nearly all the commercial treaties made between the United States and other nations, the principal exception being Cuba

At present the whole international-treaty situation is dislocated by the war. Probably 60 per cent. of the commercial treaties existing in 1913 are no longer in force and it is likely that many of those continuing will be terminated as soon as possible so as to make new ones. The American machine-tool industry so far has suffered very little by this general upheaval because of the demand at home. After the war, however, the lack of special treaties may make itself felt, and the machine industry will suffer if early steps are not taken for the protection of its foreign commerce.

Machine-Tool Manufacturers Should Have Good Understanding of Treaty Situation

It is therefore essential that the machine manufacturer of this country, large and small, should understand the facts underlying commercial intercourse as based upon foreign treaties and tariffs. He should know that commercial intercourse between countries can be marred or made by hostile or friendly tariffs, and he should especially know what is going on in the world with reference to changes in the tariff relations between the leading industrial countries. His information should extend not only to knowing how much import duty his particular product will have to pay in a certain country, but also whether these countries offer special and better rates to other countries, possibly his competitors. The fact, for instance, that most of the nations comprising the British empire allow special preferential rates to the manufactures of Great Britain gives the English manufacturer a considerable advantage over any other when competing in the British market. Our manufacturers know how rapidly American trade in Cuba has grown under the influence of the preferential treatment accorded to that market by the commercial agreement between Cuba and the United States. American goods are favored directly and indirectly in the Brazilian market with the result that Brazilian-United States commercial intercourse is growing rapidly.

How largely the interests of the machine-tool industry and the machine industry in general are bound up with the world's tariff situation may be seen from a few recent examples. A movement is under way to establish free trade between the Central American nations. Treaties have already been signed between Salvador and Honduras and negotiations are under way between those two countries and Guatemala. Also the free-trade convention adopted at the Third Central American Conference and amended by the Sixth has found much support. It is therefore to be expected that before long there will be a group of Central American states having free trade among themselves. The next step will be coöperation not only for common intercourse but also for protective purposes in the combined dealings with other nations not members of the group. This step has been contemplated for a long while in other countries and is full of possibilities. Central American states like Mexico may some day be among the best markets in our immediate neighborhood, and the machine industry of this country is therefore much interested in the tariff policies of these countries. Central America buys great quantities of farm machinery; mining machinery is bought by Mexico, and the increasing industrial development of these localities also promises considerable sales of general machinery. If as a whole they should make preferential treaties with any European country the American machinery industry would lose much of the trade that should be expected from that direction unless special inducements were offered to them.

The new customs tariff which has been recently enacted in Trinidad is also of interest to the machine industry. Formerly Trinidad allowed a special 10-per-cent. preference to goods originating in England, Canada and Newfoundland only. The new tariff now extends this preference to the British empire. The chances are that the American machinery industry will not feel this differentiation very much, as the sale of American machines to Trinidad is bound to be limited anyhow. Nevertheless it is clear that any extension of the system of preference in any country, especially if it includes producers of merchandise also manufactured and exported by the United States, must affect the interests of the United States.

Existence of Commercial Treaties

Proper commercial treaties are often of great value in opening up new commercial connections, and most tariff laws provide for the treatment of samples. There are countries with very strict laws, and many of the modern commercial treaties contain stipulations for the free import of travelers' samples and samples sent by mail. The tendency now seems to be to lighten as much as possible the burden of the commercial representative in the foreign country, and special regulations are made in the tariff laws to that end. The tariff law of Nicaragua allows the importation free of charge of small samples which are unsalable by themselves. Travelers entering the country may import samples up to a value of \$5000 free of duty if they give a bond for twice the amount of the duty and agree to export the goods before the end of six months. This means that small machines might be imported for show purposes and exported again if necessary. It is clear that where there is no special regulation for the admission and the export of samples, any country which is able to make a special agreement for that purpose will be vastly benefited against another not having one.

When the new commercial treaties are made the machine-tool industry of this country will be heard, as its commercial interests are closely bound up with those of the whole machine industry of this country, and what should be demanded is that the treaties be advantageous to the American machine industry as a whole. Of course nothing that is not granted willingly by other countries can be demanded, so it will be necessary that where concessions are made by one country equal concessions should also be made by the other. Commercial intercourse to be durable should be beneficial to both sides. This has been proved by our country by the success attained from the treaty with Cuba which has opened a great market for the products of Cuba in the United States while also giving the American manufacturer a big field for his enterprise.

The American machine-tool industry is not only interested in an active exchange of all kind of commerce between this country and others, but also in the financial relations with foreign countries, which should be on a sound basis, so that American capital in other countries will be made safe. Since the outbreak of the war many countries have changed their corporation laws. Many of these laws, like that recently passed in New South Wales, seem to be temporary measures destined for the duration of the war. Others are of a permanent character, like the new corporation law of Denmark. This law deals especially with the subject of foreign corporations, which are admitted to the benefits of the law in Denmark only in the case of Danish corporations receiving reciprocal treatment by the country of the foreign corporation. This is a clear-cut case where a treaty applies.

American Capital

The employment of American capital in foreign industries is of great importance to the sale of American machinery of all description abroad. We all know how powerfully the export of English machine tools to South America is supported by the investment of British capital in South American railways. These railroads order most of their equipment in London, and they therefore buy the largest part of their machine tools from British manufacturers. The interest taken recently by American investors in South American railroads, mines and general industrial development has already borne fruit. American engineers employed in these enterprises exert their influence in favor of American machinery. With still more American capital invested in foreign enterprises the American machine industry will soon feel the effect on their foreign sales. The investment of foreign capital therefore is a subject which might well be made the subject of international agreements.

The commercial relationship of the world as built on foreign treaties and international pacts is just now in the melting pot, and after the war many of the old treaties will become useless. The great net of preferential treaties made before the war between Germany and numerous nations will be broken, and any country which may have benefited by them by way of the most-favored-nation stipulation will have to make new arrangements of a more specific character. This is the time when the American machine builders should come forward with their proposals and inquire what might be done to further their trade in other countries.

Training Technicians and Mechanics for the Army

Last February the Secretary of War appointed the Committee on Education and Special Training, charging it with the responsibility of training 90,000 men of the National Army for technical and skilled work. The army is in need, for example, of motor-truck drivers, airplane mechanics, carpenters and blacksmiths. The selective-draft methods proving inadequate to supply this demand, the committee was formed to arrange for intensive training.

Educational plants equipped for handling large numbers of students were obviously the machinery that should be adapted to this work. So rapidly had the committee proceeded that 25 schools are now under contract to take the men, 14 schools have begun their work, and 7500 National Army men are under instruction. The number of schools will be increased until 30,000 men can be handled at one time. The courses are for eight weeks' duration and the final lot of 30,000 men (for army needs as planned at the minute) will go to the schools Sept. 1.

Arranging the Work

In arranging for the work institutions were preferred that could accommodate at least 500 men. One school expects to take 2500. The institutions include engineering colleges, universities and mechanics' institutes, while in one city the public-school system is being used. The number of different courses given at an institution depends on various conditions—the number of students, the character of school equipment, location, etc. One school—the University of Virginia—will specialize on the training of motor-truck drivers and will take 600 men at a time. For the truck-driving courses, such automobile equipment will be used as is available, and the Government, in addition, will furnish one army truck for each 20 men.

Army officers will be located at each school, and military drill will be taught simultaneously with technical instruction. The technical staff will be supplied by the institutions, and, with the army officers, will form a board to direct the administration.

The Curricula

The curricula are the same as those outlined for intensive training by the Federal Board for Vocational Education, though the staff at each school is given much latitude in the presentation of the essential matter. At some schools coöperation with the local industries is being arranged, as, for example, in the instruction on rubber vulcanizing at Akron, Ohio. At present the following courses are arranged for: Auto driving and repair, bench woodwork, general carpentry, electrical communication (telephone and telegraph work), electrical work, forging and blacksmithing, gas engines, machine shop, sheet metal.

While the men at the schools are National Army men and come through the draft boards, they volunteer for this special training. The Provost Marshal General sends out a call to the boards for men with experience fitting them for the lines in which the training is to be given, and are asked to certify volunteers from their rolls. In other words the men go to the schools directly

from their homes and are not drawn from the cantonments. As a result of this volunteer system a very good grade of men has been secured.

In addition to their experience the men are required to have had a common-school education—though this is not a hard and fast rule. Aptitude and ability to learn are the chief requirements.

Under the plan of selection by the local draft boards the results have not always been the best. Men have been sent to one school who should have gone to another. To insure proper assignment a plan is now being worked out whereby all men will be sent first to a number of reservoir schools, where they will be tested by qualified men and then assigned and sent to proper schools. In the courses themselves the aim will be to push men along as fast as their abilities warrant. Journeymen machinists, for example, will immediately be put on highly specialized work, such as airplane repairs.

All men are ranked as enlisted privates and are paid accordingly, and of course are outfitted by the Government. The schools as a rule contract for the housing, feeding and instruction in a lump sum per man per day, but in some cases the housing and feeding will be done by other parties. In arranging for accommodations the Quartermaster's Department has been of invaluable assistance, furnishing cots and other equipment to institutions having the buildings but lacking the necessary dormitories and dining-room equipment. All sorts of expedients have been used in places where building space was lacking except for the actual instruction. Armories have been converted and in several cases fair grounds have been used.

To facilitate the work the country has been divided into 10 districts, the institutions in each coming, as to the technical instruction, under the direct supervision of a district director. These in turn are under the direction of the general educational director, C. R. Dooley, formerly of Pittsburgh. The committee itself consists of three army officers, Lieut-Col. J. H. Wigmore, Lieut-Col. R. I. Rees and Major Greenville Clark. Assisting them is an advisory board consisting of Hugh Frayne, representing labor, and the following representatives of educational interests: J. R. Angell, the colleges; S. P. Capen, Federal Bureau of Education; J. W. Dietz, corporation schools; C. R. Mann, schools of pure science, and Dean Herman Schneider, engineering schools.

Nicklis Heads Machinery Association

J. D. Nicklis, of Manning, Maxwell & Moore, New York, was elected president of the National Supply and Machinery Dealers' Association at the society's thirteenth annual convention held in Cleveland recently. He succeeds Herbert W. Strong.

Anton Vonnegut of the Vonnegut Machinery Co., Indianapolis, was elected first vice president. The other officers follow: Second vice president, Crannell Morgan, of the Hardware and Supply Co., Akron, Ohio; secretary and treasurer, Thomas A. Fernley, Philadelphia. Members of the executive committee are Edward G. Wells, of the Chas. H. Besley Co., Chicago; Ernest L. Davis, of S. H. Davis & Co., Boston; Robert F. Blair, of the Pittsburgh Gage and Supply Co., Pittsburgh, and Edward B. Hunn, of C. H. Mersick & Co., New Haven.

Browning Gun Successful in Airplane Propeller Test

The Browning machine gun has successfully undergone a test to determine its value for use with aircraft. This is one of three types of machine guns with which the rate of fire can be so synchronized with the revolutions of the propeller of a tractor airplane that the gun can be fired by the pilot of a combat plane through the revolving blades. Firing in that fashion it is necessary to aim the machine gun by steering the plane directly at the target.

Airplane propellers revolve at from 800 r.p.m. to 2000. The machine gun is connected with the airplane engine by a mechanical or hydraulic device, and impulses from the crankshaft are transmitted to the machine gun. The rate of fire of the machine gun is constant and its fire is synchronized with the revolving propeller blades by "wasting" a certain percentage of the impulses it receives from the airplane engine and by having the remaining impulses trip or pull the trigger so that the gun fires just at the fraction of the second when the propeller blades are clear of the line of fire.

The pilot operates the gun by means of a lever which controls the circuit and allows the impulses to trip the trigger.

Severe Test Given Gun

The test given the Browning gun was severe. A gun was mounted on the frame of an American combat plane and connected with the airplane engine. The test was conducted on the ground and in place of the propeller a metal disk was attached to the crankshaft. The Browning gun was then required to register hits on the metal disk as it revolved at varying speeds from 400 to 2000 r.p.m. The slightest "hang fire" or delay in action on the part of the gun would have been shown by the failure of the bullets to hit precisely on the spot on the disk representing the center of the zone of fire. The gun functioned perfectly.

The Browning gun to be used with aircraft is the heavy type with the water jacket removed.

Besides the Browning the United States will also employ the Marlin aircraft gun as a synchronized weapon. Several thousand of these have been manufactured and the gun is in quantity production.

The British and French use the Vickers as a synchronized machine gun.

The Lewis aircraft machine gun is used by the British, French and American forces, but for a different purpose. In a two-seated combat plane, fixed machine guns are mounted forward to be operated by the pilot, and flexible guns are mounted to be operated by the observer in the rear seat of the plane.

It is of vital importance to have absolute reliability of function in a synchronized machine gun on tractor airplanes. Delays in fire or malfunctions due to faulty construction or imperfect ammunition cause bullets to strike the propeller blades. As many as 15 bullets have been known to strike a propeller blade without causing an airplane to fall, but the danger of such occurrences is nevertheless obvious. For that reason, every effort is made to provide the most perfect type of weapon for this work. Only specially selected ammunition is used.

By FRANK A. STANLEY

The illustration shows some of the processes and equipment in a high-grade Western plant where a varied line of punches, dies, jigs, fixtures and other special apparatus is made. Some interesting examples of presswork are included with details of tools for accomplishing the desired results.

THE toolroom of the Marchant Calculating Machine Co., Oakland, Calif., has always under way many lines of work besides that directly related to press-tool operations, although the latter naturally constitutes one of the principal items upon which the department concentrates its energies. However, over and above the laying out and making of punches and dies, the subject of special-tool construction, including the designing and building of jigs, fixtures and numerous classes of small tools and appliances, is one that is given a considerable degree of consideration. Consequently an important percentage of the toolroom's resources are devoted to the production of various devices commonly grouped under the classification of special tools.

There is too an added interest in the work of this tool organization in that it is responsible for the building of new models of machines before they are started through the process of manufacture.

The equipment of this department is modern throughout, and the location in respect to the factory buildings, as well as the situation of the plant as a whole, is such as to enable the toolroom to be supplied with sunlight along the entire length of three sidewalls. The character of the equipment and the arrangement of the department in general are well represented by the illustrations Figs. 1 and 2.

There are a number of interesting operations to be noticed in the different machines shown in the illustrations. For example, the milling machine in the immediate foreground of Fig. 2 is set up for cutting the teeth in some angular shank mills, the work being held at the required angle from the vertical plane by adjustment of the dividing head. A similar line of work in the dividing head, which will be described later, is the machining of certain classes of punches for blanking and shaving sheet-metal parts for the calculating machines made by the company.

In the milling machine just beyond the one referred to a toolmaker is at work setting up a fixture bottom side up for the operation of milling the two grooves for the short steel tongues at each end, which will serve as locating devices when the fixture is finally ready for use on the table of a milling machine. The illustration, Fig. 3, shows more milling-machine work under way on tool construction, some examples of which can be seen in other illustrations in this article. Fig. 4 is a view of one of the toolroom benches and shows a number of special jigs and fixtures awaiting inspection before returning to the factory. On the bench plate is a model calculating machine, which serves as the master and to which all tools are made to correspond. Gages, master plates, etc., are referred to this master in checking up for accuracy.

Another view of an interesting group on the toolmakers' bench is presented in Fig. 5, which represents a novel milling fixture on the bench plate ready for inspection. This is a type of fixture that has met with approval in the manufacturing department, where it has been found very useful in holding an awkward piece of work while a pair of straddle mills are run across its faces to reduce it to the required thickness.

The work, a brass piece of segmental outline, is shown in front of the fixture. As seen in the illustration, Fig. 6, it has a length across the lower corners of about $1\frac{1}{2}$ in. and a thickness of 0.275 in. It is finished to a radius on its outer edge of 1.1625 in. and the included angle represented by its beveled ends is 32 degrees.

There are several drilling and other operations to be performed on this piece before it is ready for the assembling department, but before any of the drill jigs are used the piece has to be machined to thickness, this operation being accomplished with the brass casting held edgewise in the fixture on the plate, Fig. 5.

Being only a little over $\frac{1}{4}$-in. thick when finished, it is obvious that some care must be exercised in providing a device for gripping the piece by its ends so that it will stand square and upright in the jaws

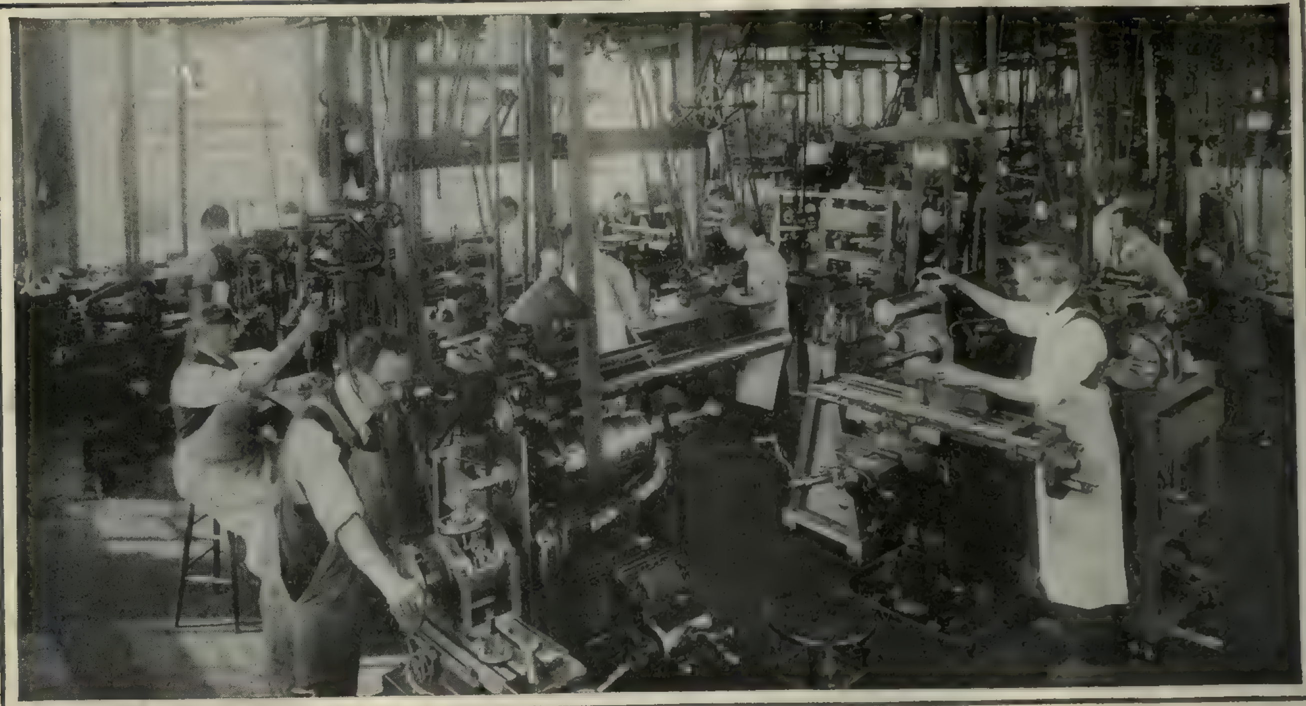
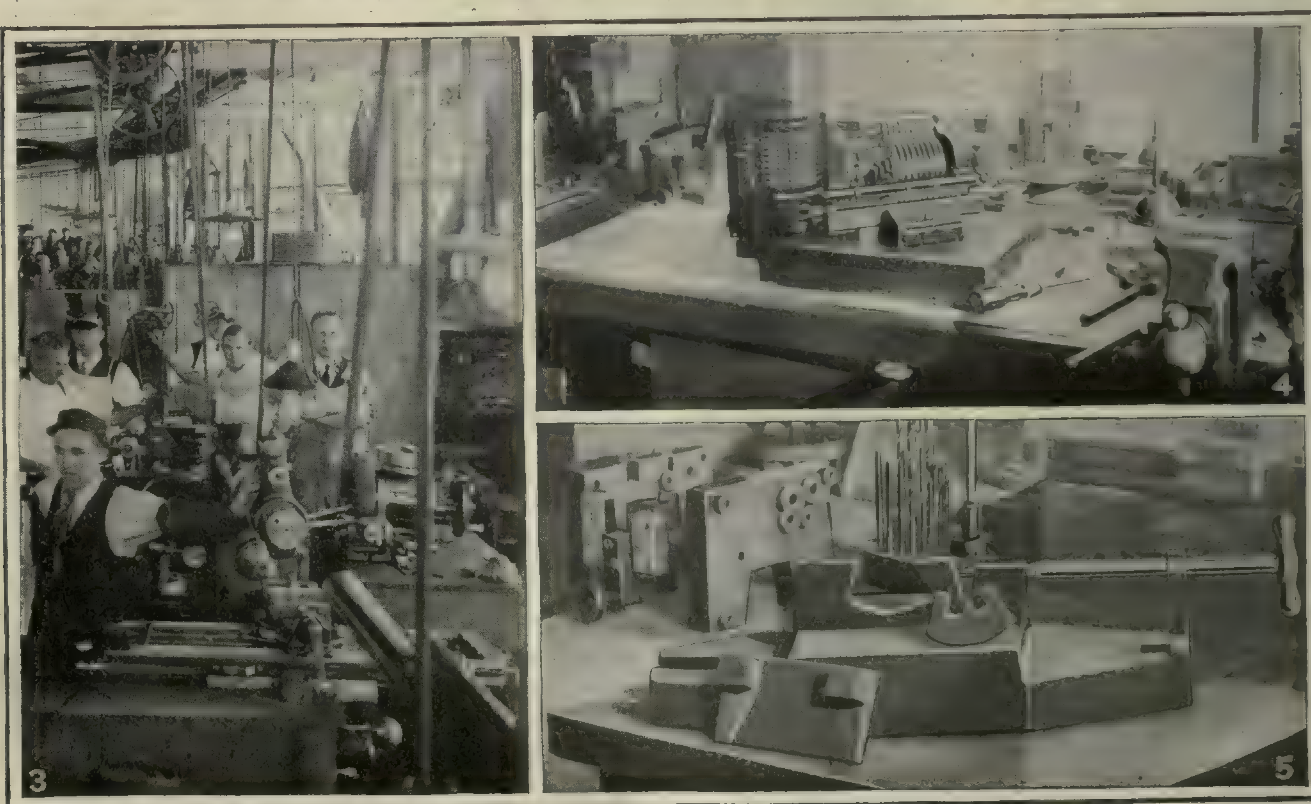


FIG. 2. TOOLROOM SHOWING SPECIAL MILLING MACHINE WORK

while the milling cut is taken. The method of locating such a piece of work so that it will be properly gripped is also somewhat of a problem.

The jaws of the fixture are very narrow, only a little less than the thickness of the work, and just thin enough to assure the cutters clearing properly. The jaw at the left, or back, is fixed, and the jaw at the right is pivoted and adapted to be set forward by operation of the screw with a cross-handle at its end. Both jaws are cut out to a V-form to correspond with the curved back and the angular ends of the brass casting to be milled, and with the piece properly set into the jaws it is easy enough to tighten up the screw and hold the work fast by its two angular ends; but before the screw is operated a locating device must be applied to position the casting so that its faces will come closely parallel to the sides of the vise jaws and thus assure cleaning up.



FIGS. 3 TO 5. MACHINES AND FIXTURES
Fig. 3—Milling and grinding machines. Fig. 4—Inspector's bench in toolroom with model machine uncovered. Fig. 5—A novel milling fixture on the bench plate

The setting piece, or locating device, is shown in Fig. 5 on the benchplate resting against the front edge of the fixture body. The illustration, Fig. 7, will give a clear idea of the simple method of application by which this little device guarantees satisfactory results in the fixture. The work is designated by the letter *A*, the pivoted jaw shown at *B*, the operating screw at *C*. The seting gage is outlined by the dotted lines at *D*, and has, as indicated, a shallow seat in the face and when applied to the side of the fixture allows the work to be set through the jaws, projecting just enough for cleaning-up purposes.

FIG. 6. DETAILS OF BRASS CASTING TO BE MILLED

The straddle mills are spaced accurately apart for the desired thickness of the work, and the upright portion of the milling fixture, including the fixed jaw, movable jaw, and screw support, are thin enough to clear the cutters when the table is properly adjusted.

It takes no more time to use this setting gage than when an ordinary piece of work requiring no particular place in a vise is being set up for milling. Once the operator becomes accustomed to placing the gage behind the fixture jaws for each piece to rest against as the jaw screw tightens, the process becomes as simple as placing the work in any milling-machine vise.

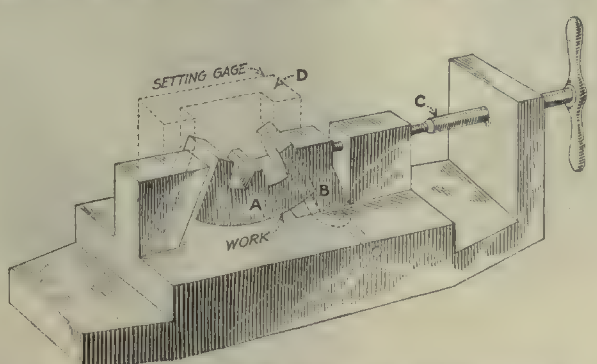


FIG. 7. THE FIXTURE WITH ITS SETTING GAGE

In making jigs and fixtures and in locating holes, etc., in press tools, this tool department makes use of the customary accurate devices in the line of master plates, buttons, sine bars, verniers for milling-machine knee and table, vernier height gages and other hand tools for bench and machine application. Without going into details at this time in reference to such equipment it may be stated that there are many applications of such tools to be seen here.

Reference was made at the beginning of this description to the method of handling certain punch and die work with the aid of the dividing head on a universal milling machine. A job of this character is illustrated in Fig. 8, which shows a blanking punch and die for a small gear wheel, and is one of a number of sizes produced with similar tools at this plant.

This blanking operation is followed by one or more shaving cuts with supplementary press tools turned out under exactly the same conditions as the blanking tools mentioned.

Where a punch is required with regular or symmetrical outline, as in the case of a gear wheel, the universal dividing head constitutes a simple medium for arriving at the desired results. When set up vertically the progress of the work may be watched closely and with convenience, and the same advantages may be found when press tools for other parts are being made if their outlines are such as to admit of either simple rotary or certain indexing movements upon the part of the head that holds the work.

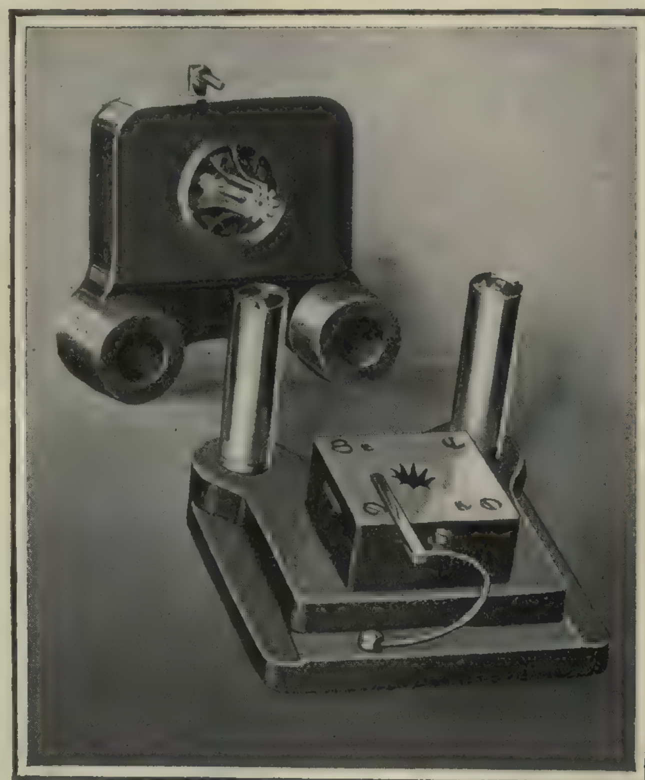


FIG. 8. A TYPICAL SET OF PRESS TOOLS AS PRODUCED IN THIS SHOP

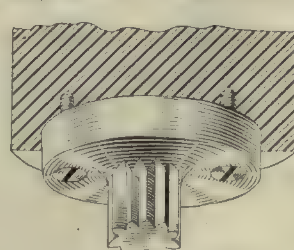


FIG. 9

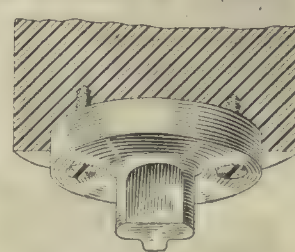


FIG. 10

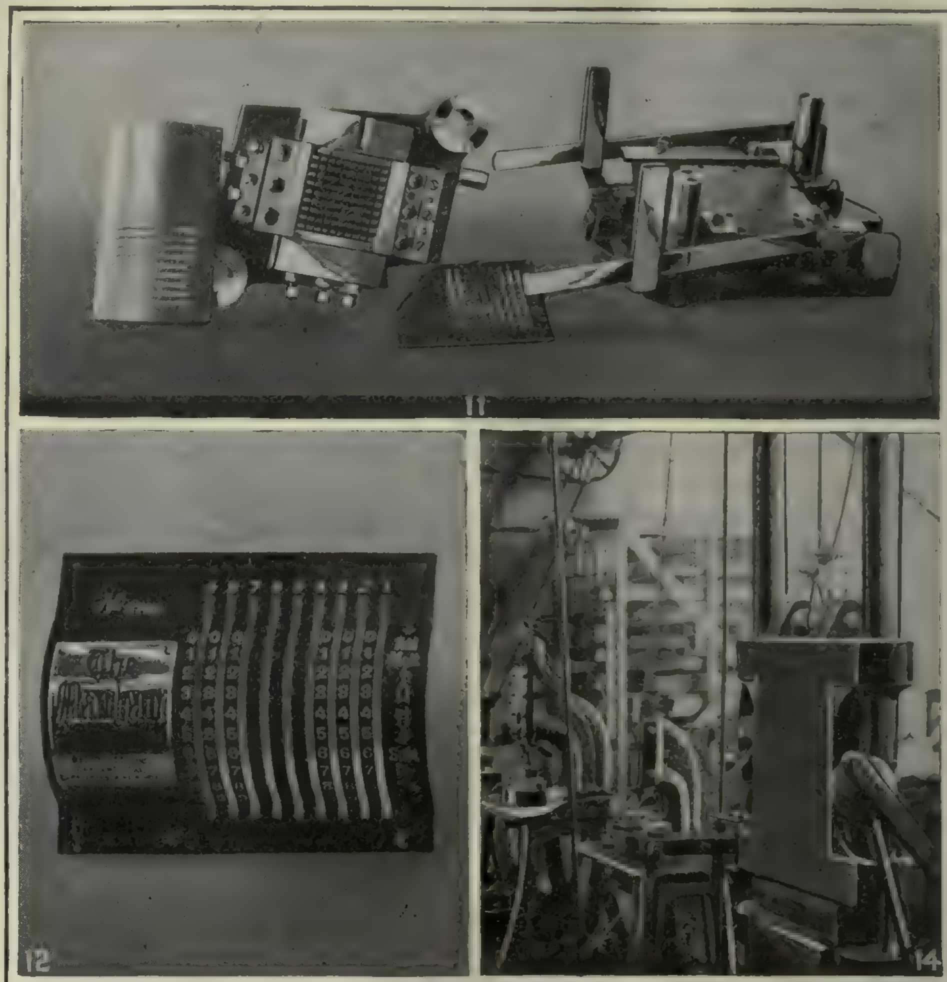
FIGS. 9 AND 10. SOLID-PUNCH CONSTRUCTION

The punch in Fig. 8 can be readily milled by indexing, and if it is desired the die can be worked out by a system of broaches. It is equally simple to cut the broaches in the same manner, and if a slight angle of clearance is desired the head provides for this by adjustment in the required direction.

The punches for various sets of dies at this plant are likely to be made in a solid piece without shank of any kind, but with a body sufficiently large to serve as a holding device for screws and dowels by which it is attached to the punch block or holder. This method of construction is applied wherever the shape of the job and the general conditions admit. Thus, the gearwheel punch in Fig. 8 instead of having a shank in the usual sense of the word is worked down from a larger size of steel, the diameter of which is sufficient to form a body of ample size for attaching directly to the block. The illustration, Fig. 9, pictures this method. The body is made a snug fit in the punch holder or head and the screws hold it securely. There is no possible weakness in a properly made punch like this, for instead of running back to a relatively small shank that gives a certain amount of flexibility throughout the entire length the back of the punch actually strengthens the whole cutting portion by the long filleted surface connecting the two, and further by the broad, flat bearing area which is provided against the bottom of the holder or head for the punch. Fig. 10 represents another type of punch with the same features of body, and the punch is made in one piece. This feature has still other advantages in that it simplifies the construction of the punch holder materially. Where a punch with the conventional shank is used the shank of the punch holder or head must be bored out accordingly, and very often this of itself weakens the holder appreciably. Clamping screws are usually necessary, and these when put in from the side are sometimes unsatisfactory. Moreover, without shanks on the punches the punch heads or holders do not necessarily require to be made with the usual shank, but can be attached by screws, tongue or key to the connecting member, the press ram. Particularly is this the case where the tools are sub-pressed or of the pillar type illustrated in Fig. 8.

In most of the press tools in use are two pillars, or posts, which are used for guiding the head and punch in alignment with the base and die. Where the punch and die are quite large and the head and base are therefore of considerable area and weight, the posts or pillars are located at obliquely opposite corners to enable the head of the sub-press to slide properly by being better balanced than if mounted upon two posts placed at the rear, as in the instance of the smaller tools illustrated in Fig. 8.

An illustration of one of the larger dies, and one in which some unusual features are found, is shown in Fig. 11. This set of tools was constructed for stamping the numerals on the face of the front cover of the calculating machine which give the positions for the setting dials. Looking at the machine in Fig. 4, which is shown uncovered on the benchplate, this sheet-metal cover will be noticed at the left of the machine, and in Fig. 12 the entire series of nine rows of numerals are shown distinctly alongside of the narrow vertical slots in which the operating levers move. The size of the characters and their spacing on the cover plate are best shown by the illustration, Fig. 13, which shows the work to be a brass plate 0.040 in. thick, which is blanked out a little more than 5 in. square and then stamped under the tools described. In the blanking operation the nine slots are punched out 3 in. long by $\frac{1}{16}$ in. wide, leaving a width of stock about $\frac{3}{16}$ in. for the stamped numbers.



FIGS. 11, 12 AND 14. THE PLATE AND STAM PING TOOLS
Fig. 11—A set of stamping tools. Fig. 12—The plate after stamping with the numbers. Fig. 14—The homemade drop for stamping figures on cover plates

The punch is made up of nine rows of figures from 0 to 9, the characters in each row being engraved on a solid block so that there are nine of these stamp blocks with 10 characters each. The body of the block in which they are fitted is planed out to receive them as a snugly assembled unit, and their ends are locked by clamps, setscrews acting against the ends and the sides being placed in the block to set the whole group of stamps up tightly.

The rear ends of the stamps, or figures, rest upon a hardened and ground steel plate in the punch block, which resists the pressure of the 90 characters when they are forced into the work. Similarly the base of the die is of steel hardened and ground to back up and support the work when struck with the punch.

It has been estimated that if this combined punch with its 90-figure stamps were to be operated under the usual power press or in a manner similar to the handling of a coining job, a pressure somewhere between 150 and 175 tons would be necessary to stamp the entire set of characters properly into the plate. These tools are, however, not used in such a press, but under a drop hammer which is a homemade machine, giving satisfactory results with little outlay for equipment.

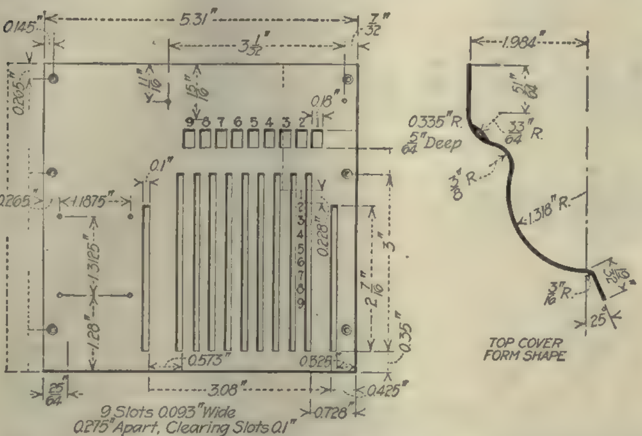


FIG. 13. DETAILS OF THE STAMPED AND FORMED PLATE

The drop press for this work is shown in Fig. 14. It has two uprights of round steel about 4 in. diameter that serve as guides for the drop, which is a heavy casting bored through the side lugs to slide over the guides. While this drop hammer has a fall of several feet, the sub-press head moves only an inch or so, and this merely for the setting of the work on the die. Once the blank is in place, the punch with its 90 stamps is lowered directly upon the brass plate, and the drop then falls with its heavy blow to force the stamp into the metal and form sharp, clear characters therein.

Lifting the Drop Mechanically

The drop is lifted mechanically and the height to which it is raised is varied to suit conditions. The dies are separated to admit the work by means of a pair of projecting arms which are shown attached to the rear of the die base in Fig. 11. There are two rolls mounted on studs on opposite ends of the punch block, and these are located in line with the two levers, or arms, on the die, so that when the latter are lifted they act against the rolls and raise the punch head clear of the die base.

When the arms are swung up to lift the punch to its uppermost position they are held there by stop pins in the slotted posts at the front of the die in which the arms travel in their up-and-down movement. While the punch is thus secured at the top of its travel the work blank is slipped on the die face and the punch is then dropped down to rest upon the work. The drop hammer in the meantime has been held up by a locking device at the right height to clear the dies when opened, and after the work is set the regular lift for the drop is thrown in and the weight rises to the point where a dog at the left side trips the hoist and allows the hammer to fall freely upon the punch.

If the illustration of the dies, Fig. 11, is examined carefully, a guide plate for the work will be noticed at the left side and at the right two small clamps will be seen. There is an adjustable stop at the rear of the die base, and at the front is located another stop which confines the work edgewise so that it is properly nested and held all the way around.

While there are two clamp screws to turn up at each setting of a fresh piece of work on the die, this takes but a moment, and the entire operation of opening the die, setting the work and operating the drop is performed easily and rapidly.

The General Form

After the covers have been numbered along their slots they are required to be bent up to the general form indicated in the end view in Fig. 13, where the central portion with the slots and numbered sections is formed to an arc of about a quarter circle, and one flat portion at an angle with the opposite edge.

The brass plate, after it has been stamped and slotted, is annealed and thus made ready for the forming process. This is carried on with a pair of simple dies made to the outline required and differing from each other only in that one is male and the other female, and the radii of the two are varied to allow for the thickness of the metal plate.

How Not to Push Production

By Entropy

Production begins in foresight, in purchases of raw material, in organization. Continuous production depends on a continuous flow of material and a continuous employment of men accustomed to the work. Some Government officials having to do with the purchase of munitions evidently have not seriously considered this aspect of the case. Their attitude evidently is that it is time enough to give another order when the first is completed. If the firm involved has sufficient faith that the new order will be forthcoming and that the specifications will not be changed then he may order material and work it up in anticipation. Otherwise it is necessary for him to wait for the new order before buying, to suspend operations in each department during the interval covered by the time between the completion of the first operation on the raw material and the completion of the contract. This time is gone and cannot be recalled. The men have scattered and cannot be recalled. A new group of men must be gathered together, with the attendant high cost, trained to do the work, and the machinery of the organization wound up and set going for each new order.

It seems as if this failure to keep contractors supplied with orders can only be due to a lack of knowledge of manufacturing conditions, as it is difficult to think of any other way in which our enemies could be more effectively helped than by the simple failure to sign an obviously needed contract.

For the Sake of the Hohenzollerns

□ □ □

IF any riveter in a shipyard drives only 60 rivets where he could drive 120 he has driven 60 for freedom and he has left 60 undriven for the sake of the Hohenzollerns. If any man works three days at high wages and loafs the next three because of the high wages he has received during the first three he is an enemy to America and an ally of the Kaiser. If any man, if any capitalist, makes an undue profit or if any workman scants his job he is playing the game of tyranny against liberty and he is false to his brothers in uniform at the front.

—THEODORE ROOSEVELT, at Carnegie Hall, New York, May 7, 1918.

Reduction of Accident Hazard

BY R. L. GOULD
Safety Engineer Bridgeport Brass Co.

A discussion of the questions confronting the safety engineer in his endeavor to minimize the risk of accident to life and limb in our industrial plants and suggestions for promoting the work.

UPON the passage of the Compensation Law in 1910 the manufacturer was confronted with a problem which at the time seemed almost insurmountable, and considerable anxiety was felt as to what the result might be on manufacture.

The two vital questions confronting the manufacturer were: "Is it possible to prevent industrial accidents, and if so, how can it best be accomplished?" In seeking the answers to these two questions let us investigate the material at hand in order to ascertain whether or not it is possible for industrial accidents to be prevented.

The chart shows a curve of the accidents in our particular industry covering a period of three years. It will be noticed that there is a general decrease as the years advance. Past experience has proved beyond doubt that we would be committing no mistake by assuming that industrial accidents are preventable. Every accident indicates some defect in materials, machines, methods or men, and, what is perhaps most common, a combination of two or more of these elements.

The relative weight to be attached to each of these factors is not constant for all industries or for all plants in a given industry. After a great deal of experience we have deduced that the efficiency for our safety work is distributed as follows:

	Per Cent
Organization:	
Attitude of officers	20
Safety committee	20
Workmen's inspections	5
	45
Education:	
Instruction of men	15
Prizes	7
Posting signs	3
Lectures	5
	30
Safeguarding:	
Safety device	17
Lighting	5
Cleanliness	3
	25

The foregoing distribution suggests the nature of successful efforts. It indicates that the prevention of accidents can be effective neither by parrot-like utterances of "Safety first" nor by the installation of mechanical safeguards alone. Furthermore, successful experience has demonstrated that spasmodic safety campaigns launched with shouting and dropped soon afterward cannot produce lasting results.

It must constantly be borne in mind that if our industrial accidents are to be prevented or even materially reduced, the seriousness of our efforts must be directed by well-studied and formulated plans, which of necessity must be constant and persistent in application. We must realize also that after we have eliminated the grossly avoidable accidents the results of our efforts will be less apparent from year to year; but having obtained a satisfactory record we must persist in our safety campaign in order to maintain it.

The reduction of accidents depends first of all upon the employer. It is of little use to preach safety to men who work about unsafe machinery and in unsafe factories. Guards cost money, but the compensation paid for a life or an eye would buy many guards for belts and exposed gears. The responsibility of the employer does not end with the installation of guards against mechanical hazards; accidents will happen after all precautions have been taken to guard the equipment through carelessness or ignorance of the workmen or through the driving of a tactless foreman. Accidents from these latter causes the employer is also financially responsible for, and if they are to be prevented he must take the initiative. By doing so the stamp of authority is placed upon the movement. It insures the application of sound business principles to the work and convinces the workmen of their employer's sincere wish to give them better working protection.

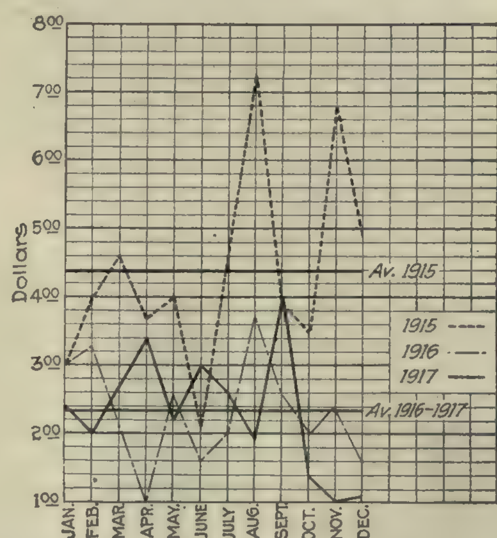


CHART SHOWING COMPARATIVE NUMBER OF ACCIDENTS COVERING A PERIOD OF THREE YEARS

Often it is impractical for the employer to be in immediate contact with his men; in such cases he must invest his superintendent and foremen with the same authority and responsibility in the work of preventing accidents that he does in maintaining production. The attitude of the superintendent is reflected in the foreman, and of the foreman in his men. It is therefore most important that the superintendent is imbued with the right ideas of safety.

Frequently the foreman has difficulty in grasping this point and therefore he needs some education, which, however, cannot be forced upon him; neither can we assume that a mere request for accident reduction will have an immediate response. The foreman, like the workman, must be taught. Some foremen object to coddling the workmen; their own experience when machines were unguarded and when the employer had no interest except in production is still the proper thing

with them. In teaching the foreman his new responsibility tact is required, as some resent interference with their men, especially if their crews have high records for output.

It has been said that there is a necessary conflict between safety and production; that guards on machinery hamper the operator and reduce his output. This is undoubtedly true in some instances. There are guards in some factories which not only hamper production but are more of an accident hazard than no guard at all. This is an important matter that some safety engineers have to learn.

From the writer's experience it has been proved that adequate accident prevention pays, and increases rather than decreases production for the following reasons: First, the personnel of the organization is kept intact, thus obviously increasing production, by reducing the cost of manufacture; second, it saves the expense of doctor and hospital bills, which amount to surprising sums in some instances; third, above all the psychological effect of an accident is very depressing and naturally reacts in lost production.

There are properly three general classes of endeavor to be considered by the safety engineer: (1) Mechanical guarding and inspection; (2) analysis of accidents, and (3) education. In the first class no effort will be made here to treat the subject exhaustively as it would require a special study of each purpose for which mechanical guards are used. It is intended only to suggest principles upon which the proper guarding of machines may be based.

Mechanical Guarding

A careful scientific study of machines as regards industrial hazard is the best means of reducing it. In this connection we submit to manufacturers at the time of a request for quotations on machines specifications of our requirements, which are that all exposed gears be entirely guarded; all large driving belts must have a guard about them, and in the case of a lathe a cover must be placed over the chuck to prevent a man's hand or jumper from being caught in the jaw-adjusting screws. It also prevents the mechanical guard from being, as it is now, an afterthought overlooked in the original design. These specifications are necessarily only general, but they save us much trouble and expense and have a good effect on manufacturers who have not yet thought of the importance of reducing the tremendous accident rate of the United States.

By a coöperative exchange of ideas all employers may learn from each other the best means of guarding their machinery. Such an exchange may result from visits of inspection to other plants or by coöperation with the associations acting as clearing houses for information.

Whenever feasible, guards should be automatic in action, application and operation, thereby removing the possibility of their being so adjusted as to neutralize the protection they should afford. A subject closely allied to mechanical guards is that of machine control. As far as possible every floor, room and machine should be under separate control. Inability to stop a machine instantly has caused many a serious accident. Whether driven by belt or by motor direct it is a simple matter to so adjust the control as to stop any machine or operation without interfering with any other.

All guards should be accessible and great care should be taken in this connection, for it frequently happens that the least little hitch in making the inspection, or in oiling, adjusting or repairing may result in an accident.

Accident Records

Accident records and their analysis are perhaps the most important phase of the safety engineer's work, for it is through the study of these that the various classes of hazards are brought out and guarded against. The following method is used by several large companies: When an accident occurs a thorough investigation is made and reported in a form for that purpose. At the same time a statement from the foreman is obtained regarding what is necessary to prevent its recurrence. This report should be scrutinized carefully by the safety engineer, and if necessary the foreman should conduct a supplementary investigation to check up the first report. Accidents that are reported by the foreman as unavoidable should be subjected to further special investigation. At the time of injury the foreman should make out and send to the hospital a record giving the person's name, number, and length of time he has worked on the machine or operation, the number of the machine, and a brief statement of the cause of the accident. Additional spaces are allotted for other information such as the number of the accident (numbering consecutively from Jan. 1), the date and time of the injury and the diagnosis of the nurse or attending physician. A copy of this is forwarded to the nurse, the safety engineer, and one is retained by the foreman. This gives the engineer necessary data from which to make his analysis. For example, the time of day may not seem to be of any great importance, but repeated investigations at our plant has brought out that more accidents occur between 10:30 and 11 a.m. and 3:30 and 4 p.m. than at any other periods of the day. By 10:30 in the morning and by 3:30 in the afternoon the accumulation of worn-out tissues in the body is sufficiently large to produce a state of physical fatigue which in turn produces mental fatigue. Hence the workman becomes less alert and at the same time his muscles become less capable of responding to the demands put upon them. This is especially true of punch-press and other operators whose work is monotonous or involves speed and close attention.

The one means of preventing the accumulation of these worn-out tissues or fatigue poisons is occasional relaxation. To prove this the writer tried diverting the attention of the operatives in various ways at this fatigue period, such as by introducing fire drills, shutting off the power, inspection of machines, etc., and the result gave great promise of success in decreasing the accident rate, while the production of the department was not lowered; in fact, it was observed in one day's experiment that production actually increased.

The word welfare has been often used during the experimental stage of the efforts of employers to create among the workmen a feeling of loyalty and to increase the spirit of coöperation. As these attempts have been made quite generally in a spirit of paternalism, charity and philanthropy, their possibilities as an aid to efficiency and safety have sometimes been lost sight of or subordinated. Yet, since a workman does not and can-

not detach himself as the tender of a machine from his existence outside the factory, the employer should be interested in the man's welfare generally. For example, we recognize the close relationship between the free-lunch counters and accidents; suitable places in the factory building, therefore, should be provided where the men may eat their lunches and spend their noon hours, and great care should be exercised to avoid creating the impression of paternalism, as this would surely lead to failure. Perhaps the best way of determining the time when it would be successful is to wait for a demand from the employees. Never establish a wonderful, complete restaurant and then ask the men to come to it; rather wait until the demand arises and then build up gradually to meet it.

Washrooms, locker rooms, and washing and bathing facilities pay safety dividends. Washing facilities are effective in reducing the number of infections, while bathing facilities ward off occupational diseases and help to preserve the general health of the employees.

The possibilities of welfare work have never been sounded. Too often the subject suffers from misguided interest or sympathy rather than from the lack of use, but properly arranged and conducted it becomes a powerful factor in safety and efficiency campaigns. That the name often meets with opposition from the workman is because of the tactless methods used by employers who did not know the conditions in their shops nor were close enough to the workman to know his feelings.

Carelessness a Prolific Cause of Accident

The attitude of mind which makes a workman indifferent to or contemptuous of industrial hazards is one of the most common causes of accidents. Add to this ignorance concerning proper methods of prevention and we have the two elements of a mental hazard. Carelessness and recklessness are said to be national characteristics of the American people. To illustrate this perhaps a few statistics that are easily analyzed will not be amiss. In one concern employing about 11,000 people the American boy received 5070 accidents out of a total of 17,516, the Italian being next with 4192. The percentage for employed Americans was 36; the percentage for employed Italians was 23. The percentage for injured Americans was 28.9, and for Italians 19.5. These figures show that the American boy should receive some education in personal safety, and it contradicts the belief that the illiterate foreigner is more liable to accident than the "keen" American.

Experience proves that satisfactory results are not always reached by merely telling men not to hurt themselves. Workers, like others, are often indifferent to their own safety. They continue to follow unsafe practices because they have always done the work this way and "have never been killed yet." This blind belief that old methods and old practices are best is one of the most difficult obstacles to overcome in the extension of safety ideas. Furthermore, workmen like other classes of people, resent innovations. They add contempt to indifference when safety is first talked to them, for they look upon guards and safety practices as an accusation that they are unable to take care of themselves. They oppose the book of rules as an insult to their intelligence.

Even when a workman has been told that a certain practice is dangerous; even when he knows that an accident has occurred to another man because of a similar practice, he does not believe that he too might be injured in the same manner. If the accident occurred in his department he may discontinue the practice for a time, but, generally speaking, he lacks imagination, and he is unable to picture himself in the place of the man who was injured.

Education

All that has been said points to the need of safety education. Safety talks and orations may avail for a time if they produce a strong emotional effect. Warning signs prevent certain classes of accidents if they are heeded. Safeguards prevent other accidents if they are not removed or broken in such manner as to render them useless if not an actual hazard. Punishment changes the trend of thought for a time if it is not evaded. But the most effective means of reaching the workman is education of a type that makes him really think safety and that aids in the formation of safe habits.

Most men can be convinced of the necessity of avoiding unsafe methods and places if they are tactfully approached. As stated before, education must begin with the superintendents or foremen who are actually in charge of the men. Coöperation is usually found to be the better plan, for each man, even while learning, can be enlisted to teach others.

The man in charge of safety work must be an "easy boss." He must have unusual personality so that he can gain and retain the confidence and support of every man in the plant, from the head of the enterprise to the most recently hired common laborer. His chief stock in trade should be suggestion rather than force, however. A rule that is not enforced is worse than no rule at all, and no rule should ever be established that will not be lived up to by everybody from the president of the establishment down. Thus suggestion, education and persuasion are the proper courses to pursue until the majority of the men have adopted the desired practice. Then such practice may be announced as a rule of the plant to be enforced as are other rules.

For the persistent minority who refuse to adopt the practices of the majority some form of discipline is required. Discharge is seldom necessary, but occasionally some irresponsible individual who refuses to act upon a suggestion, the success of which has been demonstrated, and who threatens to demoralize his department by refusing to comply with safety rules, becomes such a menace to the safety of himself and his fellow workmen that dismissing him becomes necessary and there should then be no hesitation in doing so as a warning to others.

Organization

Marked success in the prevention of accidents can be obtained in industries where safety work is organized and responsibility for results is properly placed. In the first place some one with the qualities alluded to in the preceding paragraph should be selected as a director of the safety work, who will give part or all of his time to this work, this depending largely on the size of the plant and the scope of the work. He should have associated with him as a committee the various superintendents of the plant, care being taken not to place

a director or officer of the company on this committee, as the tendency would be for such an officer to dominate the meetings and squelch the initiative of the other members. The duty of this committee would be to act as an advisory board and to discuss with the safety engineer the various problems which confront him and on which he has not the authority to act. It should also have power to pass on general policies and practices, lay out propaganda, etc.

As soon as the campaign to reduce accidents is launched, frequent meetings of the superintendents and foremen should be held to measure the progress of the work and to discuss means of creating interest and enthusiasm. Committees of foremen should be formed and should be assigned definite duties, such as inspections of mechanical guards, investigations of the causes of accidents which occur in the plant and recommend means of preventing their recurrence.

Meetings of Employees

After much guarding has been done and coöperation of the superintendents and foremen has been secured, a meeting of all the employees should be held, by departments if necessary, and the causes of accidents and the means of preventing them should be discussed. At such a meeting a workmen's committee should be appointed and its duties outlined. Earnestness, sincerity and enthusiasm should be the keynote of this meeting so that the campaign among the workmen may be given sufficient impetus to carry it past the first line of opponents who need to be convinced of the value of such work.

Because of the necessity of experimentation even in the installation of mechanical guards until definite safety standards can be applied it is desirable that the directors of safety in various plants be given every opportunity for exchanging ideas. Since so many accidents are common to all industries such an exchange between men even in widely different lines is productive of results.

The functions of the workmen's committee in general may be divided into two kinds—educational and regulatory. The emphasis placed on the latter will vary in different industries. If there is a supplementary staff of inspectors working with the safety engineer the functions of the workmen's committee ought to be chiefly educational. If on the other hand there is not such a staff the functions will be divided.

It has been the experience of the writer that the benefits derived from the workmen's committee lies chiefly with the regulatory phase. For a long time after their formation or until the physical hazard of the plant is reduced to a minimum the workmen's committees give their entire attention to such physical hazards as are discovered, and upon the adoption of the first suggestion the good work begins and a friendly rivalry has been created.

These suggestions can be capitalized and made valuable in shop housekeeping and the detection of unsafe practices, such as bad lighting, ill-ventilated rooms, unsanitary toilets, etc., which are often overlooked by the safety inspector.

It has been found desirable to provide foremen and workmen a means of checking up the progress of the safety campaign in their department; to encourage them in their efforts to produce results in the form of a smaller percentage of accidents and to spur them on when their records are below the average. A scoreboard record for successive periods is a concise method of presenting such comparisons. It is highly desirable that all injuries, even those that seem trivial, should be reported in order that infection may be prevented. The matter of what should be an accident is being seriously considered by the National Safety Council and by the United States Bureau of Labor, but I think I am safe in saying that most concerns consider the loss of one day's time an accident, and this tends to remove the incentive of the workman to hide trivial injuries in order to keep up the score of his department.

A simple and convenient system is to base the score upon the ratio of lost-time accidents to the average number of employees. For example, assume that in a given department employing an average of 200 men there are eight accidents; this gives us a rate of 40 accidents per 1000 employees. By subtracting 40 from 1000, considered a perfect score, we obtain an efficiency safety score of 960 for the month.

It is of course unfair to compare one department whose work is particularly hazardous with that of a department whose work is less so. It is therefore advisable to compare each department with itself. By comparing the score of a department for a given month with its average monthly score for the preceding year a satisfactory measure of progress can be attained.

Some employers have found that they can increase interest in inter-departmental competitions by offering monthly, quarterly, or yearly prizes to the winners. Some give a safety banner to the department with the highest score, and numerous schemes are being worked out with a view to the material reduction of accidents.

Fishing for Inventive Suckers

By George L. Appel, Jr.

I was greatly interested in the revolutionary invention conceived by the master mind of E. A. Dixie for simplifying the rifling of gun barrels, as published on page 737 of the *American Machinist*. However, I believe it to be susceptible of improvement.

His method with large guns was to make a solid central rod and put the rifling on it. Why not dispense with the outer tube entirely and use only the central rod? Consider the saving that could be made. Rifling the outside of the tube and turning it wrong side out I do not consider feasible. I once made a machine to turn macaroni inside out before cooking so that the boiling of any of the early settlers could be avoided. So long as my own high degree of skill was applied to the machine it worked well, but I found it very difficult to teach anyone else to operate it. This, I think, would be the great drawback to the method as applied to rifle barrels.

Why would it not be better to cut the rifling on the surface of a suitable nickel-steel plate, then roll it and weld it after the maner of making gas pipe. The rifling could then be done on a milling machine.

As to taking the slip out of the banana peel, the editor pertinently remarks that it would be necessary to sand the inside of the peel as well as the outside. What is easier than to cross the banana with spinach, which seems to harbor plenty of sand in its interior?

II. Screw Machine Work

The screw-machine department of the factory in which the operations discussed in this article take place is under the supervision of W. F. Carmody, who was detailed by Brown & Sharpe in 1915 to go to France to supervise the installation of their screw machines for the French government. This of itself is something of a recommendation, and that Mr. Carmody has developed some interesting tools and methods for screw-machine work goes without saying.

SHOP records show that the screw-machine department of the Felt & Tarrant Manufacturing Co., Chicago, Ill., produced nearly 10,000,000 parts from Dec. 17, 1916, to Dec. 17, 1917. A large percentage of these parts was finished to tolerances of from 0.0001 to 0.00025 in., which the writer believes is a degree of accuracy almost unheard of in screw-machine production.

These results were not secured at a sacrifice of time; on the contrary, in most cases the time per piece would be considered low even if the limits were more liberal. Fig. 7 illustrates a few of the many parts made on Brown & Sharpe automatics.

Mr. Carmody is an advocate of cast-iron cams for automatics, and uses some interesting methods in making them. The blanks are cast in various sizes for the different-size machines and cover either a full circle, a half circle or whatever part may be desired, and are bored and faced on both sides ready for the layout, as shown on Fig. 8.

The layout templet, or protractor, is shown applied to a cam blank in Fig. 9. It will be noticed that this protractor is not divided into degrees, but into 100 divisions, which facilitates the work.

The layout for the piece to be made is figured and

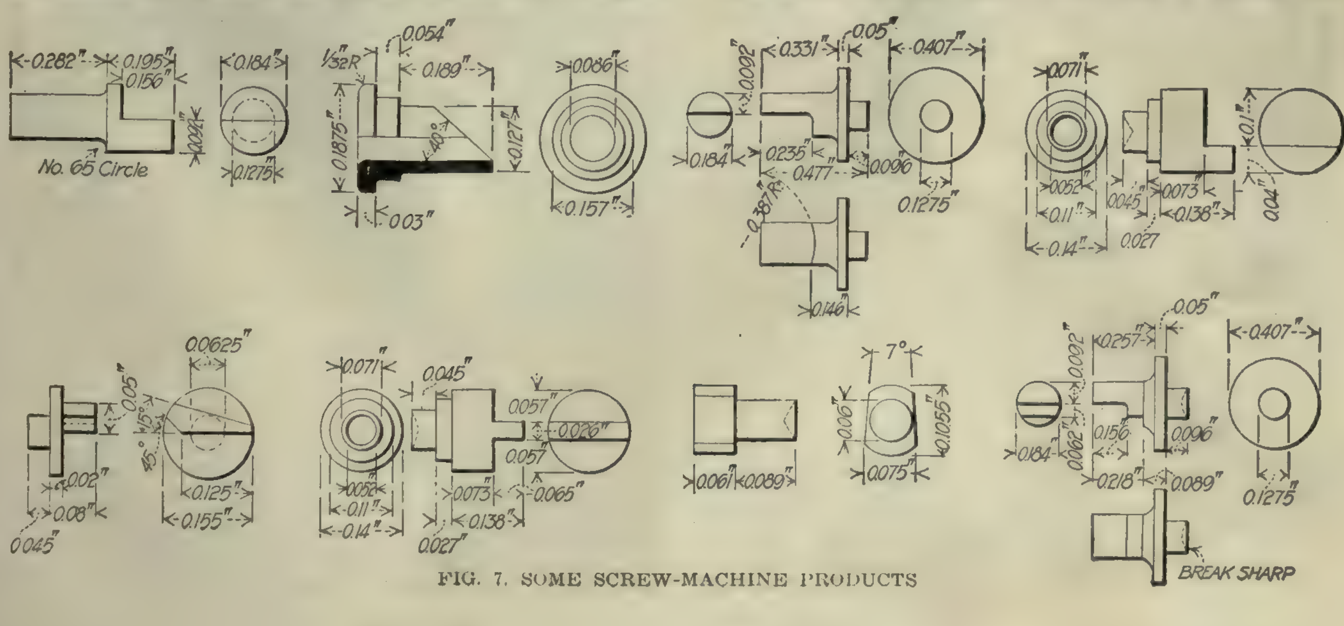
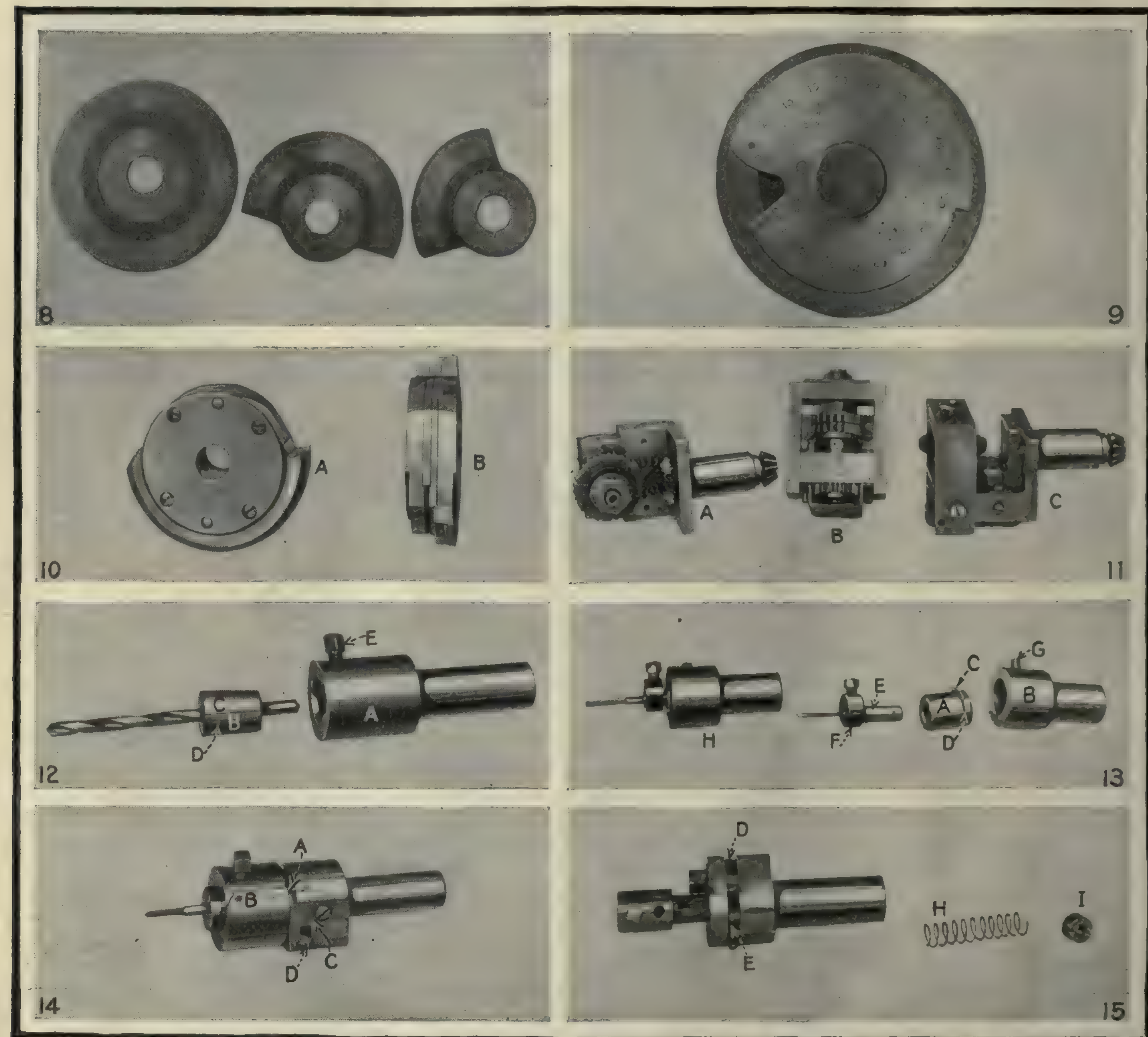


FIG. 7. SOME SCREW-MACHINE PRODUCTS

charted on the form sheet. This sheet contains all the data required to make the piece, the number of revolutions and cam travel, etc. On the opposite side of the sheet is given all the data required by the toolmaker for setting up his milling machine. This means that the toolmaker loses no time in figuring or in drilling out dead stock as is the case when cams are made from flat steel or iron stock.

After the cams are finished they are hardened. This is done by heating the piece up to a low red and plunging in a mixture of chemically pure red sulphide of arsenic, 10 oz., and chemically pure sulphuric acid 9 lb. The ingredients are mixed in a stone jar and are stirred up well just before plunging the piece to be hardened. Great care must be exercised in using this mixture. The container should be under a hood, with strong draft to carry off the fumes, and the operator should have arms and hands well protected with rubber clothing and rubber gloves, for the liquid spatters and will cause severe burns if it gets on the hands or clothing. The fumes, if inhaled, may produce acute arsenical poisoning. The degree to which the work is heated varies somewhat with the iron and the age of the hardening mixture and is arrived at by experimenting.

In order to secure the exact thickness of the turned shoulders and fins or the exact width of deep grooves built-up forming tools are used similar to those shown in Fig. 10. The tool at A shows the method of fastening the several members together with dowels and screws. The piece at B shows a cross-section of the tool and how extremely sharp corners are obtained by undercutting to allow one member to enter another. While this method at first sight may look expensive it is really the cheapest way to make forming tools where extreme accuracy is required and where deep cuts are necessary, for it is a comparatively simple matter to grind and lap each member to exact size after hardening, and should any one part break it can be readily replaced without making an entire new tool.



FIGS. 8 TO 15. SCREW-MACHINE CAMS AND TOOLS

Fig. 8—Cast-iron cam blanks. Fig. 9—Protractor for cam layouts. Fig. 10—Built-up forming tools. Fig. 11—Milling attachments for B. & S. automatics. Fig. 12—Type of drill holder used. Fig. 13—Floating reamer holder. Fig. 14—Tap holder ready for use. Fig. 15—Some tap-holder details

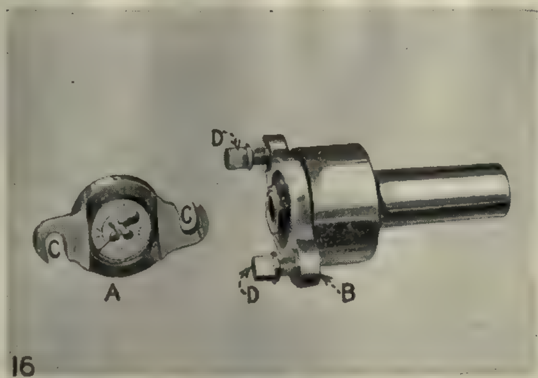


FIG. 16. BUTTON-DIE HOLDER

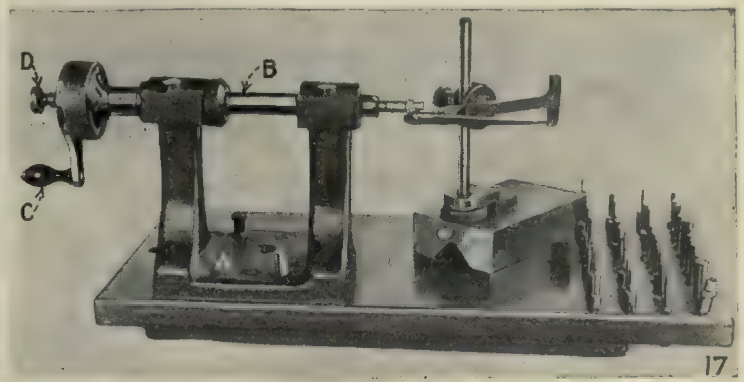


FIG. 17. TEST GAGE FOR CONCENTRIC PARTS

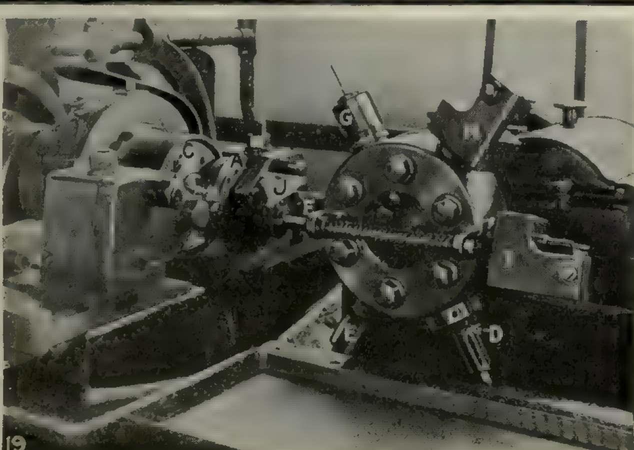


FIG. 19. AUTOMATIC SET-UP FOR FIG. 18

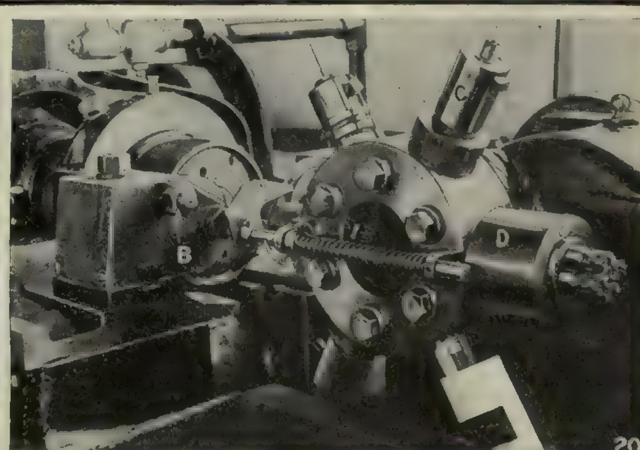


FIG. 20. AUTOMATIC SET-UP FOR FIG. 21

Mr. Carmody does not depend on formed cutters for exact diameter of hubs, shoulders, etc., but uses them to bring these parts to within two or three thousandths of an inch of size, and finishes to exact size with box tools, and secures most accurate results and fine finish by their use. Wherever possible these box tools carry a pilot to support the work. The writer has measured up pieces on one end of which there was a shaft about $\frac{3}{16}$ in. in diameter by 2 in. long and found that this shaft did not show a variation of over 0.0001 in. throughout its entire length.

By referring to Fig. 7 it will be seen that many of these pieces made on the automatics have milled portions. This milling is all done on the automatics with milling attachments similar to those shown in Fig. 11. These attachments fit the turret head of the automatic and are operated in the same manner as regular drilling attachments.

In the illustration *A* is shown one of these tools with the metal case removed to expose the two miter gears. Pinions on the end of the miter-gear shaft and on the cutter shaft serve to drive the cutters shown in the tool at *B*, in the middle. These milling cutters are spaced to mill a tongue of exact thickness. *C* shows a tool with gear covers in place ready for use.

There are a number of drill, reamer, tap and die holders in use in this shop, which greatly facilitate quick set-up and quick replacement in case of breakage.

All parts of the drill holder shown in Fig. 12 are hardened and ground. The taper hole in the head of *A* is ground to a standard gage so that all holders are interchangeable. The taper plug *B* is hardened and ground to fit the taper hole in the head, and the hole for the drill shank is ground true with the outside. The wedge *C* is ground for relief on the sides so that it gets a bearing on the drill shank before it wedges in the plug. A pin driven into holes drilled through the plug and wedge at *D* keeps them from coming apart. The hole in the wedge is redrilled so that it has sufficient play on the pin *D* to permit of its being clamped to the drill shank by the setscrew *E*. Each holder is provided with plugs having various-sized drill holes.

The reamer holder shown in Fig. 13 provides for quick replacement of broken reamers and allows the reamer to center itself in the work. The plug *A* is ground to fit the hole in the head *B* and is provided with a soft-steel tongue *C*, which fits the sawed slot *D*. This slot is sawed about one-third of the way through the central hole in the plug. The holder *E* is enough smaller than the hole in the plug to insure the correct amount of float and has a slot sawed in it to match the one in the plug *A*. True with the outside is a hole of the same diameter as the reamer shank. The outer end is split centrally for some distance back to permit clamping by the setscrew in the collar *F*, which is drilled eccentric to afford bearing for the screw.

To assemble this holder a reamer is put into the holder and fastened by the setscrew and collar *F*. It is then inserted in the plug until the sawed slots align and the tongue or key *C* is slipped into place. These parts are then slipped into the head and fastened by the setscrew *G*. The parts assembled are shown at *H*. The reamers used are made from ground stock and have three lips, or lands, and do all the cutting on the end. The lands are left of sufficient width to support the reamer.

A tap holder of unusual construction is shown in Fig. 14. The part which holds the tap is of similar construction to the drill holder already described, but is ground straight instead of tapered and the bottom of the clamping wedge is flat. The taps are bought with shanks of special sizes so that one holder can be used for a number of sizes of taps. The shank has a flat ground on it to match the flat on the wedge. A hardened pin at *A* in the back of the head *B* engages the hardened-steel finger *C* when the tap is cutting. This finger is adjustable by means of the screw and slot shown, so that the depth of the tapped hole can be regulated. When the tap has entered the work the correct distance the pin *B* and finger *C* disengage and the tap and holder are free to turn so that no further cutting takes place.

A longitudinal milled slot in the shank of the holder engages a hardened pawl *D* in the head. The pawl is held in place by a spring *E*, Fig. 15, screwed to the outside of the holder. When the head is turning in tapping position the pawl slips over the groove in the holder shank, but as soon as the work is reversed to withdraw the tap the pawl *D* engages in the slot and backs it out. The holders are held back in the heads by the spring and screw shown at *H* and *I*.

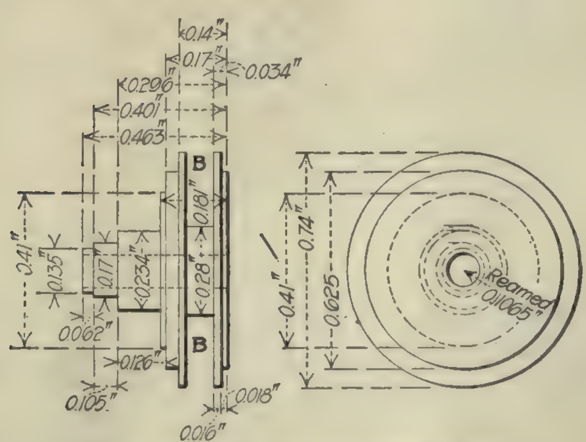


FIG. 18. A DIFFICULT PART TO MAKE

The button-die holder shown in Fig. 16, *A*, shows the back side of the holder with a die in place, suitable screws being provided for adjusting and clamping the die. The slots *C* are a loose fit on the binding screws *D* in *B* so that the die may center itself on the work when setting up. When the die has been centered on the work the binding screws are tightened down and hold it firmly in place.

A gage for testing parts is shown in Fig. 17. The head *A*, is mounted on a cast-iron surface plate and carries a hardened and ground shaft *B* in adjustable bearings. Thrust collars are also provided to prevent end play. At the rear end of the shaft is a crank *C* for turning it. The front end of the shaft has a ground taper hole. Hardened and ground tapered-plug mandrels are provided to hold the work. A Starret test indicator mounted on a base provides means for testing the pieces. The shaft *B* is hollow and has a knockout bar *D* to drive out the plug mandrels, a set of which are carried on the base as shown at the right.

One of the most difficult parts to make on account of the various diameters and the small width of slot, together with the small limits, is shown in Fig. 18. The tool set-up for this job is shown in Fig. 19.

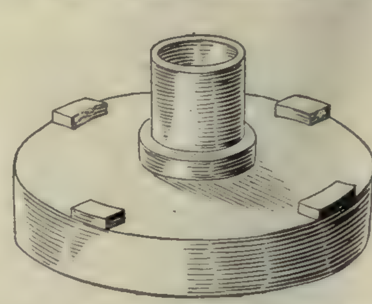


FIG. 21. AN UNUSUAL PIECE OF AUTOMATIC WORK

Two forming cutters are used and operated at the same time and so support the work. The back tool *A* roughs out the groove *B*, Fig.18, and cuts off the finished work. The tool *C*, Fig. 19, roughs the various hub diameters and finishes the groove, about 0.0003 in. being left by the tool *A* for finish.

The tools in the turret are: *D*, stock feed stop; *E*, center spotting tool; *F*, drill; *G*, reamer; *H*, first box tool; *I*, second box tool.

The piece *J* carried by the bar and spring extending across the face of the turret is an automatic drill cleaner which removes chips from the drill as it is withdrawn. The action of the tool is better shown in Fig. 20. The sheet-metal guard carries on its front a flat steel finger with an opening through which the drill passes. When the drill is not in cutting position its point just protrudes from this opening, but as the drill comes to position and the turret advances the end of the bar *A* strikes the stud *B* on the front tool holder and retards it so that it is kept from touching the work or interfering with the drill. As the drill is withdrawn from the work the spring on the rod forces it forward and strips the chips from the drill, thus preventing a great deal of drill breakage due to clogging.

The set-up shown in this cut is for forming and milling the piece shown in Fig. 21. In order to secure the four little studs on this piece it is counterbored with tool *C*, Fig. 20, and then end milled with the quadruple milling fixture shown at *D*.

A Modern Ordnance Plant

The Secretary of War has entered into an arrangement with the United States Steel Corporation by which that corporation undertakes to construct and equip for the Government a modern ordnance plant on a site that is to be selected in the interior of the country. A committee formed from officers of the corporation and its subsidiary companies, men fitted by education and experience, will be in immediate charge of the work. They will receive no compensation for their services. The plant is to be built, equipped and operated at the expense of the Government by the United States Steel Corporation without profit. Cannon of the largest calibers will be manufactured, as well as heavy projectiles in large quantities.

ORDNANCE DEPARTMENT

Changes Made in the Organization

Changes have again been made in the organization of the Ordnance Department, the statement issued by the War Department being as follows:

By an order of the Acting Chief of Ordnance certain changes are made in the organization of the Ordnance Department.

The chief purpose of these changes is to obtain greater freedom of action and increased efficiency in the operating divisions of the Ordnance Department charged with the execution of the ordnance program by bringing the operating divisions more closely in contact with the Acting Chief of Ordnance.

Divisions Under New Order

The divisions under the new order are as follows:

(a) The Administration Division—The name of the General Administration Bureau is changed to that of the Administration Division, without however any change in the work with which it is charged, which is administration of finance, personnel and property; the collection and dissemination of information other than statistical information, and the maintenance of relations with certain outside agencies.

(b) The Engineering Division—The name of the Engineering Bureau is changed to that of the Engineering Division. The Engineering Division is charged with the preparation of designs and specifications of material and the decision as to types to be manufactured.

Estimates and Requirements

(c) The Estimates and Requirements Division—Charged with the formulation of requirement schedules based upon the man power program dictated by the General Staff. This division is also charged with the statistical analysis of the work and progress of the Ordnance Department.

(d) The Procurement Division—This division is charged with the purchase of all ordnance material, a task which includes the development of facilities for manufacture, as well as the letting of contracts where such facilities already exist.

(e) The Production Division—Charged with the responsibility for production.

(f) The Inspection Division—Charged with the responsibility of maintaining quality and uniformity in production.

(g) The Supply Division—To this division is assigned the entire task of storage and distribution of more than 50,000 different articles supplied by the Ordnance Department to the armed forces.

This form of organization places special emphasis upon the importance of production, and gives the freest rein to those divisions charged with that responsibility.

The changes made do not however constitute a reorganization of the Ordnance Department. The achievements of that department during the past few months are considered to have demonstrated the soundness of the form of organization planned last fall, and finally established by official order on Jan. 14, 1918.

It has been realized for some time that certain modifications and improvements in the plan of organization would be suggested by actual operation under that form of organization.

The order just issued is an improvement and development of the plan of organization as it existed heretofore.

Principle Change

The main change, it will be noted, is the elimination of the Control Bureau and the substitution of the Estimate and Requirement Division, its duties being as stated in paragraph (c). This change, it will be seen, does away with any check or control on the other divisions, except such as may be exercised by the Administration Division. This change, it is assumed, will not prove entirely displeasing to either the Procurement or the Production divisions.

The changes noted maintain to what might be called an extreme degree the functional method so dear to the hearts of all true disciples of F. W. Taylor. Those who feel that while the functional idea has its useful field it should be subordinated to a centralized control of products, and point out that under this plan there is no one man who is responsible for guns or rifles, or grenades. The gun designer, for example, is responsible for design, but has no authority or responsibility when it comes to letting contracts, following production or inspecting to see that they are right. Each division has its gun man, but no one man has his finger on the pulse of the gun situation and keeps tabs on the whole unit, carriage and all. Some feel that some such change must be made before the machine will run as smoothly as it should.

How to Deal with the Ordnance Department

By A. Breach

I was greatly disappointed in the article headed "How to Deal with the Ordnance Department" on page 545 of the *American Machinist*. I hoped that I could learn something from it, but failed to do so. I did find out, however, that the Ordnance Department was a pretty big thing and required a great number of square feet for its business.

Now, Mr. Editor, why should it be necessary for anybody wanting to obtain a contract and having a shop in which to carry it out have to go to Washington? If he goes he cannot take his shop with him, and the officer whom he sees has to accept his verbal statements instead of written ones sent by mail. Does it not seem that the Ordnance Department cannot be relied upon to read and carefully consider a statement and must therefore be approached and worried into acknowledging the existence of a shop prepared to do its work?

As to the question of brokers let the officer who wrote the article take off his uniform and go to Washington and see if the broker does not exist as well as the other conditions described.

Today no officer or civilian can figure the cost of anything within 10 per cent., and any man that cannot get more than 10 per cent. on contract, at least having so much profit in sight over and above the usual unexpected, is not a business man, but a gambler.

New Restrictions Put on Exports To Conserve Tonnage

In order to conserve materials and labor and add tonnage to the fleet carrying men and munitions to Europe the War Trade Board has arranged to have the governments of Great Britain, France, Italy and Belgium pass upon the advisability of releasing all proposed exports before licenses are granted to shippers. This new rule was put into effect on May 15, and no application for licenses will be considered unless the official representatives of the nations named believe them to be essential to the war.

Coöperation of Boards

The War Industries Board will work in close coöperation with the War Trade Board and the agents of the allied governments. These organizations must give their sanction when shipments of material over which they supervise are involved, even though licenses have been granted. This will give the War Industries Board absolute control of the materials which they believe should be conserved in this country.

The plan is to make possible a survey which will be invaluable in distributing the resources of the United States among the principal nations with which it is allied, and therefore prevent the useless consumption of materials and labor in making articles for export which for the present may not be exported.

The new ruling does not cover shipments to the colonies, possessions and protectorates of the nations. The following is the text of the instructions that have been given out:

On and after May 15, 1918, applicants before filing applications for license to export any commodity to the above-named countries must obtain thereon the written approval of the mission in the United States of the country to which the exportation is to be made. To secure this approval applicants should forward their applications, duly executed in triplicate, with proper supplemental sheets attached thereto to the British War Mission, Munsey Building, Washington, D. C., for shipments to the United Kingdom; the French High Commission, 1954 Columbia Rd. N.W., Washington, D. C., for shipments to France; the Italian High Commission, 1712 New Hampshire Ave. N.W., Washington, D. C., for shipments to Italy; the Belgian Commission, Room 202, Council National Defense Building, Washington, D. C., for shipments to Belgium.

One copy of approved applications will be forwarded by the missions directly to the Bureau of Exports, Washington, D. C.; one copy retained, and the other copy returned to the applicant for his convenience in keeping a record.

Applicants will be required to agree with the War Trade Board not to purchase nor acquire for export, nor to take any steps in the process of producing, manufacturing or fitting for export the articles specified in the application until an export license has been duly granted.

If, prior to May 15, 1918, any of the articles specified on such applications were purchased or acquired for export or if any steps were taken in the process of producing, manufacturing or fitting for export such articles, applicants must agree that after export licenses have been issued exportation thereunder will not be made until written approval of the United States War Industries Board has been received with respect to articles in Schedule A.

Applicants should not apply to the United States War Industries Board for approval until they are actually in receipt of export licenses.

On July 1, 1918, all outstanding licenses granted on or before May 14, 1918, will be revoked. Any goods not exported against such licenses may thereafter be shipped only if licenses are secured after being applied for, as above set forth.

The following articles are given in Schedule A as adopted May 13, 1918:

Aluminum (metal); asbestos; boilers, high-pressure steam; carbon electrodes; chemicals as follows: acetates, all acetic anhydride, acetone; plates; sheet bars; slabs; tinplate; wire rope; lumber, all kinds; machine tools as follows: slotters (all sizes); grinders (internal, plain and universal); arsenic compounds, all; carbon disulphide; chrome compounds, all; cyanides; dyestuffs, all; etylmethylketone; explosives; formaldehyde; glycerine; manganese compounds, all; nitrobenzol; potassium salts, all; pyrites; saccharine; chromium ore; copper (metal); copper wire and cable; ferroalloys, all; graphite (crucibles and electrodes); iron and steel products, consisting of billets, blooms, boiler tubes, ingots, pig iron; boring machines (horizontal and vertical); boring mills; lathes (30-in. swing and larger); milling machines, No. 3, or Universal, and larger; planing machines (all sizes); radial drills (4-in. arm and larger); manganese compounds, all; manganese ore; mercury; mica; nickel (metal); optical instruments; optical glasses; sodium metallic and any metal or ferroalloy thereof; spiegeleisen; tin (pig or block); tungsten, tungsten steel and ore and wolframite.

In the interest of greater expedition in the issuance of import licenses the War Trade Board has decided to ask the coöperation of importers. On and after May 20, 1918, applicants for import licenses will be asked to state the paragraph or paragraphs in the tariff schedules under which the commodity sought to be imported is classified. This will enable the Bureau of Imports to determine at once whether the commodity is restricted or unrestricted. The tariff schedule should be set forth just beneath the description of the commodity.

SIDELIGHTS

EDITED BY E. C. PORTER

Every shipyard in the United States has been asked to speed up production so as to make July 4 the greatest ship-launching day in the history of the world.

* * *

The United States Ordnance Department has contracted for construction of two plants for production of picric acid, one to cost $7,000,000 at Brunswick, Ga., the other $4.000.000 at Little Rock, Ark.

* * *

Director General Schwab of the United States emergency Fleet Corporation has offered a reward of $10,000 to workers in the shipbuilding plant which will produce largest surplus above its program for this year.

* * *

The New York Industrial Commission reports that the average weekly earnings of all employees in the state's industries was $19.25 in April, 1918, as compared with $15.50 in 1917, $14.15 in 1916, and $12.54 in 1915.

* * *

According to orders issued by Director General McAdoo, after July 1, 1918, all freight charges must be paid in advance except that credit extension of two days may be allowed if a surety bond is filed to cover payment.

* * *

The complete severance of Government operation from corporate interests of United States railroads is indicated by the action of Director General McAdoo's releasing from active executive management the presidents of all railroads under Government control. Federal directors will be appointed in their places and as far as possible from among the operating officers of each property. Their salaries will be limited to $15,000 a year.

* * *

The production of bituminous coal for February is reported at 42,000,000 tons as compared with 43,000,000 tons in January and 40,000,000 tons in February of last year. The daily production for February was 1,783,000 tons compared with 1,643,000 tons in January and 1,753,000 tons in February of last year. Shipments of anthracite coal for March set a new high record for a month's output, the total being 7,277,000 tons compared with 5,812,000 tons a month ago and 6,989,000 tons a year ago.

* * *

Our problem, says the Federal Reserve Board, is to convert less essential into more essential production and distribution of goods. The saving of credit and money goes hand in hand with the saving of labor and materials in the program of adjusting the business of the nation to a war basis. Our best hope of avoiding competition between the Government and its citizens for credit, money, labor and materials, which can only result in credit and price inflation and higher costs of living is saving.

* * *

The largest steamer ever built for the French merchant marine was launched from the Chantiers de France at Dunkirk, France, in April, says *Commerce Reports*. The vessel measures 444 ft. in length, displaces 19,000 tons, and has a total carrying capacity of 12,000 tons. The Germans have tried to destroy the ship by aerial bombs, by bombardment with long-range guns and by destroyers. The successful completion of the work is a wonderful tribute to French determination in the face of almost insuperable obstacles.

* * *

The *North Bend*, the first contract wood ship to be completed under the new program of the Shipping Board, began her initial voyage on May 15. The vessel left from a Pacific port for a short coastwise trip and will return with a cargo of coal. The voyage will be in the nature of a trial trip, and if successful the *North Bend* will be assigned to ply between San Francisco and Honolulu. The vessel was built at the yards of the Kruse Banks Shipbuilding Co. of North Bend, Ore. She is of the Hough type and of 3500 tons.

* * *

The War Trade Board announces that the authority of branch offices and collectors of customs to license shipments of commodities not on the Export Conservation List of a value less than $100 for export to Great Britain, France, Italy and Belgium will be withdrawn on July 1, 1918. Individual licenses will be required for such small shipments to these countries which have not left the country on or before June 30, 1918, and should be applied for in accordance with the procedure which was given out on May 13, 1918 (W. T. B. R. 104). This procedure does not apply to the colonies, possessions and protectorates of these countries.

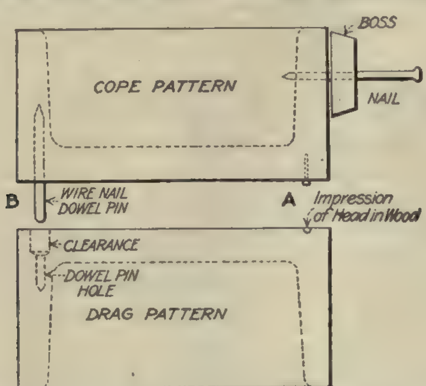
* * *

The American infantryman in France carries 100 more rounds of rifle ammunition on his person than does the German soldier. The American carries 220 rounds and carries it with ease in the 10 pockets of his light canvas-web belt and his two bandoleers. The German soldier has only 120 rounds and 30 of the 120 are awkardly carried in his knapsack. The exact weight of the 220 rounds carried by the American soldier in France is 12 lb. With the Springfield rifle 23 aimed shots can be fired a minute. Firing from the hip (magazine fire without aim) 40 shots can be fired a minute. The new United States Model 1917 (modified Enfield) does even better. Firing point blank into German waves, pumping 12 shots a minute an infantryman's amunition is exhausted in 18 min. Assuming that the rapidity of fire of the German rifle is equal to that of the American rifle, the American infantryman, because of his web equipment, is better by 8 min. and by 100 rounds than the German infantryman.

Dowel Pins for Wood Patterns

By M. E. Duggan

Among the many patterns that the patternmaker is called upon to make almost every day are the split pattern, the pattern with loose pads, bosses or core pins, and loose projecting members which are located on it and held in their proper position in several ways. Used for this purpose are metal and hard and soft wood dowels; also the recessed pattern method and the core print with the dowel pin turned on it. Other ways are the drawout or loosely fitted pins, which are made of hard or soft wood or metal wire; the wooden pins I have sometimes seen varnish finished, and the wire pins are often made with a fancy bend or eye in one end. Because some shops consider these details to be



METHOD OF DOWELING USED FOR PATTERNS

good patternmaking they are demanded; and these shops have a system which must be followed in the construction of all of their patterns regardless of the quantity of castings to be produced from the pattern.

My doweling method differs somewhat from any that I have seen, and is used on all patterns made by us. After determining the location of the pin, fine wire brads are driven into one-half of the pattern, shown in the illustration at *A;* the two halves of the pattern are then matched together, and the projecting heads of the brad are pressed into the opposite half of the pattern for a locating impression. The brads *A* are then drawn out, and in their places holes are drilled, into which dowel pins made of wire nails are driven, these being shown at *B*.

Holes are then drilled into the opposite half of the pattern, using the locating impression already made to receive the dowel pins. These holes are countersunk with a ¼-in. drill, about ¼ in. deep, as indicated in the sketch. These countersunk holes are better than the plain, straight hole, since the halves are more quickly matched together without damaging the hole by the pin.

Our foundry has on hand a stock of standard sizes of wire nails, so we pay no attention to pins. When loose pads, core prints, etc., are to be attached to the pattern the patternmaker just drills the holes and the moulder fits the nail. If a pin is lost he can readily go to the keg and get another, and thus avoid calling on the patternmaker to replace them.

Portable Cylinder-Boring Machine

By Martin H. Ball

The accompanying illustrations are of a boring machine that was designed to rebore both upright and horizontal cylinders from 12 to 24 in. in diameter. For the larger bores a head with longer arms is used to avoid excessive overhang of the cutting tool.

The outfit is driven by a small electric motor fastened to a pair of long skids upon which is placed sufficient weight of scrap iron to hold it in place against the belt pull. For small cylinders a small pulley on the motor is

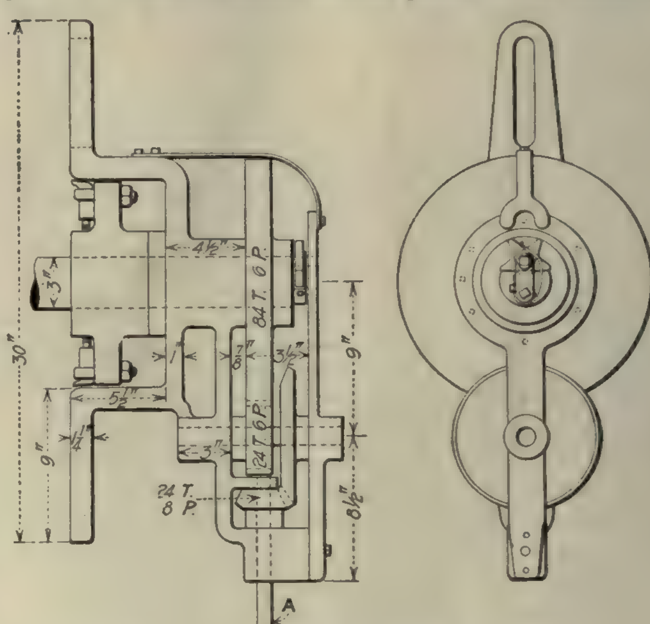


FIG. 1. A CYLINDER BORING MACHINE

direct-connected by belt to a large pulley on the shaft *A*, Fig. 1; and for the larger cylinders a countershaft is interposed on the skids with the motor to secure the necessary reduction in speed.

The performance of the outfit has been very satisfactory. The bevel gears make it possible to have the driv-

ing shaft in a horizontal position regardless of the position of the cylinder. The frame, gears and head are made of cast iron. The main bearing in which the boring bar rotates is machined to fit the bar, all other bearings being cored out large enough for babbitt metal to be run. The large gear made especially for this job is keyed to the bar with a hollow key, allowing the feed rod to pass through it.

For cylinders above a 12-in. diameter, the frame is blocked out from the end of the cylinder to an extent equal to the thickness of the cutting tool, to allow a cut to be taken to the extreme end of the cylinder.

A small crank (not shown) is used to run the cutting head along the bar by hand, and a long socket wrench is used to loosen the nuts on the eye-bolts after the finishing cut is taken to avoid the scratch that the cutter would otherwise make in withdrawing the head.

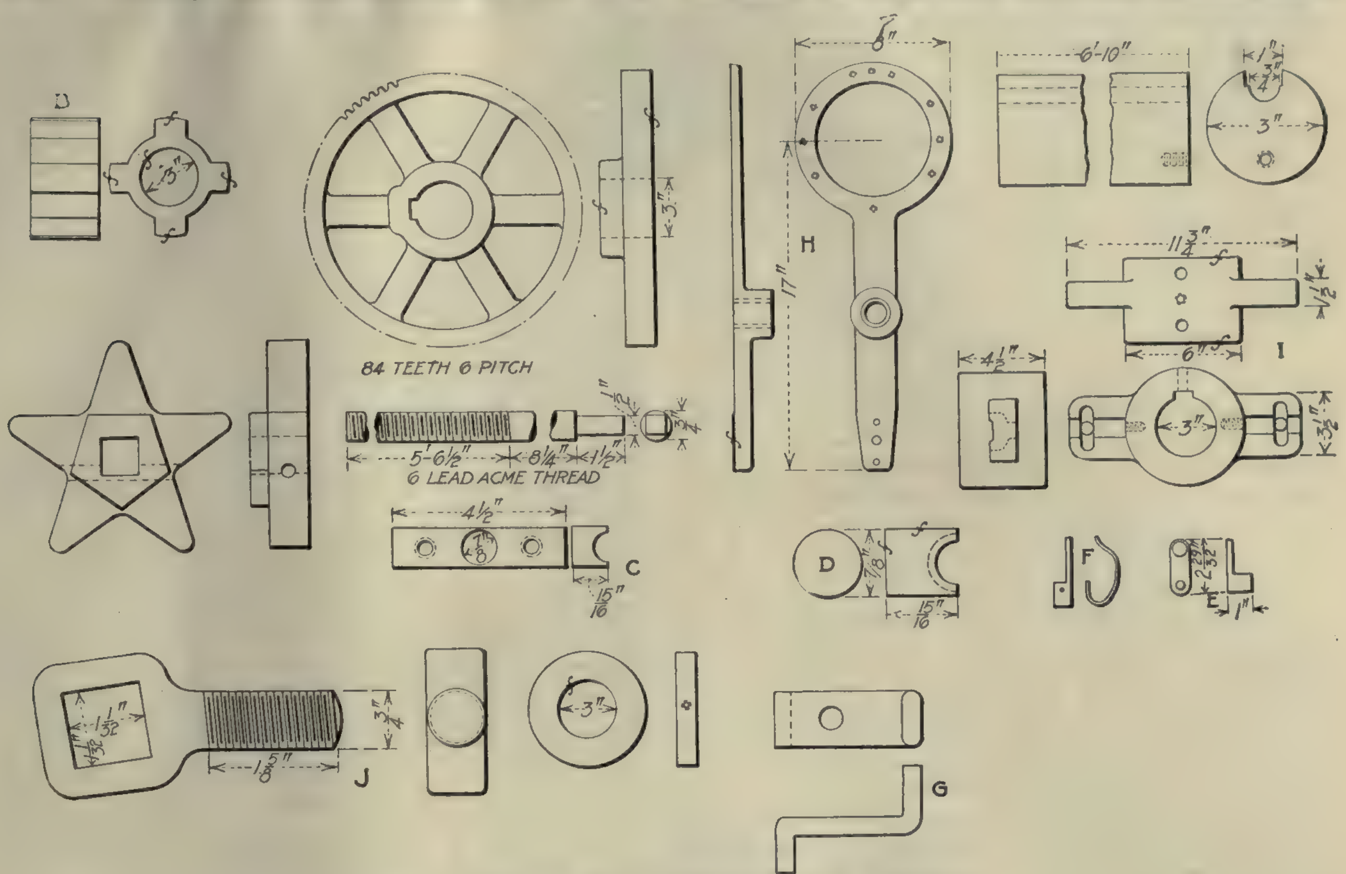


FIG. 2. DETAILS OF CYLINDER-BORING MACHINE

The support *B*, Fig. 2, was made as shown for use on an upright cylinder to fit the gland opening in the cylinder head; it provides openings around its outer edge for the cuttings to drop through. A leather washer with about a 5-in. outside diameter—a tight fit on the bar—is slipped over the bar just above this support to keep the cuttings out of the bearing.

The feed screw lies in the bar, and is connected to the boring head by the key *C* and the half nut *D*, which fit into it; the key is held to the head by the two ½-in. capscrews tapped into the end holes of the key.

The star wheel is a steel casting and is pinned to the feed rod, the rod and wheel being held in place by the cap *E*. The spring *F* is in turn fastened to this cap, its outer end resting on one of the flats of the hub of the star wheel, when the star wheel points are not in contact with the feed fingers *G*.

The spacing of the tapped holes in the part of frame *H* is such that 1, 2, 3, 4 or 6 feed fingers may be used.

The tools, which are made from 1-in. square stock, are held in the groove provided in the head *I*, by the eyebolts *J*. This groove is placed at an angle which provides leading rake on the cutting tool without special forging. A backing-up screw sets against the back ends of the cutting tool as shown.

Installing with Limited Head Room

By W. A. Lailer

A machinery manufacturer found that he could use to advantage a large milling machine, but there was no room for it in the main shop building. The only location available was in a small bay containing a number of lathes, where the head room was limited because of the low roof, the small traveling crane being only about 11 ft. above the floor line. The over-all height of the milling machine best suited for the work was about 13 ft., so that it could not be placed on the floor level and still be served by the crane.

The factory superintendent devised a novel method of installation. The table of the machine was about 3 ft. above the floor line; accordingly, he dug a pit into which the machine was placed so that the machine table was on a level with the floor. This left 10 ft. of the machine tool projecting above the floor line.

The pit was made of concrete with sufficient space on all sides to give the operator ample working room. With the machine table on the floor level it was possible to handle large pieces with the small crane.

The Worcester Spring Meeting of the

THE spring meeting of the American Society of Mechanical Engineers at Worcester, Mass., was opened in the ballroom of the Hotel Bancroft by a greeting made by R. Sanford Riley, president of the Worcester Chamber of Commerce. This was followed by a cordial welcome by Pehr G. Holmes, Mayor of the City of Worcester, and a response by President Charles T. Main. Charles G. Washburn made an address on "The Growth of an Industrial City," giving a brief history of the growth of many of the important industries located in Worcester.

The opening session closed at 9 o'clock and the guests adjourned to the Worcester Art Museum where the reception was held, this being followed by a dance at the Woman's Club located across the street. This is said to be the first time that the Art Museum has been opened for social affairs other than those connected with art exhibits.

Reports of Committees

At the business meeting Wednesday morning the reports of various committees were presented and discussions followed, these being deferred to a special session on account of lack of time.

The report of the Committee on Screw Thread Tolerances, which has already been published in these columns, elicited much discussion. Major H. J. Bingham Powell advocated the adoption of one standard of thread for all the allied countries and to do away with the U.S.S., Whitworth and S.A.E., compromising on a series of pitches finer than the two former and coarser than the latter. He drew attention to the advantages of the Whitworth form of thread, but suggested a change in angle.

H. E. Harris pointed out the danger of assuming that the tapped hole was the same as the tap and objected to some of the measuring devices.

Admiral R. S. Griffin hoped for the adoption of a rational tolerance as it was needed in all naval and similar work.

Mr. Hoagland illustrated the advantages of having the lead long in the tapped hole and short in the screw, where it was necessary to have a tight fit, this because of the flow of metal which is pointed out by the Committee in its report.

Messrs. Briggs, Van Kuren and Miller of the Bureau of Standards made known some of the discoveries which their investigations and practice had brought out in connection with the measurement of gages in Washington. Some of these will be shown later. Among the others who discussed the report were Major Louis Fischer and Messrs. Hartness, Wilhelm, Fuller, Case and Jones. As is probably known, the Tilson bill for a Committee on Screw Threads includes two members of the A.S.M.E.

The report of the Committee on Weights and Measures caused the usual discussion whenever the metric system is brought up. The report gave replies to a questionnaire to Latin-American countries, which indicates that the metric system would in nowise assist in securing trade in those countries. This, as the report of the British commission, makes it seem extremely doubtful as to the wisdom of considering the matter further at this time.

The activities of the society have so increased and broadened that it has become necessary to hold simultaneous sessions at nearly all times. The significant paper at the general session was that of Morris L. Cooke on "The Public Interest as the Bed Rock of Professional Practice." Mr. Cooke pointed out that while the doctors and lawyers both placed service to the public first, all of the engineering societies placed duty to the client as the first consideration. The only exception, as pointed out by Calvin W. Rice, was the German Engineering Society, which, as with everything German, placed the fatherland above all.

The war has brought us all to a realization of the fact that we must henceforth consider all problems as world problems and there were no differences of opinion as to the necessity of considering humanity as a whole rather than any particular section of it. The unanimity in this respect was most remarkable and shows very clearly how the war has spread a regenerating influence over the minds of men.

Mr. Cooke's Views

The following outline of the paper gives the author's ideas in brief:

"The object of this paper is to determine what has been, and apparently continues to be, the attitude of engineering organizations toward society as expressed in their rules of conduct. This, according to the author, is a time of stock taking and of a critical examination of the orders under which society and its constituents elements are operated. Within the church, among labor organizations, in government, in the educational field and in the professions—everywhere, in fact, the same searching inquiry is going on as to aims and methods, and it is his belief that there is no better time for a review of the codes of ethics designed to regulate the professional practice of engineers. It is further sought to develop the engineer's concept of his public relationship and responsibilities as contrasted with such relatively minor obligations as those to the profession of engineering, to a client, to fellow engineers, and to himself."

Code of Ethics

It was voted to have a thoroughly competent man prepare a new code of ethics which should embody the higher ideals of the engineers of today, and at the timely suggestion of L. P. Alford it was decided to include a revision of the aims of the society which have of course broadened to a remarkable degree since the present statement was prepared. There is a growing feeling in many quarters that the future of all countries rests

so largely on the engineer that he must play a bigger part in all communities and in the nation. To do this he must recognize that his first duty is to the public, as Mr. Cooke so ably pointed out.

George H. Haynes presented a paper on the subject "The Small Industry in a Democracy." Mr. Haynes pointed to the very rapid consolidation of business that has occurred in the United States in the last 30 years and showed the results of this policy in this country. Big business, he said, is primarily productive of quantity rather than quality. The personality of the small employer and his interest in his employees go far in securing a spirit of coöperation and teamwork which are seldom present in a large concern. The small industry improves the morale and stimulates ambition and enthusiasm. Mr. Haynes pointed out that the effects of the conditions of the present day are very deep and far-reaching and that when the men who have been awakened and taught to think and have seen more of the world that was formerly included in their sphere come back to industry they will demand more opportunities than have formerly been open to them. When that time comes it may be that the small industry will be the thing to make democracy safe for the world.

Address of Doctor Hollis

Dr. Hollis followed with an address in which he stated that what we must face now, and what the people of the United States are able to face now, is the truth, and no publicity bureau, he said, should be allowed to tamper with it in any way whatsoever. Goodwill and coöperation, from the lowest to the highest individual, are the things most needed at the present time.

The address by J. E. Rousmaniere on the subject of "The Textile Industry in Relation to the War" brought out many interesting facts in regard to what has had to be done on account of the great expansion necessary in the manufacture of textiles. As in many other lines of war work some of the greatest difficulties have been presented on account of the very rapid increase necessary and the shortage of materials naturally resulting.

After the morning session a very fine buffet luncheon was served to members and their guests in the electrical-engineering laboratories of the Worcester Polytechnic Institute.

Wednesday Afternoon Sessions

At the Wednesday afternoon session John S. Holbrook, vice president of the Gorham Manufacturing Co., Providence, R. I., presented a very interesting paper entitled "Converting a Factory for Munition Manufacture." The Gorham company, which was formerly engaged almost entirely in jewelry work, has been very successful in converting and enlarging its factory for the production of various forms of munition. The work turned out has included shell cases, hand grenades and other parts such as rifle rods, powder cans, bomb sights, gunners' quadrants, etc., and has been performed for nearly all of the Allied governments. The company is also engaged in the manufacture of Stokes trench-mortar shells. Since starting on munition work the Gorham company has taken over plants formerly occupied by other manufacturers and has also built new factories. Mr. Holbrook stated that a large part of the machinery is entirely new and that women were not as yet employed to any great extent in any of the shops except the one making hand grenades.

Other papers presented at the three simultaneous sessions on Wednesday afternoon were "Some Economic Aspects of Fire-Protection Problems and Hazards in War Times," by Donald Pryor and Frank V. Sackett; "Oil Fuel in New England Power Plants," by Henry W. Ballou; "A Foundry Cost and Accounting System," by William W. Bird; "Moisture Reabsorption of Air-Dried Douglas Fir and Hard Pine, and the Effect on the Compressive Strengths," by Irving H. Cowdrey; "A High-Speed Air and Gas Washer," by John L. Alden; "Investigation of the Uses of Steam in the Canning Factory," by Julian C. Smallwood; "The Safety Engineer," by L. A. DeBlois; and "New Course of Instruction in Safety Work," by George N. Follows.

William W. Bird of Worcester, Mass., member of the society, outlined the foundry cost and accounting system which has been developed as a result of experiments carried on in connection with the commercial foundry at the Worcester Polytechnic Institute in his paper on "A Foundry Cost and Accounting System." The system, he stated, is giving good satisfaction, the results being fairly accurate and the comparative monthly data which it keeps before the foundry officials have been found to be thoroughly reliable as a signal system. All of the work can be done by the regular clerical force in a small amount of extra time, and the services of an expert accountant are not required.

General War Session

The general war session on Wednesday evening was considerably different from the program announced on account of the fact that a number of the speakers were unable to attend the meeting. Paymaster C. E. Parsons represented the United States Navy and told of some of the work being done on the procurement program of the Government. A number of other speakers followed and the meeting was finally adjourned to the roof garden where a dance was held.

Three simultaneous sessions were held on Thursday morning, the papers presented at the general session being "Stresses in Machines When Starting or Stopping," by F. Hymans; "Electric Heating of Molds," by Harold E. White; "Elastic Indentation of Steel Balls Under Pressure," by C. A. Briggs, W. D. Chapin and H. G. Heil; "Air Propulsion," by Morgan Brooks; "A Self-Adjusting Spring Thrust Bearing," by H. G. Reist, and "Efficiency of Gear Drives," by C. M. Allen and F. W. Roys. This latter paper was reproduced in part in one of our recent issues.

The "Electric Heating of Molds" was submitted by Harold E. White of Ampere, N. J., member of the society, who said that in forming parts made from hard rubber and the various phenolic condensation products now available the standard procedure has been to employ metal molds filled with the material which are placed between steam-heated plates attached respectively to the upper and lower platens of a hydraulic press. The difficulties he encountered in the use of this method led him to devise the one here described, in which the heating is done electrically. Briefly, it consists in magnetizing the molds with alternating current at 60 cycles.

As the molds are of steel and generally hardened they heat up rapidly, due to induced electric currents and also in part to hysteresis losses. Various advantages of the new method are pointed out, and it is stated that it can probably be utilized to advantage in the production of die castings of readily fusible metal and also in drawing the temper of hardened-steel parts.

Two papers were presented at the fuel session—"An Investigation of the Fuel Problem in the Middle West," by A. A. Potter, and "Topical Discussion on Fuel Economy," arranged for by the Fuel Conservation Committee of the Engineering Council.

Vocational Training Session Deals with Emergency War Work

The vocational-training session was devoted principally to the emergency technical war training being carried on at the present time. Major Cassidy spoke of the work being done by the army and mentioned particularly the important work being done by the engineers. One of the interesting pieces of work spoken of was the completion in 60 days of shelter houses for 500,000 troops. They were made in sectional form, with all windows, doors, etc., in place, and all parts except the flooring were shipped in this manner. Major Cassidy also gave interesting account of the tunneling operations which finally ended in the capture of Messines Ridge. Addresses were also made by Arthur L. Williston, educational director for New England, Committee on Education and Special Training, War Department; and by Lieut. André Morize, French Military Mission Northern District, detailed to the Department of Military Science and Tactics at Harvard University. A motion-picture film prepared by the War Department was shown, being one of those used for the instruction of soldiers. The particular film presented showed the heavy Browning gun, the method of operating the parts, and the methods of assembling and disassembling for cleaning purposes or repair.

At noon the party went to the plant of the Norton companies, where a buffet lunch was served. Attractive souvenirs were distributed, these taking the form of stones for sharpening kitchen or carving knives, small stones for pocket-knife or similar work, and circular slide rules showing the relations between the diameter of a grinding wheel, the revolutions per minute and the surface speed.

After this a session was held in the administration building and trips through the factory were arranged. The papers presented at the professional session included "The Workman's Home and its Influence Upon Production in the Factory and Labor Turnover," by Leslie H. Allen; "Indian Hill Development Work of the Norton Company," by Clifford S. Anderson; "Employment Methods as Followed by the Norton Company," by E. H. Fish; "Vestibule Schools," by J. C. Spence, and "The Norton Hospital Service," by Dr. W. Irving Clarke. Arrangements had been made to take the guests through the model industrial village of the Norton company at Indian Hill, but a shower prevented a general particpitation in this trip.

Thursday evening a garden party and dance was held at the Worcester Country Club, and refreshments were served.

On Friday rain somewhat marred the trip to Camp Devens, where demonstrations of various kinds of warfare were to have been made; but the weather cleared in the afternoon and the trip to Concord and Lexington and return by way of the Wayside Inn was enjoyed by many. This trip covered some of the most interesting historical ground in Massachusetts, ground that is almost strewn with monuments and tablets commemorating early events in the history of this country.

The ladies were entertained on Wednesday and Thursday by various trips to shops and other points of interest in and about Worcester.

Many of the concerns opened their plants to visitors during the days of the meeting, the following being some of the concerns doing this: Arcade Malleable Iron Co., John Bath & Co., Inc., Coppus Engineering and Equipment Co., Crompton & Knowles Loom Works, Eastern Bridge and Structural Co., the Graton & Knight Manufacturing Co., the Heald Machine Co., Morgan Construction Co., Morgan Spring Co., Norton Co., Norton Grinding Co., Powell Machine Co., Reed-Prentice Co., Reed & Prince Manufacturing Co., Rice, Barton & Fales Machine and Iron Co., Royal Worcester Corset Co., J. E. Snyder & Son, the Spencer Wire Co., Standard Plunger Elevator Co., Whitcomb-Blaisdell Machine Tool Co., the George C. Whitney Co., M. J. Whittall Associates, Worcester Pressed Steel Co., Worcester Boys' Trade School and the Worcester Girls' Trade School.

All the guests were presented with an attractive booklet giving the program for the meeting and containing numerous illustrations showing points of interest in and about Worcester.

Negro Training Schools

Definite arrangements have been completed to send selective Negro draftees to schools and colleges this summer for special training in radio engineering, general engineering, electricity, auto mechanics, blacksmithing and the operation of motor vehicles. Accommodations have been provided for about 4000 men who will be sent to Howard University, Tuskegee Institute, Hampton Institute, the Negro Agricultural and Technical College, Prairie View Normal and Industrial College, the Colored Agricultural and Normal School, Branch Normal School, Georgia State Industrial College, Florida A. and M. College, Atlanta University and Western University. On graduation they will be assigned to regiments of colored troops.

Close to 157,000 Negro soldiers are now in the National Army. Of these 1000 are line officers holding commissions of captain and first and second lieutenant. There are approximately 250 Negro medical officers in the Medical and Dental Reserve Corps. The army now includes two divisions of Negro troops commanded by Major General C. C. Ballou and Brigadier General Roy C. Hoffman. When fully constituted these divisions will embrace practically all branches of military service, including infantry, engineers, artillery, signal corps, medical corps and service battalions with men technically trained in all branches of scientific work.

There are openings in the veterinary corps of the National Army for Negroes skilled in veterinary and agricultural work. Two thousand volunteers between the ages of 18 and 40 and not subject to the selective draft are wanted in the Veterinary Corps.

EDITORIALS

The Control of Wages and Labor

AN ATTEMPT is to be made to bring order out of choas in the handling of labor both as to wages and its distribution. And this is such a vital step in the way of Governmental regulation that it must receive the sympathetic coöperation of all who desire to see rational wages, uniformly good conditions, a minimum labor turnover and above all maximum production.

There has been indiscriminate stealing of men by alluring advertisements, by personal solicitation and by offers of exorbitant wages made possible by cost-plus or large profit contracts, and the bad effects of all these are too well known to require discussion. There is no doubt as to the decrease in the production of the country owing to the constant shifting of men from one place to another as well as the bad effect on both the housing and the transportation problem. Indeed some authorities state that as high as 40 per cent. of the labor of the country has moved during the year.

The regulating of these problems, however, is no easy task, as it involves the setting of standard wages and a priority for labor. But as both of these have been suggested, if not demanded, by many manufacturers, it will be necessary for them to exercise patience and to coöperate to the fullest extent. For we must remember that labor cannot be asked to give up the right to move at will in search of a higher wage without compensation. We must not forget that a standard profit and a standard salary for executives is in keeping with the standard wage for the employee and that the same restriction of movement must apply to all.

* * *

Announcement has been made by officials of the United States Employment Service that not only are wages to be standardized but that the control of labor is to be centralized in the new employment offices of this department. All individual solicitation is to be eliminated so as to prevent the present competition for men and the unsettling of housing and transportation, even with a standardized wage. In other words these employment offices are to be clearing houses through which all labor must pass in order to know how much is available at all times, and of what class.

The fixing of a standard wage is of itself a task that would try the wisdom of a Solomon. It will not and cannot satisfy all—it is bound to be a compromise, and it is probably better so. Then too we must remember that conditions vary to such an extent that some compensation must be made to balance the account.

A plant so located as to require an hour's travel each way, with its attendent expense, must expect to pay enough more than the standard base rate to compensate for the extra time and expense. The principle of the base price with extras, as is common in many commodities, can be applied here as well. But it will not be easy and we must be prepared to make allowances for human errors of various kinds.

The fixing of a standard wage rate will of itself tend to prevent an undue movement of men. Add to this the placing of men through one central agency, the virtual priority of labor in essential industries, and there is no doubt as to the greatly increased stability of labor. This has worked out very well in the shipyards of the Pacific coast.

By preventing the shifting of labor alone production can be automatically increased to a considerable extent. Men will also be taken from nonessential industries and in this way add to the number available for munition and similar work. But the training of additional men and women is becoming more and more necessary every day.

* * *

There are many details to be worked out, and when the magnitude of the task is considered we must not expect that mistakes will not be made or that good judgment will always be displayed. The establishment of sufficient employment offices to handle all this labor is of itself a gigantic task, and to secure competent managers for them all will be next to impossible. Here, perhaps, is where sympathetic coöperation will be most necessary and also where concerns having good employment managers can be most helpful.

If this regulation does come, and we are assured that it is on the way, let us meet it in a spirit of helpful coöperation. There are bound to be many things which can be criticised, but let us make all criticism helpful instead of antagonistic, and an aid to the increasing of production all along the line. Let us realize that it is an earnest attempt to secure a sufficient supply of labor for all essential industries and to stabilize manufacturing to the end of aiding in winning the war, and help in every way possible.

National War Savings Day

THE 28th of June has been designated as National War Savings Day, and all are urged to enlist as regular buyers of War Savings and Thrift Stamps or other Government securities. We cannot do better than to quote President Wilson regarding the subject of thrift.

"This war is one of nations—not one of armies, and all of our own hundred million people must be economically and industrially adjusted to war conditions if this nation is to play its full part in the conflict. The problem before us is not primarily a financial problem, but rather a problem of increased production of war essentials and the saving of the materials and the labor necessary for the support and equipment of our army and navy.

"Thoughtless expenditure of money for nonessentials uses up the labor of men, the products of the farms, mines and factories, and overburdens transportation, all of which must be used to the utmost and at their best for war purposes.

"The great results which we seek can be obtained only by the participation of every member of the nation, young and old, in a national concerted thrift movement.

"I therefore urge that our people everywhere pledge themselves, as suggested by the Secretary of the Treasury, to the practice of thrift, to serve the Government to their utmost in increasing production in all fields necessary to the winning of the war, to conserve food and fuel and useful materials of every kind, to devote their labor only to the most necessary tasks, and to buy only those things which are essential to individual health and efficiency, and that the people, as evidence of their loyalty, invest all that they can save in Liberty bonds and War Savings stamps.

"The securities issued by the Treasury Department are so many of them within the reach of every one that the door of opportunity in this matter is wide open to all of us. To practice thrift in peace times is a virtue and brings great benefit to the individual at all times; with the desperate need of the civilized world today for materials and labor with which to end the war, the practice of individual thrift is a patriotic duty and a necessity.

"I appeal to all who now own either Liberty bonds or War Savings stamps to continue to practice economy and thrift and to appeal to all who do not own Government securities to do likewise and to purchase them to the utmost extent of their means. The man who buys Government securities transfers the purchasing power of his money to the United States Government until after this war, and to that same degree does not buy in competition with the Government.

"I earnestly appeal to every man, woman and child to pledge themselves on or before the 28th of June to save constantly and to buy as regularly as possible the securities of the Government, and to do this as far as possible through membership in War Savings societies.

"The 28th of June ends this special period of enlistment in the great volunteer army of production and saving here at home. May there be none unenlisted on that day."

Training Instead of Stealing Men

THE works manager who desires to secure the greatest production does not allow the foreman of one department to steal men from the other departments of the shop. He establishes an employment department, and if he cannot hire a sufficient number of skilled men he trains new ones to do the work.

Considering the various shops of the country as departments of a great national manufacturing institution it is easy to see the futility and the wastefulness of allowing one firm to steal men from another. And yet this is being done in a wholesale manner—openly in some cases, underhandedly in others.

Shops with cost-plus contracts are offering as high as $1.10 an hour for gage makers, with the result that gage-making shops on work which is equally important in the winning of the war cannot hold their men unless they meet the same rate. This they are often unable to do owing to their working on a fixed price based on the rate previously paid.

The effect of this is to unsettle labor, to cause unnecessary transportation and housing difficulties, and, worst of all, to delay production. It is of little use to urge men to stick to their jobs while we allow indiscriminate inducements to be offered to get them to desert their employers. And the fact that the cost-plus contract allows the manufacturer not only to offer unheard-of wages but to actually add to his profit by so doing makes it all the more reprehensible.

Private manufacturers are not the only ones to suffer by this practice. The Government arsenals are in the same predicament and are having great difficulty in some cases to hold men enough to maintain their schedule. We are losing heavily in total productiveness by allowing men to be stolen from firms engaged on important work.

Price fixing and priority orders are dangerous tools unless handled with rare judgment, but both have been found necessary in several instances to prevent a similar condition in commodities. But as manufacturers did not coöperate voluntarily to overcome this condition, did not begin to train men instead of stealing them by various inducements, something on the order of priority or price fixing, or both, is very likely to be resorted to in the near future.

If the majority of shop managers had possessed the vision and the practical insight into the needs of the country and of the industry as shown by John C. Spence, whose school for training workers is shown elsewhere in this issue, this difficulty would not have arisen.

Too many unfortunately have been content to attempt to build up their own shops at the expense of others. The evils of this are too well known to be dwelt upon. And if the drastic federal regulation shall become necessary the least we can do now is to coöperate to the utmost, for the evil must be remedied, and as rapidly as possible.

Our Marines—The Devil Hounds

THE way in which our Marines are making themselves felt in the gigantic battle which is now going on on the west front in France is extremely gratifying to every red-blooded American. It is, however, no surprise to those who are at all familiar with the achievements of the Marine Corps for many years. We have heard comparatively little about them except in quelling some of the disturbances and periodic revolutions which have taken place in the small countries near our shores. And then the reports usually simply record the fact that "The Marines have landed and have the situation well in hand." Just what this sort of training has done is being made evident by the dash and stubbornness which has characterized their fighting in France.

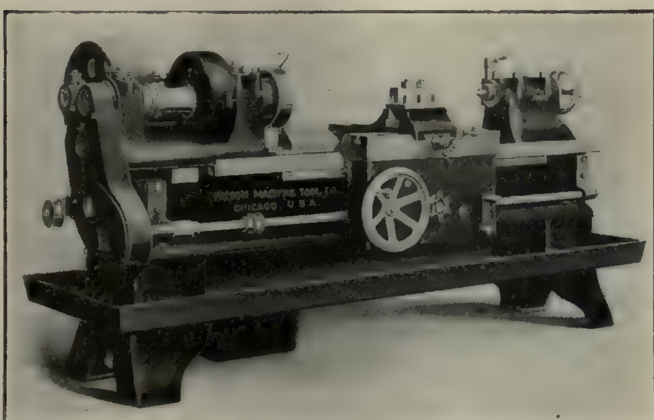
Some idea of the fighting qualities of the Marines can be gleaned from the fact that the German compliment them by designating them as "Devil Hounds" in a similar manner as they called the Highlanders the "Ladies from Hell." But regardless of what they are called they are showing the world what we have always known, that as fighters they are second to none.

We are very glad to do them honor by using the insert which appears in this issue, and we trust that our friends will post these in conspicuous places as an inspiration for us all to emulate the Marines as best we may by doing our full duty wherever we happen to be.

This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist"

Fulton Shell Lathe

The Fulton Machine Co., Chicago, Ill., has recently brought out a new shell-turning lathe that is being marketed by the Gale Brewster Co., Chicago. The machine is of the single-belt-drive type and is made either



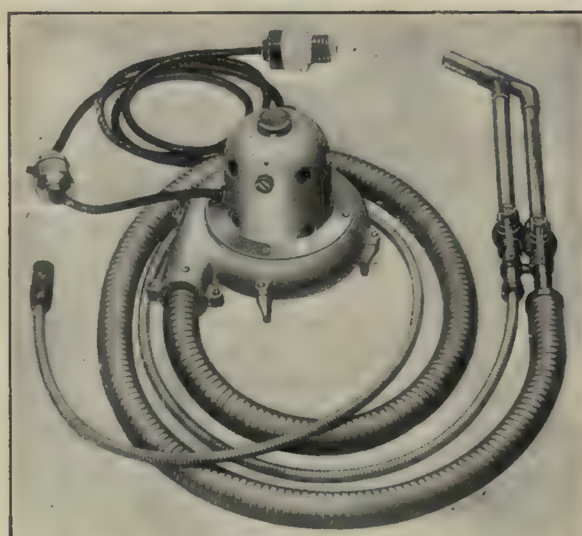
FULTON 20-IN. SHELL LATHE

Swing over bed, $20\frac{3}{4}$ in.; swing over tool slide, 9 in.; front-spindle bearing, $4\frac{1}{2}$ x 8 in.; rear-spindle bearing, 3 x 6 in.; taper in spindle, Morse No. 5; thread on spindle nose, 4 U. S. S., $3\frac{1}{2}$ in. in diameter; width of belt, $5\frac{1}{2}$ in.; headstock pulley, $6\frac{1}{2}$ x 8 in.; gear ratio in headstock, 14.86 to 1; headstock gears, $2\frac{1}{2}$ in. face 5 pitch and $2\frac{3}{4}$ in. face 3 pitch; diameter of feed rod, $1\frac{1}{2}$ in.; feeds of carriage per spindle revolution, 0.124, 0.0989, 0.0783, 0.06125, 0.045, 0.037 and 0.029 in., one feed furnished per machine; width of bed, 20 in.; depth of bed, 17 in.; width of standard carriage, 31 in.; width of turret carriage, 30 in.; rack, 4 pitch $1\frac{3}{4}$ in. face; rack pinion 3 in. in diameter; turret, 20 in. across flats, $7\frac{1}{4}$ in. high; tool hole in turret, $3\frac{1}{2}$ in. diameter; length of bed on standard lathe, 8 ft.; length of bed for turret lathe, 10 ft.; diameter of tailstock spindle, $3\frac{1}{2}$ in.; distance between centers with 8 ft. beds, 36 in.

in standard or turret form as desired. It is claimed that very heavy and massive construction has been followed in designing the lathe and the gear drive is of the all-steel type in order that the greatest possible degree of strength can be given to the operating mechanism. The machine is of the 20-in. size.

"Bantam" Portable Brazing Torch

The illustration shows a portable brazing torch that is now being manufactured by the Tyler Manufacturing Co., 64 Pearl St., Boston, Mass. The outfit is designed to be connected to ordinary gas-supply pipes and electric sockets and can be readily carried from place to place about the shop where welding or heating is required. The air for the forced draft is supplied by a motor-driven blower and is conducted to the torch through flexible tubing. The motor is of the universal type and will operate on either direct or alternating current. The voltage generally supplied is 110, but other voltages can be furnished if desired. The gas supply should be of $\frac{1}{4}$-in. pipe size and the outlet should have a $\frac{5}{16}$-in. hole. A complete outfit consists of a motor blower, 5 ft. of air hose, 5 ft. of gas hose, brazing blowpipe and cord and attachment plug. It is claimed that the



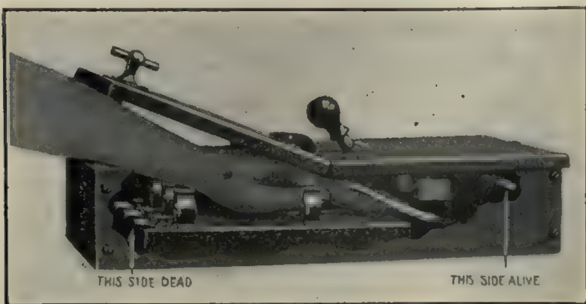
BANTAM PORTABLE BRAZING TORCH

torch will develop a temperature with illuminating gas as fuel of 2300 deg. F., and that the motor will supply a quantity of air sufficient to operate four burners like the one regularly supplied with the outfit.

Westinghouse "Krantz" Safety Switch

The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Penn., is now marketing the Krantz autolock safety switch which is shown in the illustration. This is intended for use on main circuits or wherever an ordinary knife switch would generally be applied. The switching parts and fuses are fully inclosed in a steel box, the cover of which is in two parts, one being a permanent covering for the end of the box containing the switch and the other part being hinged so as to swing back and permit the renewal of fuses. A latching mechanism makes it impossible to open the

cover without first throwing the switch to the off position and rendering all fuses and other accessible parts dead. The switch contact cannot be closed as long as the door is open. The device is also so made that the cover can be locked or the switch handle may be locked in on or off position. Contact is made by means of laminated-spring copper brushes which are double ended and provided with auxiliary arcing contacts at each end. The outer leaves are of bronze to provide additional spring pressure. The stationary contacts are of hard-

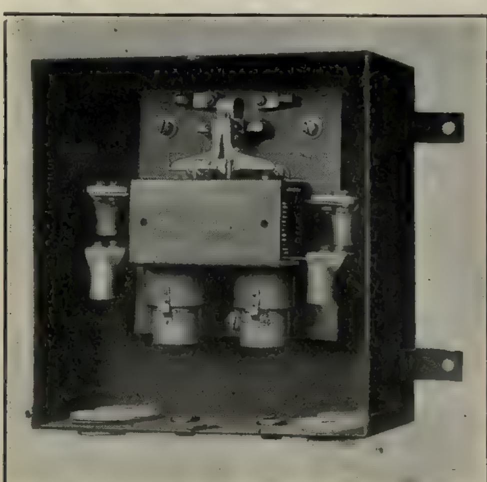


KRANTZ AUTOLOCK SWITCH

drawn copper and are mounted on slate bases. In closing the pressure between the contacts causes the laminations of the brush to spread apart, giving it a wiping or self-cleaning action. Switches are supplied for 250, 500 and 600 volts for either alternating or direct current in capacities up to 2000 amperes.

Westinghouse Overload Relay for Alternating - Current Motors

The illustration shows a new overload relay that has been placed on the market by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Penn. This is intended for supplying overload protection for alternating-current applications equipped with starters or switches having low voltage protection. The device is

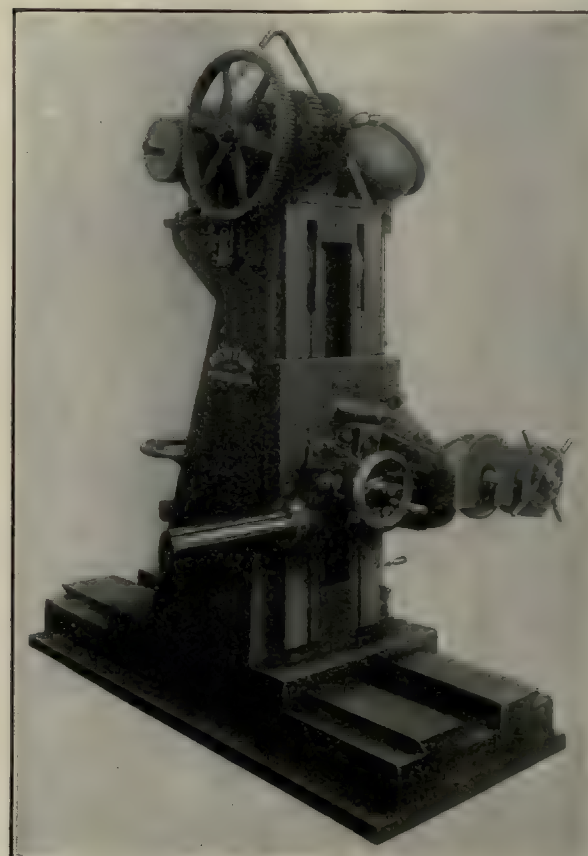


WESTINGHOUSE OVERLOAD RELAY

inclosed in a sheet-metal case, the cover being secured by two thumbscrews and provided with a safety device which automatically trips the relays when the cover is removed, thus rendering all parts of the relay dead as long as the cover remains off. The relay operates by means of magnet coils, which are inactive on all loads less than that for which they are set. When the current value reaches or exceeds this setting the coils lift plungers which break the control circuit and cause the low-voltage relay to open the line circuit. With no current flowing in the lines the coils are deënergized and the relay is automatically reset. Oil dashpots are provided which allow the relay to carry a momentary overload without tripping. The time limit is adjusted by means of a small perforated disc in the dashpot. A scale is provided so that the relays can be easily adjusted for any current value, and the spring lock is provided which holds the dashpot securely after it is once adjusted. The device is made for all commercial frequencies and voltages and with capacities of from 5 to 300 amperes.

Newton Horizontal Boring and Drilling Machine

The Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Penn., is now marketing a horizontal boring and drilling machine, which is shown in the illustration. It is adapted to be used either as a portable or



NEWTON HORIZONTAL BORING AND DRILLING MACHINE

Diameter of spindle, $3\frac{1}{2}$ in.; size of taper spindle nose, No. 5 Morse; length of spindle feed, 30 in.; feeds, 0.016 in. to 0.048 in. per spindle revolution; spindle speeds, 25 to 130 r.p.m.; length of hand adjustment of upright on base, 40 in.; maximum distance of spindle from bottom of sub-base, 52 in.; minimum distance of spindle from bottom of sub-base, 18 in.; motor recommended, 10 hp. 500 to 1200 r.p.m.

as a stationary machine. The spindle drive is either direct or back geared, depending upon the work in hand. The saddle is provided with vertical adjustment only, and is counterweighted in order to insure ease of operation. The spindle is provided with both slow and fast hand-feed adjustment.

Chamberlain Toolholder

The Chamberlain Machine Works, Waterloo, Iowa, is now marketing a new type of toolholder which it is claimed will hold stellite or the most brittle high-speed-steel tool bits without cracking or breaking. As may be seen from the phantom view the tool bit is placed in position, after which it is secured in place by means of a taper-wedge rack which is pushed into place by means of the pinion-actuating mechanism. The main shank of the toolholder is of drop-forged, 60-point carbon steel, machined and heat treated, the wedge groove being reamed and lapped to size. The taper wedge rack is made of drawn stock, heat treated, and has a bearing in the toolholder on its entire length. The pinion is the actuating member and is turned from bar steel, the teeth being formed by inserts of drill rod. It has a square head and is operated by means of a 4-in. wrench which is furnished with the toolholder. The features claimed are that the tool bit is supported for its entire length, which obviates any breaking tendency. It is also claimed that this form of construction distributes the stress due to holding of the tool bit in place over the entire tool bit and thus obviates breakage. Another feature is that tool bits $\frac{1}{2}$ in. in length can be securely held. The device is at present made in four sizes, which may be had in either straight, right- or left-hand style. The holders vary in size from $\frac{1}{2}$ x $1\frac{1}{8}$ x 6 in. to $\frac{7}{8}$ x $1\frac{3}{4}$ x 9 in., the cutter sizes being from $\frac{5}{16}$ to $\frac{1}{2}$ in. square.

CHAMBERLAIN WEDGE TOOLHOLDER

Detroit "Bulldog" Belt Lacer

The Detroit Belt Lacer Co., Hubbard Ave. and A St., Detroit, Mich., is now marketing the "Bulldog" belt lacer and closing machine. The lacers consist of hooks, or loops, forced into the ends of a belt, after which they are joined by means of a rawhide pin as shown in the illustration, Fig. 1. The double-ended hooks are placed in the closing machine shown in Fig. 2, and the end of the belt inserted, after which the operation of the handle shown closes the ends of the hooks together and secures them rigidly in place in the end of the belt. The hooks are put up in sections containing 84 hooks, giving a length of 12 in. Sections, however, may be easily cut apart to adapt them for any width of belt desired. The ends of the hooks are staggered somewhat, which it is claimed gives a better hold and distributes the strain. While being inserted into the belt the hooks are held in a removable holder which may be seen projecting from the right side of the machine shown in Fig. 2. These holders are furnished separately if desired, and by their use the hooks may be inserted with a hammer, making the use of the machine unnecessary. The use of the machine, however, makes a quicker and neater job than is otherwise possible. This machine has a double-jaw action and the hooks are driven from both sides, the belt being held central at all times.

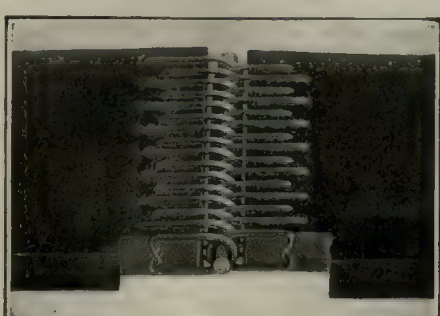


FIG. 1. "BULLDOG" BELT LACER

FIG. 2. MACHINE FOR INSERTING "BULLDOG" BELT LACING

U. S. Smelting Furnace

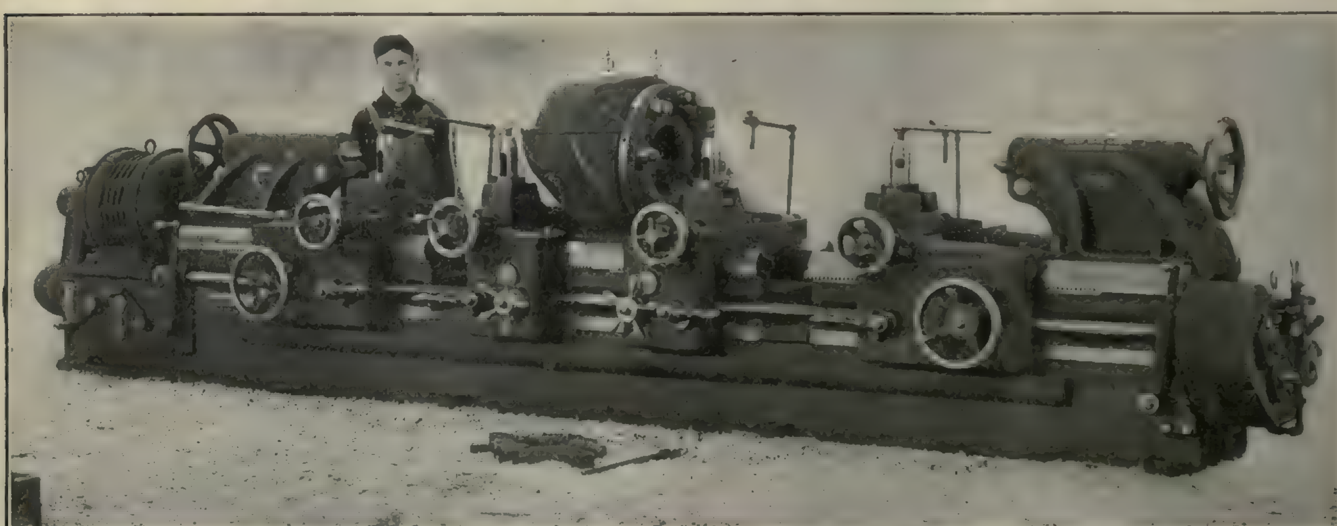
The U. S. Smelting Furnace Co., Belleville, Ill., is now marketing the smelting furnace shown in the illustration, this being adapted for nonferrous metals. It is made in four sizes with melting capacities of 200, 500, 1500 and 2500 lb. The two smaller furnaces are

U. S. SMELTING FURNACE

revolved by hand and the two larger by hand or motor power as desired. The furnaces are designed for melting copper, bronze, red brass, yellow brass, turnings, grindings, sweepings, aluminum, white metal, etc., the fuel used being oil or gas. During the melting process the furnace is turned on its side and revolves, the flame passing in through the mouth. This operation keeps the metal in motion, and the hot lining of the melting chamber passes above as well as beneath the metal, which gives uniformity to the heat. The life of the refractory brick lining is claimed to be such that over 150,000 lb. of metal may be melted before relining is necessary.

Niles-Bement-Pond Journal and Axle-Turning Lathe

The Niles-Bement-Pond Co., 111 Broadway, New York City, has recently placed on the market a new machine known as its combination journal turning and axle lathe, which is for inside or outside journals. The machine is of the center-drive type, the top portion of each end of the bed being arranged to slide, thus forming gaps to allow mounted wheels to clear. The illustration shows the lathe with the gaps open. When the gaps are closed the carriages will travel up so as to turn the wheel seats of axles. The center driving gear is provided with a projecting sleeve or bearing at each side, the gear being made in halves and driven from a pinion carried in the bed. The center head has a hinge cap and forms a continuous bearing for the center gear and also covers and guards this gear. The cap is clamped by one large bolt and is counter-weighted in order to insure ease of operation. Provision is also made so that when the cap is swung up it automatically lifts the top half of the main driving gear, thus making it easy to place an axle in the lathe. Four carriages are provided, two for inside journals and two for outside journals. When the machine is used as an ordinary axle lathe for outside journal work the two outside carriages are used for turning the collars, outside journals, sand guards and wheel seats. When used for inside turning the two outside carriages are used for wheel seats and the two inside carriages for the journals. The feed for all carriages is by means of bronze open and closed nuts. The two tailstocks are carried by the upper bed members and both spindles are adjustable by means of hand wheels. Axles are driven by means of hinged dogs acting through a double equalizer drive plate. A pump for cutting lubricant is supplied, together with a suitable drainage system. The machine is arranged for three forms of drive as follows: (1) A three-step cone with two-speed countershaft giving six speeds to the driving head ranging from 16 to 48 r.p.m. (2) A 15-hp., 220-volt, direct-current motor having a speed range of 3 to 1. The motor is mounted on a baseplate attached to the left end of the bed and is geared directly to the driving shaft, giving speeds ranging from 16 to 48 r.p.m. (3) A 15-hp., 220-volt, 3-phase, 60-cycle, alternating-current motor mounted on a speed box at the left-hand end of the machine and geared directly to it. Four mechanical changes of speed are provided by the box and power is transmitted by gearing to the driving shaft, giving speeds ranging from 16 to 48 r.p.m., which are sufficient for the work performed on this machine.



NILES-BEMENT-FOND COMBINATION JOURNAL TURNING AND AXLE LATHE.

Swing over lower bed or sole plate, 45 in.; swing over upper bed, 30 in.; swing over carriage, 15 in.; maximum distance between centers, 7 ft. 9 in.; diameter of main bearing, 16 in.; length of main bearing, 13 in.; speed changes, three, $\frac{1}{8}$ to $\frac{1}{4}$ in. per spindle revolution.

Mechanical-Laboratory Assistants Wanted by the Government

The Government is in need of a number of mechanical-laboratory assistants and draftsmen for important war work in the development of parts from sheet metal, fabric and rubber. Graduates from manual-training schools with one or two years' shop experience or men with one or two years in an engineering school are desirable and the pay is dependent upon ability and experience. Applicants are asked to send a small photograph and to state their age, references, positions in the draft and willingness to enlist or be inducted in the army for work of this nature, if requested to do so. The address is Mechanical Research and Development Division, Army Defense Problems, American University, Washington, D. C.

LATEST ADVICES FROM OUR WASHINGTON EDITOR

Washington, D. C., June 15, 1918.—The question of machine tools for the big-gun program is still about where it was when Colonel Reed addressed the convention of machine-tool builders at Atlantic City. The list given out at that time is not considered final and may be said to be a guide rather than the exact requirements.

One of the points to be very carefully considered is that of sizes. As stated in the list there would be orders for 48 in., 50 in., 56 in., etc., boring mills. This, needless to say, is an unwise selection as there should be as few sizes as possible in order to facilitate the making of the necessary machines. Generally speaking it is better to vary the sizes by a foot than by any smaller increment, as this will greatly reduce the number of sizes to be made and in that way facilitate production. The advantages of quantity production becomes apparent even in a comparatively small-sized lot as compared with making a few of varying sizes.

Then too the orders should be so placed as to make it easy to secure the most machines in the shortest time. If certain shops can handle all of one size better than a few of several sizes they should be given orders in that way. Some shops, however, would probably be able to handle work of different sizes on account of the capacity of their equipment. All of these things should be carefully considered in placing the orders, the main requirement being that of speed in getting machines into the gun shops and at work on guns.

Where a Reserve Would Have Helped

We have talked much of a machine-tool reserve, and the need of such a reservoir is now very evident. One of the firms having a contract for guns is in sore need of a lot of planing machines to handle work which they did not expect to do. Being accustomed to drop-forgings where the amount of finish is very small, they did not figure on the kind of forgings which are coming out of the gun shops. These are little more than chunks of steel and require a lot more planing than they counted on.

But there are no planing machines to be had without robbing someone else and upsetting the program generally. A few hundred planing machines in reserve would have helped just such cases as this. There is, however, little use in talking of a reserve at the present time, as all the machine-tool-making capacity, especially in large machines, will be needed for the machines to equip the shops.

A machine-tool dictator would probably be able to locate some sort of machine-shop capacity near the forge shop and utilize this to rough out the surplus stock. In some cases the machines used in stone work are available for this and should be utilized. An overseeing eye on all work of this kind will enable us to secure a much greater production than we realize as yet.

Many Machines Still Needed

The need of a machine-tool program is not yet fully appreciated, even without such unforeseen demands as those just mentioned. It does not seem to be fully understood how few really large machine tools we have or how many of these it will be necessary to use in making our supply of new machine tools. The sooner we can begin on these the better for all concerned.

Another important work for one branch of the machine-tool dictator's force might well be to keep tabs on the way in which the large machines of the country were being used. If we could keep all our large machines at work on large work only we should have accomplished much. A careful oversight of work in shops having large tools, to prevent these tools being used on small work as long as there was large work to be done, would be equal to increasing our supply of large machines.

We need careful, organized effort to get the most out of such equipment as we have. A corps of trained engineers who can direct such work with intelligence and discretion would be worth even more than may appear on the surface. Men of this caliber are not easy to get, but they must be found, and when found they must give themselves up to such work as they can do for the best interests of the country.

A Suggestion Regarding Material

In line with the article in my letter of May 30 the Wapakoneta Machine Co., Wapakoneta, Ohio, suggests a plan that may cover the difficulty of obtaining materials. "It is to give to each manufacturer making an essential article for the Government a serial number similar to the food licenses used by the flour mills or similar to the licenses used by coal dealers. The use of this number in connection with the firm name would allow the purchase of necessary supplies and raw material from mills and warehouses.

"We all know that steel deliveries on all small quantities of specific sizes are slow, and this means that the manufacturer must place stock orders which will cover the majority of his needs. If the manufacturer may only

order against Government orders this means the misuse of numbers on orders now in process of manufacture or gradually dropping out of the stock delivery which they now can make, and this will delay many other necessary industries.

"The license number can be used to eliminate the holding up of orders for raw materials at warehouses and mills and eliminate the misuse of Government order numbers. It will also take care of the industries that cannot sell to the Government direct owing to the nature of their product, and it will allow these industries to have the raw material to make the supplies for jobbers who are selling direct from the shelf and warehouses.

"The product which we manufacture is essential to carrying on the war, yet our order file will show less than 1 per cent. of our orders being booked direct with the Government. Hence, when it comes to getting our raw material from the mills and warehouses, we are in the same position as the pig-iron users mentioned in the letter."

Buttons for War Workers

Another subject which is receiving careful consideration is the use of buttons to show who are on war work, with the possibility of a second button or insignia of some sort to indicate that the wearer sticks to his job. For this after all is what counts to a greater degree than many of us realize. Records in many shops show an unbelievable loss due to the absence of men who are responsible for certain parts of the work and whose failure to appear causes far greater loss in production than might appear on the surface. Let us remember that these are both radical experiments in industry and try to do all we can to get the best results in all cases.

Leslie Henry Colburn

Leslie Henry Colburn, general manager of the Colburn Machine Tool Co., Franklin, Penn., died at his home in that city May 26. He was 51 years of age and was born in Fitchburg, Mass., Mar. 20, 1867. Mr. Colburn was founder of the Colburn Machine Tool Co. He went to Franklin, Penn., from Toledo, Ohio, where he was superintendent of Baker Brothers. He was first known as the inventor of the Colburn keyway cutter, which was built by Baker Brothers and which had a large sale in this country and in others. He next developed a high-speed, heavy-duty drilling machine for drilling bicycle, automobile and harvesting machinery parts. Shortly after he became acquainted with Gen. Charles Miller and other prominent Franklin business men, and the Colburn Machine Tool Co. was proposed and organized with General Miller as president, H. W. Breckenridge treasurer, and L. H. Colburn general manager, who proved a very successful combination.

Mr. Colburn's father, Henry J. Colburn, a master mechanic in designing and building wood, metal and glass working machinery, in 1900 designed and patented a universal-saw table which was one of the first machines built by the Colburn Machine Tool Co., and was advertised as "Built like a machine tool." Shortly after this machine was put on the market a draw-stroke vertical shaping machine was designed and built by the company. Next a vertical boring mill and later a high-speed heavy-duty drilling machine were built. They met with great demand and the universal-saw table and draw-stroke shaping machine were discontinued.

Trained by years of practical experience Mr. Colburn was able to put a finish of beauty and strength to every detail of machine designing which passed his inspection. As an example of his practical views in this regard he was asked by Prof. J. J. Flather for his formulas for bearing designs. Mr. Colburn replied that he used no formulas and knew nothing about the mathematics of machine designing, but simply used his experience and ordinary judgment in his proportions.

LESLIE HENRY COLBURN

Professor Flather answered that if he would favor him with a few of his working drawings he could make up formulas from them, as he admired his judgment of proportions, which showed symmetry and strength. Mr. Colburn complied and Professor Flather received the drawings. In his drafting room, Mr. Colburn kept wooden models of shafts, etc., for the designers to look at when deciding upon important sizes, as a mere dimension of a diameter is often confusing or misleading.

Mr. Colburn came from a long line of ancestors noted for their mechanical skill, and his brothers are all known for their engineering and mechanical ability. He married Leora I. Westbrook of Detroit, Mich., June 14, 1892. Besides his widow Mr. Colburn leaves three brothers, Charles B. Colburn of Franklin, Penn., George L. Colburn, general manager of the Colburn Gear and Manufacturing Co., Boston, Mass., and Harrison S. Colburn, president of the Harrison S. Colburn Real Estate Co., New York.

Conservation of Technical Engineering

By Alfred D. Flinn

Secretary Engineering Council

An Address to the Secretaries of War and the Navy

Technical engineers of every branch of the profession who are taking part in the war activities of the army and navy are alarmed at the unfortunate waste of technical training caused by drafting and enlisting engineers for regular service with little or no regard for their technical attainments. These technically educated and experienced men are essential to the successful conduct of the war and cannot be replaced. There is continuing evidence that America is repeating in some measure England's mistake of sending technical men into the ranks when they should be carefully conserved for special duties in the fighting forces or on the technical staffs of the army, the navy and the essential war industries.

These facts have been forced upon the attention of engineers who have been coöperating with the Government through the Naval Consulting Board, the National Research Council and the Engineering Council. These organizations have had requests constantly made to them for engineers, chemists and other technical men for a variety of military services. Thousands of names have thus been furnished to the Government departments and bureaus. The Engineering Council especially has devoted attention to this personnel work through its committee, known as the American Engineering Service, which has available classified lists of approximately 25,000 engineers besides unclassified lists of many more. It is from these lists, directly or indirectly, that most of the names have been selected for war service.

The Engineering Council was founded by the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers and American Institute of Electrical Engineers, and other engineering societies are coöperating with it in this service, the total membership represented by these organizations being approximately 50,000. Already from 10 to 15 per cent. of the members of these organizations are in the uniformed services of the country, and it is safe to say that a large majority of their remaining members are in the Government civilian service or otherwise directly or indirectly engaged in the war. Engineers do not seek to avoid fighting, but earnestly desire to be given opportunities for fighting and other services in which they can be most effective and which cannot be performed by others.

It is known that through the Committee on Classification of Personnel in the War Service Exchange of the War Department and some other ways efforts are being made to counteract the tendencies toward the loss of our technical men in the ranks of the army and navy. It is believed, however, that these efforts are insufficient and that they should at once be supplemented by other stringent measures dealing with the subject in the draft boards and recruiting stations.

In view of the foregoing the Engineering Council, created to provide means for united action and to speak authoritatively for its member societies on all public questions of common interest to engineers, respectfully offers the following:

Whereas, Technically trained engineers are indispensable to the army, the navy and the war industries, in engineering corps, ordnance bureaus and signal corps, in aviation, submarine and tank service, in shipbuilding, and in many other assignments; and

Whereas, Through draft and otherwise many of these irreplaceable men have been and are being diverted so that their special qualifications are not being utilized; be it

Resolved, That in the opinion of the Engineering Council technically trained men of all ages should be enrolled and conserved for technical duties, and special efforts should be made immediately by the War and Navy departments to find and record such men among drafted and enlisted forces and to assign them to places in which their special qualifications are needed; and be it further

Resolved, That the Engineering Council offers to assist the War and Navy departments in locating and classifying such men, if its assistance be desired, provided these departments will give the necessary facilities for collecting information about engineers now in the army and navy or whose names are upon the selective draft lists.

These resolutions are offered solely in a patriotic spirit of helpfulness.

Personals

F. O. Hoagland, formerly with Pratt & Whitney, is now works manager and vice president of the Bilton Machine Tool Co., Bridgeport, Conn.

R. W. Ellingham, recently works manager of the Heald Machine Co., is now sales manager of the Bilton Machine Tool Co., Bridgeport, Conn.

C. E. Carpenter, general European manager of the Allied Machinery Co. of America, has accepted a captain's commission in the United States Quartermaster's Department in France.

Henry Japp, connected with the British Ministry of Munitions in the United States, has been made a Knight of the British Empire as an appreciation of the work he has accomplished. In the future he will be known as Sir Henry Japp, K.B.E.

Winthrop Ingersoll, of the Ingersoll Milling Machine Co., Rockford, Ill., has been advised of the death of his son, Clayton C. Ingersoll, who was in the aviation service in France. The many friends of Mr. Ingersoll extend their heartfelt sympathy.

Frank Wollaeger, Jr., secretary of the Kempsmith Manufacturing Co., who enlisted in the Milwaukee Base Hospital Unit, has been transferred to the Ordnance Department and is now at Camp Hancock, Augusta, Ga., taking special training for his work in this department.

Obituary

Lieut. Henry W. Clarke of Newton, Mass., son of Charles A. Clarke, was killed in action in France on May 29, 1918. He was attached to Company M, 16th Division, machine-gun attachment of the United States Army. Lieutenant Clarke was associated with his father in the manufacturing business of the Universal Boring Machine Co. at Hudson, Mass.

Business Items

The Sullivan Machinery Co. has established a branch office at Washington, D. C., at Room 210, Union Trust Building, 15th and H Sts. Ralph T. Stone, associated with the New York office of this company, will be in charge.

The Doehler Die Casting Co., Toledo, Ohio, which is housed in its new factory building completed a little over a year ago, has outgrown its quarters, and in order to provide for its expansion it has taken over the plant of the Ohio Electric Co.

The Raymond Engineering Corporation, 309 Lafayette St., New York, has acquired the plant and all the machinery of the Bosch Magneto Co., Plainfield, N. J. Purchases of machines and tools are being made for increasing the gage, jig, fixture and die departments. Within a short time the corporation expects to announce the acquiring of several other shop units.

Trade Catalogs

Ticket Cancelling Box—Ingersoll-Rand Co., 11 Broadway, New York. Form 9010; four-page catalog; 6 x 9 in. on the "Sergeant" ticket cancelling box.

Leyner Shank and Bit Punch—Ingersoll-Rand Co., 11 Broadway, New York. Form 4039; eight-page bulletin, 6 x 9 in., on Leyner shank and bit punch for punching out holes in bits and shanks of hollow-drill steel.

The Abbott Burnishing Process by Means of Steel Balls—The Abbott Ball Co., Hartford, Conn. Catalog; pp 24, 4 x 9 in. The catalog illustrates and describes the Abbott patented burnishing barrel and carbonized steel balls.

"Little David" Pneumatic Tool—Ingersoll-Rand Co., 11 Broadway, New York. Form 901; four-page leaflet, 8½ x 11 in., showing the complete line of "Little David" pneumatic tools. Tables of sizes and capacities are given and illustrations show all the tools and their applications.

Equipment for Sugar Factory and Refining Service — Ingersoll-Rand Co., 11 Broadway, New York. Form 9028; 18-page catalog, illustrating and describing equipment for sugar factory and refinery service A separate Spanish edition of this catalog is also available for those who desire it.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Press, No. 4

Moore & Co., Grand Ave. and Franklin St., Chicago, Ill.
"American Machinist," May 30, 1918

Weight, 2800 lb.; weight of flywheel, 575 lb.; size of flywheel, 30 x 4½ in.; speed of flywheel, 115 r.p.m.; diameter of round opening in bed, 8 in.; oblong opening in bed, 12 x 6 in.; opening through back, 12 in.; center of slide to frame, 6½ in.; die space on top of bolster plate, with stroke down and adjustment up, 8½ in.; distance from bed to gibs, 12¾ in.; standard stroke, 2½ in.; adjustment of slide, 3 in.; thickness of bolster plate, 2 in.; square hole in slide for punch-holder shanks, 2 in.; floor space over all, 40 x 44 in.; bolster plate, 15 x 22 in.; slide, 9 x 9 in.

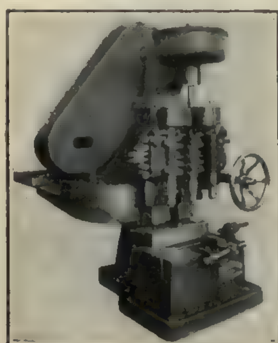
Planing Machine

Bickett Machine and Manufacturing Co., Cincinnati, Ohio
"American Machinist," May 30, 1918

Made in sizes from 36 x 36 in. to 52 x 42 in.; the specifications of the 42 x 42-in. size being as follows: Width of table, 38 in.; thickness of table, 6 in.; distance center to center of Vs, 17½ in.; depth of bed, 22 in.; face of housing, 7½ in.; depth of cross-rail, 13 in.; length of down feed on rail head, 12 in.; face of bull wheel and rack, 5 in.; width of driving pulley, 3⅝ in.; height 108 in.; width, 102½ in.; speed of table, 50 ft. per minute; weight with 8 ft. table, 22,000 lb.

Rail-Drilling Machine

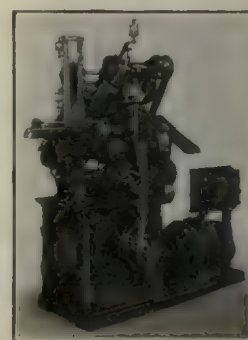
Newton Machine Tool Works, 23d and Vine Sts., Philadelphia, Penn.
"American Machinist," May 30, 1918



For drilling simultaneously the holes required in the ends of rails. All important bearings are bronze bushed and the spindle, spindle gears and rack pinions are of nickel steel. All gears and the driving belt are completely inclosed. The drive is by electric motor and two feeds 0.04 and 0.007 in. per spindle revolution are available. Diameter of spindles, 1¾ in.; minimum distance between spindle centers, 3½ in.; maximum distance between spindle centers, 9 in.; maximum distance from top of table to end of spindles, 19½ in.; size of work table, 16 x 30 in.

Drilling Machine, Multiple Spindle for Ignition Tubes

Langelier Manufacturing Co., Arlington, Cranston, R. I.
"American Machinist," May 30, 1918



For drilling twenty-two 0.141-in. holes through brass tubing with a wall thickness of 0.035-in. The machine is entirely automatic in action and the output is said to be 20 tubes a minute. The jig chamber is kept free of chips by means of streams of compressed air and oil, the latter also serving for lubrication purposes. The spindles are mounted on ball bearings and driven by spiral gears which are inclosed and run in oil. Ball bearings are also used on the spiral gearshafts which extend to the rear of the machine and which are driven by endless belts. Speed of spindles, 2800 r.p.m.; floor space, 30 x 60 in.; height, 68 in.; weight, 3000 lb.; electric motor, 5-hp. Westinghouse.

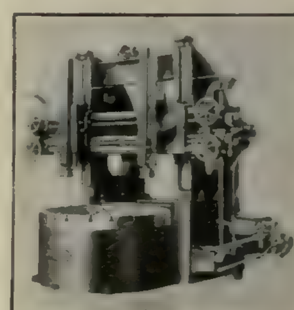
Press, No. 3

Moore & Co., Grand Ave. and Franklin St., Chicago, Ill.
"American Machinist," May 30, 1918

Weight, 1800 lb.; weight of flywheel, 370 lb.; size of flywheel, 26 x 4 in.; speed of flywheel, 125 r.p.m.; round opening in bed, 7 in. in diameter; oblong opening in bed, 11 x 6 in.; opening through back, 11 in.; depth of throat, 5½ in.; die space on top of bolster plate with stroke down and adjustment up, 6¾ in.; distance from bed to gibs, 8½ in.; standard stroke, 2 in.; adjustment of slide, 2 in.; thickness of bolster plate, 1⅞ in.; square hole in slide for punch-holder shanks, 2 in.; floor space over all, 36 x 38 in.; bolster plate, 14 x 21 in.; face slide, 7 x 7½ in.

Boring Mill "Maxi-Mill"

Bullard Machine Tool Co., Broad St. and Railroad Ave., Bridgeport, Conn.
"American Machinist," June 6, 1918



Capacity, work up to 63 in. in diameter and 52 in. in height under the cross-rail and tool-holders; diameter of table, 61 in.; table speeds, twelve, 2.5 to 42.18 r.p.m.; feed changes, eight, 1/96 to ½ in. per revolution of table, either vertical or horizontal; vertical movement of tool slides, 36 in.; swivel of tool slides, 45 deg. either side of vertical center; driving pulley, 24 in. in diameter, 5½ in. face; r.p.m. of driving pulley, 405; motor drive, 15 hp., constant-speed motor mounted on bracket at rear of machine and connected by belt; weight, 28,000 lb.; floor space with motor drive, 11 x 13 ft.; maximum height with bars in extreme upper position, 130 in.; minimum height, 118 in.

Tapping Machine, Type P

H. Lichtenberg, 82 Beaver St., New York City
"American Machinist," May 30, 1918

The device is pivoted on a base and has a semicircular adjustment sector, by means of which the machine may be swung into any position from horizontal pointing to the right to horizontal pointing to the left. The illustration shows the machine in a vertical position. It may be also equipped with a handwheel for hand-tapping work. Capacity up to $\frac{5}{16}$ in. in steel, ⅜ in. in brass or similar alloys and ⅜ in. for hand-tapping work. Diameter of table, 6 in.; distance from center of shaft to slide rod, 3½ in.; vertical adjustment of table, 6 in.; diameter of driving pulley, 5 in.; width of driving pulley, 1½ in.; bench space 7 x 8 in.; weight 40 lb.

Trucks, "High Level"

Orenstein-Arthur Koppel Co., Koppel, Penn.
"American Machinist," June 6, 1918

The feature of this device is that the surface level of the truck is considerably higher than ordinary, thus rendering it much easier for the workmen to transfer heavy parts from the truck to the machine or vice versa. Is so constructed that the load is balanced on the center axle, which is provided with wide-tire, roller-bearing wheels. The truck is of heavy construction throughout and its rated capacity is two-thirds of a ton.

Patent Applied For

Reversible Ratchet Wrenches. Lowell Wrench Co., Worcester, Mass. Catalog "M." Pp. 20; 6 x 9 in. This catalog gives a number of illustrations of the reversible ratchet wrenches, together with a description, prices and sizes.

Sim-pull and Sim-plex Countershafts and Belt Shifters. The Mossberg Wrench Co., 25 Charles St., Providence, R. I. Catalog. Pp. 16; 6 x 9 in. Various sizes are given, together with prices. Several halftone and line drawings are also given.

No. 2 Turret Screw Machine. Southworth Machine Co., Portland, Me. Circular. Pp. 4; 8½ x 11 in. Gives a description of the No. 2 turret screw machine with plain head, automatic chuck, bar feed and hand longitudinal feed to cutoff. Features of this machine are given, also specifications and illustrations.

No. 4 Turret Screw Machine. Southworth Machine Co., Portland, Me. Circular. Pp. 4; 8½ x 11 in. The circular describes the No. 4 turret screw machine with geared friction head, automatic chuck, bar feed and hand longitudinal feed cutoff. Some of the features are given together with specifications and illustrations.

Bolt, Nut and Rivet Works. Hoopes & Townsend Co., Broad and Buttonwood Sts., Philadelphia, Penn. Catalog 27. Pp. 78; 6 x 9¼ in. The arrangement and classification of each article in this catalog frequently exhibits list prices, weights, sizes and numbers on one page which makes a desirable, quick and ready reference to the principal articles manufactured.

Fenestra Monitor Sash and Operator—Detroit Steel Products Co., Detroit, Mich. Catalog, section 2; pp. 42; 8½ x 11 in. The contents of this catalog include Fenestra horizontally pivoted sash, continuous center pivoted sash, continuous top hung sash, horizontally rolling sash, worm and gear operator, and continuous operator. A number of line drawings and halftone illustrations are given.

Sand Blast Machinery—J. W. Paxson Co., Philadelphia, Penn. Bulletin No. 28, 40 pp.; 6 x 9 in. The bulletin is illustrated and describes the horizontal and oblique tilting sandblast tumbling barrels in various sizes with an automatic nozzle attachment for sandblasting, large quantities of small castings, iron, brass or steel. Cleaning cabinets, sand sifters, dryers, bucket elevators, suction sand-handling system, air compressors, and accessories are also shown.

The Truscon Building Products. Truscon Steel Co., Youngstown, Ohio. Booklet. Pp. 104; 3½ x 6 in. This is the eighth edition, revised, showing the various Truscon products with their application, covering reinforcing steel, floretyles, Hy-rib and metal lath, pressed-steel joists and studs, highway reinforcements, curb bars, concrete inserts, steel windows, steel buildings, hollow tile, chemical products, etc. It also gives tables of carrying capacities, strengths, etc. A copy will be sent free to interested parties.

New and Rebuilt Tools—New York Machinery Exchange, Inc., 50 Church St., New York. Folding art calendar giving the number, size and weight of new and rebuilt boring mills, milling machines, punches and shears, bulldozers, bending rolls, planing and shaping machines, presses, hammers, engine lathes, turret lathes, screw machines, drilling and grinding machines, saws, gear cutters, keyseaters, cutting-off and pipe machines, power equipment, etc. This folder is issued monthly and will be sent to interested parties upon request.

Calculating Bearing Loads. U. S. Ball Bearing Manufacturing Co., Chicago, Ill. Booklet. Pp. 32; 9¼ x 12 in. This booklet shows in detail the methods used in calculating the load on bearings resulting from various types of drives as follows: (1) belt drive, (2) rope, (3) chain, (4) spur-gear drive, (5) helical-gear drive, (6) bevel-gear drive, (7) helical-bevel gear drive, (8) wormgear drive. Diagrams are given for each type of drive showing the various forces acting. The booklet should be valuable to anyone interested in questions of this kind.

Scientific Industrial Illumination. Holophane Glass Co., 340 Madison Ave., New York. Booklet. Pp. 36; 6¼ x 9¼ in. This booklet is divided into four parts. The first part shows the need for scientific illumination and discusses its economic advantage. The second section discusses the fundamental principle of scientific illumination. The third part describes and illustrates new types of industrial lighting units manufactured by the company for shop, factory, office and drafting-room illumination and for yard and protective lighting. The fourth section contains a collection of general engineering data which should make this book especially valuable as a ready reference book.

New Publications

Principles of Mechanism—By Walter H. James and M. C. Mackenzie. Two hundred and forty-one 5 x 7½-in. pages; 192 illustrations and a number of diagrams in the appendix. Published by John Wiley & Sons, New York. Price $1.50.

This is one of the Wiley Technical Series and is compiled by instructors in the Massachusetts Institute of Technology. It is intended to present the elementary principles of mechanism in a way that makes it adaptable for use in evening technical schools, trade schools, mechanic arts high schools and other schools where it is desired to teach the subject thoroughly yet without going into the highly mathematical treatment. Typical problems are solved throughout the text and a large number of problems are included for solution by the student. The book is well arranged in regular textbook style, with numbered paragraphs with black-face-type headings. Commencing with general definitions the various chapters treat of revolving and oscillating bodies, transmission of motion by means of cylinders, cones and disks, gears and gear teeth, belts, ropes and chains, inclined planes, wedges, screws, worm and worm wheels, cams, simple wheel trains, links and linkages.

Graphics—By H. W. Spangler. Ninety-five 6 x 9 in. pages; 88 illustrations; cloth. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price $1.25.

This volume is primarily intended to be used as a reference book on the subject of graphics, containing the substance of the course of lectures given on this subject to the students in mechanical, electrical and chemical engineering at the University of Pennsylvania. It has been the intention of the author to cover only the fundamental principles, and many of the short cuts commonly used have been omitted, as it is the author's belief that these special methods will be readily grasped by anyone familiar with the fundamental principles involved. Some of the subjects covered are: Equilibrium; forces; triangular frames, lettering diagrams; signs of forces; equilibrium polygons; parallel forces; checking graphical work; approximate loads; snow; wind; inclined members; horizontal members; uniform moving load; Pratt truss; chord stresses; nonuniform moving load; maximum shear from equilibrium polygon; graphics of machines; friction; wedge and screw; bearing friction; bell crank; engines; gearing; chains and sprocket wheels; pulleys; bending and twisting moments; forces in one plane; secondary beams; overhanging beams; forces inclined to beams; forces not in one plane; compression in a shaft; counterbalancing; combination bending and twisting moments; bending and torsion diagram; inclined crank loads; etc.

A Handbook on Piping—Carl L. Svensen. Three hundred and fifty-nine 6 x 9-in. pages; 359 illustrations; 100 tables; 8 plates. Published by D. Van Nostrand Co., 25 Park Pl., New York. Price $4.

There are many things which every engineer is assumed to know about piping, but the sources of information are not always so readily available as to justify this assumption. In designing certain pieces of work requiring the use of piping, the designer often has to search through a mass of catalogs, handbooks, or even fittings themselves, to obtain accurate information which is not always forthcoming. The inconvenience and loss of time resulting from the lack of a ready source of information regarding pipe and its accessories would seem to justify the publication of this book. The variety and extent of the formulas, tables, illustrations and plates will make it valuable to both engineers and students. The frequent use of the names of companies furnishing tables and data or which are engaged in pipe work is of special value to the practical man, but is a feature frequently omitted from books of this kind by authors who do not appreciate the real value of such names. The author of this handbook, however, has done considerably better than the average in this respect. Of course little originality can be shown in a book of this kind, but the arrangement is good and the various subjects are easily found by use of the table of contents and liberal index. The various chapters deal with pipe, dimensions and strength of pipe, pipe threads, pipe fittings, pipe joints, standard valves, special valves, steam piping, drip and blow-off piping, exhaust piping and condensers, feed-water heaters, piping and heating systems, water and hydraulic piping, compressed-air, gas and oil piping, erection, workmanship, piping insulation, piping drawings and specifications.

Essentials of Descriptive Geometry—Second edition, revised. By F. G. Higbee, M.E., professor and head of the department of descriptive geometry and drawing, State University of Iowa. Two hundred and eighteen 6 x 9-in. pages; 314 illustrations; cloth. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price $1.80.

This book has been prepared with the intention of presenting only such parts of the subject of descriptive geometry as have actual utility in the industrial drafting room. The author begins by taking up the problems of projection and gradually works up through the various steps to the more complicated phases of the subject. Throughout the book the particular stress is laid on the analysis of each problem into its various component parts, a feature which should be of great value in helping the beginner to grasp the subject. A considerable number of problems are presented, and these are so selected as to give the student an idea of some of the work that is done in commercial work.

The material of the first edition has been corrected and revised and some parts rewritten. A chapter on tangencies has also been added. An eight-page appendix presents a number of useful geometrical constructions. The illustrations throughout the book are particularly pleasing.

The chapter headings are as follows: I, Orthographic Projection; II, Profile Plane; III, Assumption of Points and Lines; IV, Planes; V, Location of Points, Lines, and Planes; VI, Revolution of Points; VII, Problems on the Line; VIII, Problems on the Plane; IX, Problems on Angles; X, Problems on Points, Lines and Planes; XI, Surfaces; XII, Plane Surfaces; XIII, Cylindrical Surfaces; XIV, Conical Surfaces; XV, Intersection of Surfaces; XVI, Surfaces of Revolution; XVII, Warped Surfaces; XVIII, Tangent Planes and Lines; XIX, Model Making; XX, Appendix.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

The American Society for Testing Materials will hold its twenty-first annual meeting at Atlantic City, N. J., June 25-28, with headquarters at the Hotel Traymore. The permanent headquarters of the secretary-treasurer are under the name of the society, Philadelphia, Penn.

Boston Branch National Metal Trades' Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No 2 Southern Foundry, Birmingham..	$33.00	$33.00	$.....
No. 2X, New York	34.25	.....	47.00
No. 2 Northern Foundry, Chicago	33.00	37.00	50.00
*Bessemer, Pittsburgh	36.30	37.25	55.95
*Basic, Pittsburgh	33.10	33.95	50.00
No. 2X, Philadelphia	34.25	33.75	46.75
*No. 2, Valley	34.10	33.95	50.00
No. 2 Southern Cincinnati	35.90	35.90	42.90
Basic, Eastern Pennsylvania	32.75	33.75	42.50

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.195	$4.195	$5.00	$4.20	$5.00	$4.20	$5.00
Soft steel bars	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Soft steel bar shapes	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Soft steel bands	4.945	.....	....	....	....	....	....
Plates, ¼ to 1 in. thick	4.445	4.445	8.00	4.20	7.00	4.45	8.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.25
Warehouse, New York	4.70	4.60
Warehouse, Cleveland	4.10	4.45
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
*No. 28 black	5.00	6.445	6.445	9.50	6.385	8.25	6.45	8.50
*No. 26 black	4.90	6.345	6.345	9.40	6.285	8.15	6.35	8.40
*Nos. 22 and 24 black	4.85	6.295	6.295	9.35	6.235	8.10	6.30	8.35
Nos. 18 and 20 black	4.80	6.245	6.245	9.30	6.185	8.05	6.25	8.30
No. 16 blue annealed	4.45	5.645	5.645	9.20	5.585	7.95	5.65	8.70
No. 14 blue annealed	4.35	5.545	5.545	9.10	5.485	7.85	5.55	8.60
No 10 blue annealed	4.25	5.445	5.445	9.00	5.385	7.75	5.45	8.50
*No. 28 galvanized	6.25	7.695	7.695	12.00	7.695	10.00	7.70	10.50
*No. 26 galvanized	5.95	7.395	7.395	11.70	7.335	9.75	7.40	10.20
No. 24 galvanized	5.80	7.245	7.245	11.55	7.185	9.55	7.40	10.05

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 10%	List plus 25%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Current	One Year Ago
New York	$15.50–19	$20.00
Cleveland	15.00	12.30
Chicago	17.00	12.00

In coils an advance of 50c. usually is charged.

Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	22.10 to 33.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

*Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

***Special Welding Wire**

⅛	33.00
5/32	30.06
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel (heavy)	7.50	8.00	7.50
Spring steel (light)	11.00	11.25	11.00
Coppered bessemer rods	9.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel	8.50	8.25	8.50
Floor plates	6.19½	6.00	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
⅛, ¼ and ⅜..	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			

LAP WELD

2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%

BUTT WELD. EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜..	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			

LAP WELD. EXTRA STRONG PLAIN ENDS

2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to [illegible]	44%	32½%	4½ to [illegible]	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	41.9%	26.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	37.9%	23.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	31.00
Tin, in 5-ton lots	91.00	85.00	61.00
Lead	7.25	7.25	12.00
Spelter	7.62½	7.50	9.25

*Government price.

ST. LOUIS

Lead	7.12½	7.25	9.25
Spelter	7.31½	7.10	12.00

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper sheets, base	32.50-33.00	32.00	42.00	34.00	42.00	32.50	42.50
Copper wire (carload lots)	31.00	32.00	39.50	34.00	39.00	32.00	40.00
Brass sheets	31.75	30.75	45.00	30.00	41.00	30.00	43.50
Brass pipe base	36.50	36.50	47.50	41.00	48.00	40.00	47.50
Solder ½ and ½ (case lots)	62.00	62.00	39.75	62.00	39.50	70.00	39.50

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	38.00
Chicago	28.00	42.50

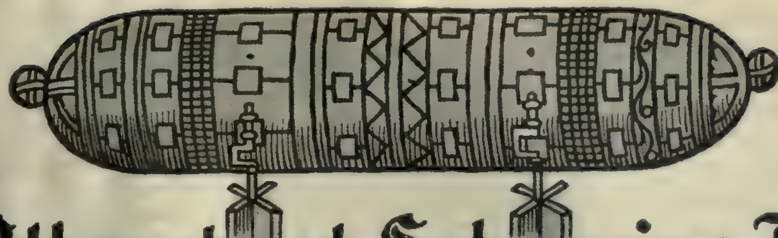
ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 15.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	18.75	21.00	18.40	21.50
New York	16.50	23.00	17.00	23.25
Chicago	21.00	22.50	21.50	23.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	13.00	20.00
Chicago	13.50	28.00
Cleveland	16.00	27.50



Early Attempts at Submarine Building

By H. H. Manchester

This very interesting article tells about the attempts of the ancients to devise submarine boats. One designer went so far as to design a boat provided with cannon that could be discharged under water. From the description of this arrangement it is apparent that the inventor came close to anticipating the torpedo tubes of the present day.

ALTHOUGH the success of the submarine has come only within the present generation, the first attempts at their use began some five centuries ago. The first principles of submarine navigation, perhaps, may be said to have been acquired by divers of the most ancient times.

References to divers for pearls, sponges, and the mollusks from which the Tyrian purple was extracted go back to the days of the Pharaohs and ancient Phœnicians; but the earliest definite statements of apparatus used to assist them appear to be made in Aristotle about 350 B.C. After mentioning how the ears of those who dive in the sea are in danger of bursting, Aristotle says that the divers cut their ears and nostrils and bound sponges about their ears. In another place he writes that a leather air bag was used by the divers, and compares it to the trunk of an elephant. Far more important than this, however, is his account of what seems to be the beginning of the diving bell. "In order that these fishers for sponges may be supplied with easy respiration, kettles are let down to them in such a way that they are not filled with water, but with air; for they are let down heavily weighted so that they do not turn upon either side, but remain upright."

FIG. 1. DIVER'S LEATHER BAG, 390

Aristotle also records the fact that divers were used to some extent by Alexander the Great at the siege of Tyre.

Other information about apparatus employed by divers is given by Vegetius in his book on military affairs written about 390 A.D. A medieval edition of this book illustrates not only the leather bag (Fig. 1) mentioned by Aristotle as used by divers for breathing, but a helmet (Fig. 2), which was bound over the head and shoulders and had a leather tube extending above the surface. The romances about Alexander the Great gave free vent to the imagination in describing his exploits beneath the sea, and several of the manuscripts contained pictures illustrating them. In one of these miniatures, the date of which is about 1320, we see a large glass barrel, Fig. 3, resting on the bottom of the sea and occupied by the king. In proximity is a diminutive whale, two children of the deep and a couple of sea dogs, which seem at no loss to live beneath the water. Chains for lowering and raising the barrel are visible, but there is no sign of any air tube leading to the surface. While this illustration is very quaint the idea of a water-tight vessel was a distinct advance, and marks what might be called the first step from diving apparatus to submarine.

A direct application of this conception, Fig. 4, was made by Robertus Valturius in 1460 in his "De Re Militari." The design he showed was for a boat of the form of a cylinder with a pointed prow and stern. Both the prow and stern were detachable, so that the boat could be easily transported. It was intended for crossing rivers without being seen by the enemy, and for this purpose it was made water tight all around so that it could be sunk below the surface. Two cranks, which drove two paddle wheels, were also used to guide the boat. It was said to be capable of holding 12 men for the period necessary to cross a river. The two other designs at the top of the same plate are for different boats, but suggest an approximation to broken screws to be used in driving these vessels or the submarine. In the next century there were several allusions to diving apparatus, including a rigid tube by Leonardo da Vinci, about 1490, and a diving bell experimented with at Toledo, Spain, in 1538. But leaving diving operations aside, the next notice taken of submarines seems to be the one by Olaus Magnus, the Bishop of Upsala, in his "History of the North," published in Latin in 1555. He declares: "Halfway to Greenland there is found a kind of pirates that use leather boats. By a method of navigation not so much above as below the water, they creep up in ambush and bore holes in the ships of merchants below the pump. I saw two of these leather boats, Fig. 5, in the year 1505 on the

west wall of the cathedral, dedicated to Saint Halvard, and hung up so as to be seen. These boats Haquinas, king of the same country, was reported to have taken while passing near to the coast of Greenland with a fleet of war, when the pirates sought to have drowned his ships. The inhabitants of that country get no small profits by such treacherous acts through boring holes secretly, as I have said, underneath the sides of ships, letting in the water, and presently causing them to sink."

Although the text seems a little obscure, this passage may possibly be considered to mark the earliest employment of submersibles.

The next important advance toward the principles of the submarine was probably made by William Bourne of England in 1578, Fig. 6, and consisted of the method he proposed for lowering and raising the vessel. His plan was to have the sides of the vessel in part double,

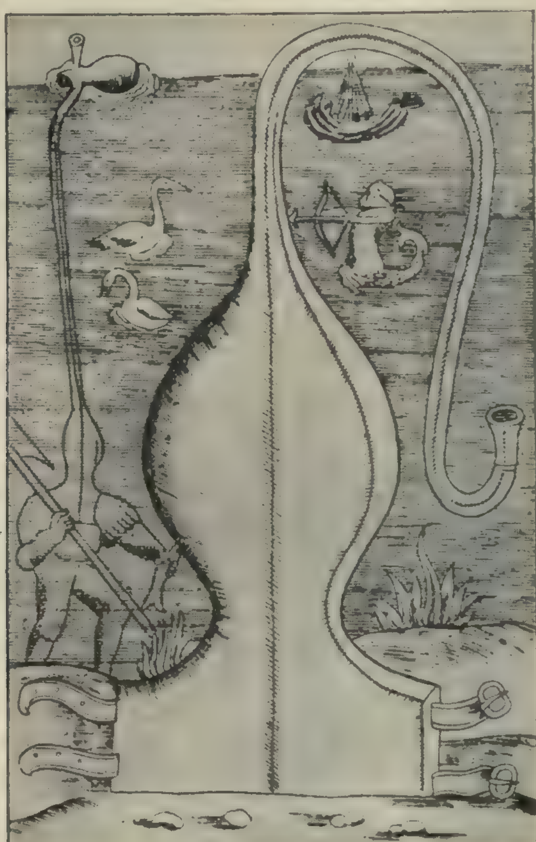


FIG. 2. DIVER'S HELMET, 390

but connected by a flexible membrane such as oiled leather, so that they could be drawn apart or forced together by means of hand screws. There were to be holes in the outer shell of the vessel, through which the water would enter when the second shells were drawn inward. This of course would sink the vessel. When it was desired to raise the vessel, the screw was used to force the inner shells tight against the outer one and drive out the water. This was a rather clever adaptation of the crude power available in those days for the purpose at hand, and it involved principles of displacement that have been applied ever since.

A somewhat similar construction was proposed by Magnus Pegelius in 1605, and Lorini in 1609 describes a rigid column and a caisson for submarine work.

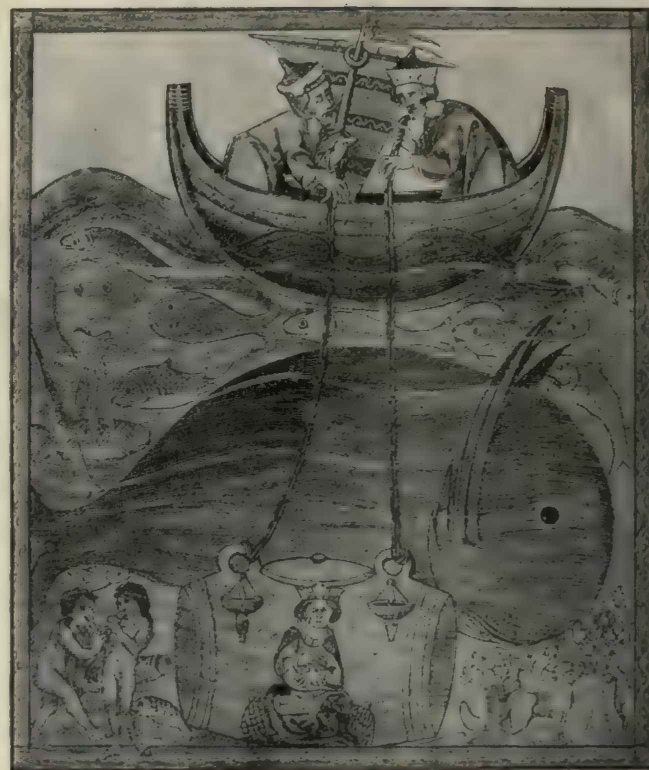


FIG. 3. SUBMARINE CASK, 1320

The next noteworthy effort in submarine building was by Cornelius van Drebbel in 1620 and subsequent years. He built several boats for submarine use, which he made water tight by stretching oiled leather all over the outside. In 1624, in the presence of King James I,

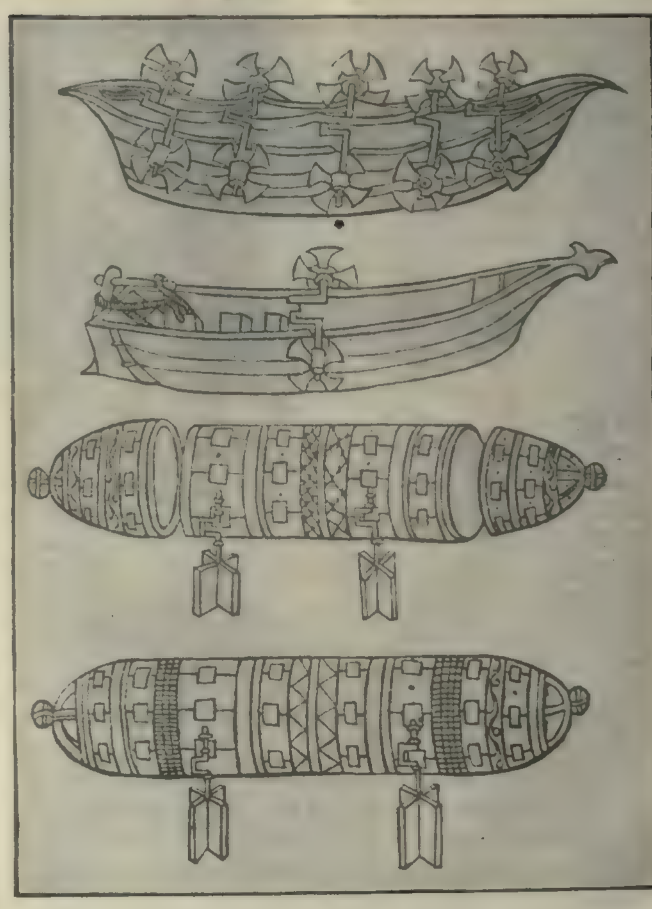


FIG. 4. SUBMARINE BY VALTURIUS, 1460

his patron, and a large number of spectators, he carried out several experiments in the Thames. He went down from 12 to 15 ft., and remained completely submerged for several hours. There is no exact description of his boat extant, but it was said to have been raised and lowered by means of a double bottom. It had a capacity for 15 persons, and was controlled by 12 oars which worked through water-tight flexible-leather joints.

FIG. 5. SUBMERSIBLE LEATHER BOATS, 1555

Besides what was then considered the remarkable success of his vessel, Drebbel claimed credit for an even more important invention in "the composition of a fluid that would speedily restore to the troubled air such a proportion of vital parts as would make it again, for a good while, fit for respiration." Possibly he had some recipe for releasing oxygen from water, but he died in 1634 without disclosing this part of his secret.

In 1634 Mersenne proposed a submarine with a metal hull which should be spindle shaped so as to allow progress in either direction. His plan was also to have cannon with lids at the mouth which would open at the moment of discharge, and fall back into place immediately afterward. Jean Barrie, in France, took out a patent in 1640 for apparatus for fishing and salvaging,

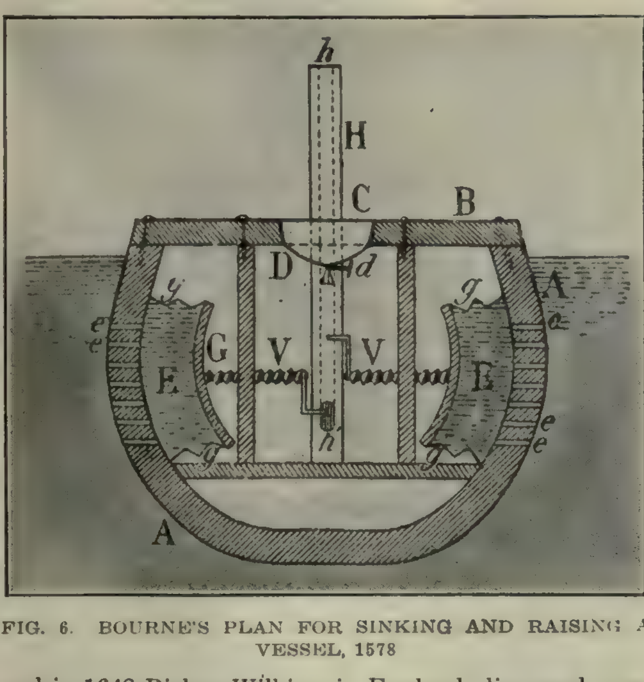


FIG. 6. BOURNE'S PLAN FOR SINKING AND RAISING A VESSEL, 1578

and in 1648 Bishop Wilkins, in England, discussed more or less prosaically the obstacles and advantages of submarine navigation.

A few years after this there came upon the scene a submarine builder who had all the imagination of the most enthusiastic inventor. This was de Son, who constructed a submarine, Fig. 7, at Rotterdam in 1653. It was said that with his vessel he guaranteed to destroy a hundred ships in one day. He claimed he could go from Rotterdam to London and back in the same length of time, or to the East Indies and back in a month. De Son's boat was 72 ft. long, 12 ft. high, with an 8-ft. beam, and was worked with two paddle wheels as shown in the cut.

A method of lowering and raising a submarine, Fig. 8, which is exceedingly interesting from its very simplicity, was that proposed by Borelli in 1678. His design was to have a number of goat skins or leather bags inside the ship with their mouths bound to holes in the bottom of the boat. When these bags were left extended the water entered through their mouths and filled them,

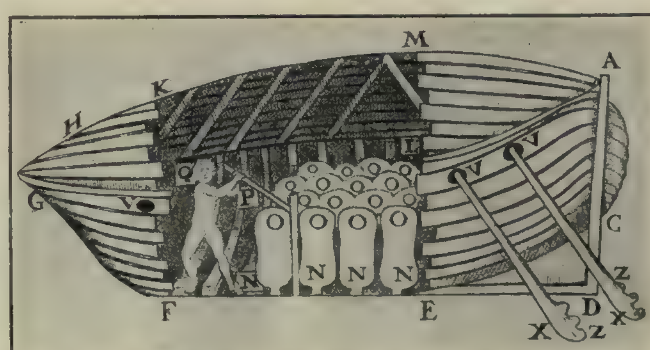


FIG. 8. METHOD OF RAISING AND LOWERING SUBMARINE BY USE OF LEATHER BOTTLES, 1678

thus sinking the boat. In order to ascend to the surface, the leather bags were compressed by means of levers so as to drive out the water and lighten the boat. His plan included the use of oars worked through water-tight leather openings similar to those used by Cornelius van Drebbel.

In 1685 J. M. Ciminius of France took out a patent for a ship to rise and sink; and in 1688 Roger Doligny, also of France, made proposals for a machine to go to the bottom of the sea and sink ships.

Denis Papin, whose name is familiar in the history of steam, proposed a submarine with a spout through which a man could crawl to fasten a torpedo to a ship. This gave his vessel much the appearance of a large tea kettle. His plan also included a pump for driving out the water, and a tube to the surface.

Between 1690 and 1716 Halley made various experiments with diving bells, which served to give a

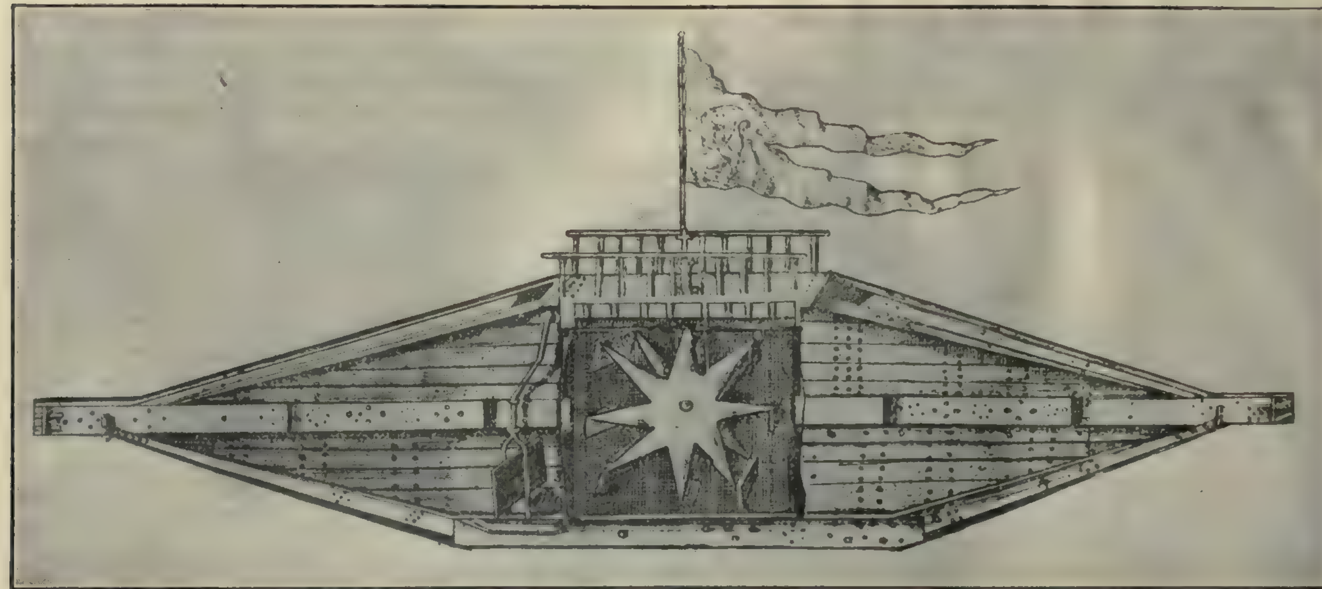


FIG. 7 DE SON'S SUBMARINE, 1653

better understanding of the problems of air and water pressure involved in the submarine. In 1715 John Lethbridge made a number of experiments under water by means of first a sugar barrel and then a copper vessel not much larger in size. In 1749 we read of a boat by Nathaniel Symons in which screws were employed to lower or raise it somewhat as in the design of Bourne, and in the same year M. Marriott describes a boat worked with goat skins as suggested by Borelli.

Probably the first genuine submarine that was actually used to attack a ship was the "Turtle," Fig. 9, in 1776, which was designed by David Bushnell in America. This was shaped like two turtle backs joined together and standing upright with a conning tower on top and would hold only one man. It had an immersion tank, and probably the first safety weight, which could be released in an exigency. It was propelled either by oars or by screws. The use of a screw has been doubted

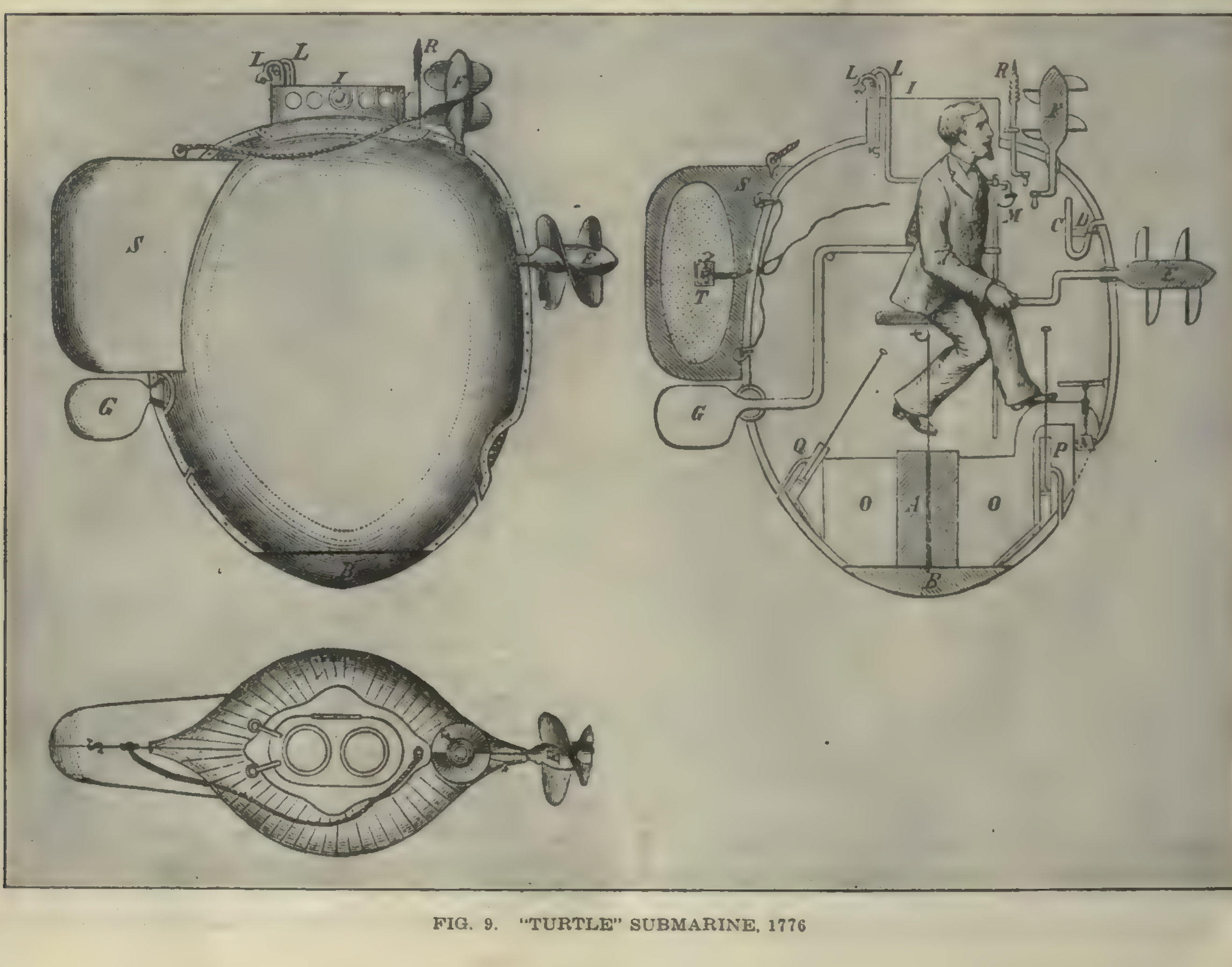


FIG. 9. "TURTLE" SUBMARINE, 1776

on the ground that screws had not yet been applied to the driving of a boat; but in a letter to Thomas Jefferson, Bushnell wrote: "An oar formed on the principle of the screw was fixed in the forepart of the vessel; its axis entered the vessel, and being turned in one direction rowed the vessel forward, but being turned in the other rowed backward. It was constructed to be turned by the hand or foot."

A torpedo with a clockwork time discharge was fastened at the stern of the "Turtle," and the idea was to bore a hole in the bottom of a ship, fasten the torpedo and get away.

In 1776 Sergt. Ezra Lee attempted in the "Turtle" to torpedo the English 64-gun frigate "Eagle," which was lying in New York harbor. It is asserted that he

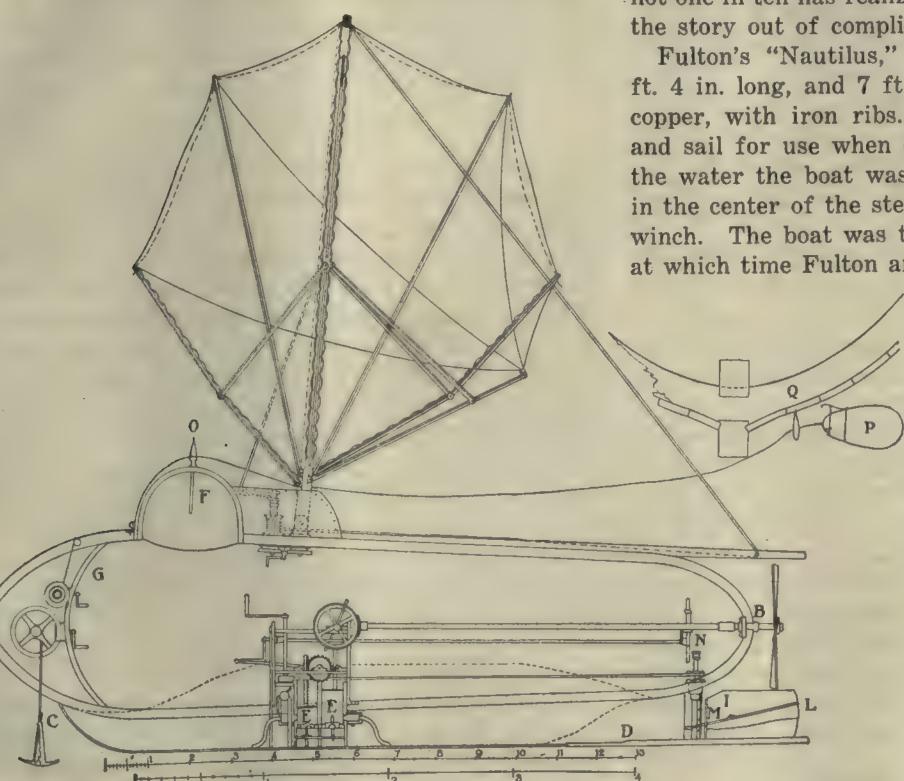


FIG. 10. FULTON'S "NAUTILUS," 1800

got underneath the ship, but failed to fix the torpedo, and after he left, the torpedo floated to the surface of the water and blew up sometime afterward to the considerable astonishment of the British.

From the considerable descriptions of the period, Lieutenant Barber of the United States navy later attempted to reconstruct the designs of the "Turtle." These show a man inside in the costume of the later period.

Submarine of S. de Valmer

In 1780 S. de Valmer made a proposal for a barrel-like submarine with pointed cones on each end and oars at the sides. The first plan for a steam submarine seems to have been by Armand Maiziere, who laid his design before the Committee of Public Safety in 1795. His oars, or paddles, were to be shaped like the wings of a bird. One set was to be used for propulsion and the other to assist the vessel to submerge, probably the first use of power for this purpose.

The next year, about a decade before his success with the "Clermont," Robert Fulton laid a plan for a submarine before the French government. The commission to which his design was referred reported favorably on it, but the Minister of Marine was unconvinced. Fulton made a model which a committee again viewed with favor and the Minister of Marine once more rejected. The inventor then carried his ideas to the Dutch, who refused to consider them. By this time Napoleon had become First Consul, and Fulton returned to France to submit his designs to him. Napoleon was sufficiently impressed to advance Fulton 10,000 fr. for building such a boat. This was completed in 1801, and Fulton named it the "Nautilus." It is a striking fact that of the millions who have read Jules Verne's "Twenty Thousand Leagues Under the Sea" probably not one in ten has realized that Verne named the boat in the story out of compliment to Fulton.

Fulton's "Nautilus," Fig. 10, was cigar shaped, 21 ft. 4 in. long, and 7 ft. in diameter. The hull was of copper, with iron ribs. There was a collapsible mast and sail for use when on the surface, but when under the water the boat was propelled by a wheel or screw in the center of the stern, which was driven by a hand winch. The boat was tried in the Seine in May, 1801, at which time Fulton and one assistant remained below 20 min. and then made their way under water back to the starting point. On June 3, 1801, Fulton was submerged for an hour. On June 26 he submerged and blew up an old hulk which was offered for the purpose, and on Aug. 7 he introduced compressed air and remained below the surface for 5 hours.

The Minister of Marine, Admiral Pleville le Pelley, however, finally refused to allow Fulton to operate his submarine because, as he wrote: "It seems impossible to give a commission as belligerents to men who use such means for destroying the ships of the enemy." In other words Fulton would have had to operate as a pirate, which is a striking commentary by the past upon the present.

Trade Acceptances and the Manufacturer*

By W. M. Nones

In this country in doing business we have passed through several stages to the present period and the adoption by common practice of the open-book account in the purchase and sale of merchandise. Your committee need not dwell upon the use or the abuse of the open-book-account system. With the great expansion of business activities it has been the keen endeavor of all sellers to reduce the term of the open credit, but business in every instance under the open-book-account system means that the seller must give

*Abstract of an address before the twenty-third annual convention of the National Association of Manufacturers held at the Waldorf-Astoria Hotel, New York, May 22, 1918.

the buyer credit for the amount of merchandise delivered until maturity, and the seller must await the remittance of the buyer at the expiration of that period, with the result that the moneys so outstanding —in many instances very considerable—are solidly tied up and entirely unusable. What is the natural result? Simply that the seller whoever he be, manufacturer, factor, wholesaler, merchant or retailer, has not only to finance his purchases and his business charges but also his sales, and if in need of financial assistance, either for proper expansion to carry him over difficult periods or for other needs, he must rely upon his ability to borrow on his one-name paper from his bank or other financial institutions.

Difficult Problems Encountered

Owing to the war in which this country is so vitally interested many difficult problems are being daily encountered; business conditions are made very difficult; conditions relating to finance and to financing have to be scrutinized very carefully. We not only have behind us and with us the conditions that we know, but we have before us conditions that can hardly be foreseen and that will depend very largely upon the duration of the war and the extent to which our great country can expand its industrial activities into foreign markets. We have had, each of us, to scrutinize our individual affairs, and we must today and for a long time to come keep a watchful eye on our investments and our expenditures and wisely transact our business affairs.

The subject of credit and of the system of the open-book account has received a great deal of attention simply because it is clearly seen how wasteful the open-book-account system really is with the tying up of hundreds of millions of dollars in open credits—real money that released could be of untold value to the owner either for immediate expansion, for investment in materials, for carrying him over difficult periods, or for investment in Liberty loans or in other Government securities; money that today is so much needed to carry on and to win the war.

Trade-Acceptance Method

The value of the use of the trade acceptance is so clearly seen by minds that have applied themselves to the subject that in October, 1917, the American Trade Acceptance Council was organized to direct a nation-wide campaign for the general adoption of the trade-acceptance method in this country, in substitution for our existing open-book-account system.

The use of the trade acceptance means a considerable change in the methods of transacting business, and there are many problems still to be solved and difficulties to be overcome in connection with this change: but we now face a period when we must not only be conservative but when we must look forward to the time of reorganization and of reconstruction after the war. And just as we have cleaned our house and strengthened our position to carry us through these troublesome times so should we provide means whereby all available assets are liquid and in such tangible, usable form that we may have them at hand.

The open accounts receivable standing on our books represent money tied up in unusable form. It is granted that the accounts are good and that they will be paid at maturity or within a reasonable period thereafter. It is also granted that a certain percentage, and perhaps a large percentage, will be paid, less cash discount on prepayment terms if such be given; but in any event large sums are outstanding and will continue so, whereas by the adoption of the trade acceptance they are immediately converted from open accounts receivable into trade acceptances receivable. The accounts with buyers are closed and the sums of the trade acceptances receivable in hand are immediately available for their full value less the discount charge for conversion into cash, this cash being then immediately available for current purposes. The seller thereby promptly obtains the use of the money involved and the buyer loses nothing on the transaction. He has simply indicated by his signing the acceptance his acknowledgment of the delivery of the merchandise against his order, his obligation for the amount due and his intention to pay at maturity date whenever that may be.

Presumed Intentions

It is to be presumed that these were the intentions of the buyer under the open-book-account system, so that the buyer has suffered no loss in giving the seller his acceptance, but on the contrary, he has made a distinct gain in that he has shown clearly his intention to pay, and when the acceptance is presented to his bank for settlement the bank sees and understands that the acceptor has fulfilled his obligations. The gain to the acceptor lies in the fact that the bank obtains the opportunity to realize the prompt settlement of accounts involved, and to see the good business methods of the acceptor which can only result in a better feeling of security on the part of the bank when the acceptor of trade acceptances comes to the bank for accommodation on his one name paper, if occasion for this accommodation should arise.

Indorsement of Trade Acceptance

The Federal Reserve Board has given its unqualified indorsement to the trade acceptance. It has empowered the Federal Reserve Banks to accept trade acceptances at a preferential rate of discount, usually one-half of 1 per cent. It is recognized that it is distinctly self-liquidating, short-termed commercial paper, indicating on its face that it is an obligation arising from the sale of goods and an acknowledgment in writing that the customer will pay a definite amount at a given date. Therefore it is paper that is distinctly acceptable above all others to the Federal Reserve Bank either from banks or in other open-market transactions.

It differs from the plain or ordinary promissory note in that the note may represent borrowing for any purpose and does not necessarily represent transactions of a self-liquidating character. It may represent the value of goods that have not or may not be sold or that are unsalable. It may represent book accounts of an unknown character or it may be drawn and sold for purposes of speculation or for diversion into outside enterprises, for capital or plant account or for purpose of an unliquid or of an obscure character whereas the trade acceptance can only be given for a current transaction signed by one party to the transaction and accepted by the other party.

The President's Readjustment and Reconstruction Commission—III

By WINGROVE BATHON
Washington Representative of the McGraw-Hill Co., Inc.

Previous articles in this series have suggested and urged the appointment by the President of the United States of a readjustment and reconstruction commission to begin to deal now with vital problems in industry which will be presented after the war. It was pointed out that many other countries, notably among them Great Britain, have already begun to attempt to solve after-the-war problems, and the personnel of a suitable commission selected from the ranks of American industry was presented in the first article in this series, the second article having dealt with the personnel suggested for an advisory council taken from the ranks of Government officials to work with such a commission.

IT WAS promised that the third article should describe some of the far-reaching work being done in this connection by Great Britain, and its presentation is for the purpose of showing the necessity for American industry to begin now through a readjustment and reconstruction commission, preferably the President's own commission, responsible only to him, to prepare to solve after-the-war problems. It may be well to state at the beginning that this description of Great Britain's Ministry of Reconstruction is taken from the official reports of the British War Cabinet to Parliament and furnished to me by Arthur Willert, secretary of the British War Mission at Washington for the purpose of this article. These reports include the year 1917 and have just been received in Washington.

After tracing the Ministry of Reconstruction in Great Britain from its early stages, before the ministry was established by the New Ministries Act in July, 1917, and during the time the agency of reconstruction consisted of a committee of ministers of the crown, the War Cabinet reported that it was found necessary to establish a Ministry of Reconstruction to continue for the duration of the war and for a period of two years, or less, after its conclusion. It was declared that a prime minister upon whose shoulders fell the responsibility for the conduct of the war could not personally assume a day-to-day responsibility for guiding the Reconstruction Committee's work. It was stated that the government at all times had been aware that as the war continued and its pressure on every side of the national life increased, the intensity of the struggle in itself enhanced the importance of the reconstruction problems which had to be faced, and that Parliament and the country were not slow in realizing that there was coming into existence a number of questions of the utmost importance which must be answered not after but before the conclusion of the war.

The Minister of Reconstruction then appointed assumed office in August, 1917, and his functions are defined as follows:

"To consider and advise upon the problems which may arise out of the present war and may have to be dealt with upon its termination, and for the purposes aforesaid to institute and conduct such inquiries, prepare such schemes, and make such recommendations as he sees fit; and the Minister of Reconstruction shall, for the purposes aforesaid, have such powers and duties of any government department or authority which have been conferred by or under any statute as His Majesty may by order in council authorize the Minister to exercise or perform concurrently with, or in consultation with, the government department or authority concerned."

In other words, as was brought out during the debate which resulted in the creation of the ministry, the minister in charge does not exercise executive functions: he appoints committees; he initiates experiments; he frames schemes for action with a view to conditions after the war; his powers are not exclusive and do not shut out other departments; he assists the other departments, provides them with information and helps them "to build a bridge which will safely carry us over from war to peace conditions." The British Parliament found that the creation of a reconstruction agency was desirable because various government departments are approaching various problems in their own way, each drawing up reports or memoranda, and that what was needed was a coördinating element not especially attached to the work or to the traditions of any one of the departments concerned. The Solicitor General of Great Britain, speaking in debate, said that what was needed was "a comprehensive coördinating mind, a fresh mind, and at the same time an authoritative mind, that will bring together the several contributions of the various specialized departments."

The Ministry of Reconstruction was then formed. For the purposes of administration the department was divided into branches dealing respectively with commerce and production, including the supply of materials; with finance, shipping and common services; with labor and industrial organization; with rural development; with the machinery of government (central and local), health and education, and with housing and internal transport.

An Advisory Council Appointed

The Minister of Reconstruction then appointed an Advisory Council "representative of all the leading interests concerned in reconstruction, and it is his hope by consulting the council freely and regularly to secure a representative consensus of opinion on any proposal which may be referred to him for advice or which may be initiated in the department." This council is organized very much like the Pan-American Financial Conference held in Washington at the beginning of the war was organized, and very much like the old War Industries Board of the Council of National Defence of the United States. In other words, experts in each line

are named to serve with government representatives. The council, like the administration of the Ministry of Reconstruction, is divided into sections, and it is stated that its membership "has been so arranged that in each section all the principal interests represented on the council should find a place; thus there are representatives of labor on the finance section as well as financiers; there are business men as well as agriculturists on the section dealing with agriculture, and so on."

The meetings of the sections of the ministry and the council are private, but it is known that they have already dealt with the standardization of railway equipment; the postwar rationing of industries; the establishment and functions of trade organizations; the organization of rural information centers; the establishment of industrial courts; house planning from the point of view of domestic economy; the future organization of voluntary women's work, and the conditions required for maintaining a supply of efficient agricultural labor.

Commerce and Production

The section dealing with commerce and production is investigating (1) the supply and control of raw materials after the war; (2) the financial facilities for British commerce and industry after the war; (3) the preservation of industries which will play an essential part in reconstruction but are in extinction through failure of supplies of material or labor; (4) the financial risks attached to the holding of trading stocks; (5) trusts and combinations, with special reference to the protection of the consumer; (6) the establishment of new industries after the war, a committee having been especially appointed to consider this question so far as the engineering industries are concerned, a parallel committee considering the labor questions involved; (7) the volume and nature of the demand for British goods after the war, and (8) improvements in trade organization for the purpose of more economical production, distribution and marketing, and expediting the turnover from peace to war.

The section dealing with finance, shipping and common services, in conjunction with the treasury, is considering the question of currency and exchange after the war, and under this section an advisory council section is at work on the disposal of government stores after the war.

The section dealing with labor and industrial organizations has agreed with the British Board of Trade and the Ministry of Labor that "a concerted effort should be made to promote in as many industries as possible representative organizations to advise the government as to the views and needs of the industries on the various industrial and commercial problems that will affect them during the reconstruction period. The Ministry of Labor is to proceed with the formation of permanent industrial councils. A conference of trade organizations is being established at the Ministry of Reconstruction, consisting of three employers, three trade unionists and representatives of the Board of Trade, the Ministry of Labor and the Ministry of Reconstruction. The Minister of Reconstruction has decided to refer to the Industrial Section of the Advisory Council the question of establishing corresponding organizations in engineering and in railways.

This section (dealing with labor and industrial organizations) apparently is further along with its work than any of the other sections, for reports have been submitted on unorganized trades and works, and probably by now on conciliation and arbitration. A general survey of industrial policy as a whole has been prepared, going into the law and labor in merchant shipping, wartime departures from trade-union practices, industrial courts, industrial structures, apprenticeship, the reinstatement of returning soldiers and sailors and international labor legislation. Furthermore surveys have been undertaken of industrial methods; inquiry is being made into juvenile employment; the question of army demobilization, it has been settled, makes the Ministry of Labor responsible for the returned soldier or sailor, and the Ministry of Reconstruction is to determine the priority of different trades; a complete list of public works which have fallen into arrears has been prepared so that surplus labor may be usefully and rapidly employed, and the Ministry of Munitions has begun work on the special problems arising out of its work.

The section dealing with rural development is examining (1) the working of the Small Holdings Act and the future of urban war allotments; (2) a report made by the Forestry Committee; (3) the rural-housing problem; (4) the organization of county offices for advice on agriculture; (5) title redemption; (6) village industries, and (7) the report of the Land Acquisition Committee.

The section dealing with the machinery of government, health, education, etc., is negotiating through a committee on the distribution of functions in regard to the formation of a ministry of health and is studying reports which have been made (1) on the functions of the Poor Law authorities; and (2) on adult education.

A Ministry of Health

The section dealing with housing and internal transport, with a view to facilitating work in connection with housing, has set to work committees on (1) supply of building materials; (2) house-building construction and (3) on building by-laws. Special investigations are being made by this section on (1) control of public-utility societies; (2) town planning; (3) rings in the building trade; (4) the working of the Small-Dwellings Acquisition Act; a general review of the problem of inland transport is also being made, the portions dealing with roads and canals having been completed. Furthermore, the ministry is in consultation with the Board of Trade concerning the future of the railways (including light railways) of Great Britain, and an inquiry has been begun into the question of storage and distribution as essential elements in transport policy.

This article is intended to be but a brief outline of the monumental amount of work being done by the British Ministry of Reconstruction; but it might be well to hark back for a moment to some of the points being taken up by the various sections. In the section dealing with commerce and production the report of the British War Cabinet to Parliament states that the question of the "volume and nature of the demand for British goods after the war" and the question of "improvements in trade organization for the purposes of more

economical production, distribution and marketing and of facilitating the turnover from peace to war" are being handled in consultation with the British Board of Trade and the Department of Overseas Trade, and that "a comprehensive scheme of work has been prepared." The British Cabinet thus states the problem:

"After the war there will be a world shortage of certain materials, and the shortage will be accentuated by the difficulty of finding tonnage. On the other hand there will be a great demand for manufactured goods."

The comment of the cabinet report in this connection will no doubt be found interesting. After stating that the results of inquiries will be used to determine the order that the demands of the trades at home and of the colonies shall be met, and "in what proportion raw materials shall be directed into certain channels, in what directions the demands for labor, power, tonnage and credit is likely to be most intense," it is stated:

"It is not a question of arbitrary restriction or of protecting some industries or developing others—it is a question rather of directing to the most productive purposes such materials as will in fact be available, and of furnishing industry with the necessary facilities, including information for making these purposes effective. The desire of the government is to leave the industries to ration themselves under certain general principles for which the government must take responsibility. What those principles should be and what form of central machinery should be devised for this purpose is one of the first questions on which the Advisory Council is asked to report."

(*Continued on page 1115*)

The Modern Foreman—What Is His Present Job?

By A. Ellsworth

In an article on page 799 of the *American Machinist*, "Entropy" inquires "What is the job of the modern foreman?" and then promptly disposes of his query by demonstrating (1) that the only job left to the poor fellow is to act as a sort of intermediary instructor for the purpose of imparting to the men the instructions he himself has received from higher up, and (2) that there "ain't no such person."

To render it doubly difficult of accomplishment for a nonexistent person the job necessitates his becoming something between a school teacher and a college professor without adopting the methods (and presumably without exhibiting the failings) of either of them.

"Entropy" says "there are foremen who have exceptional ability to train men, but the number of them who go at it intelligently is almost zero." As he had previously said that "the only hope which a foreman has today of making himself valuable is through leading his men" it is easy to see where he gets off.

He also takes a slam at the old-timer when he says: "We have a planning department, an efficiency department, and an engineering department to do what he [the old man] half did."

Not on your life, "Entropy." The old man got away with the whole job every time or went out of business, and the percentage of failures were low in those days too.

The net result of your line of reasoning is to prove that not only are there no foremen now, but that there never were any, which conclusion is amply refuted by the present high standing of the mechanical arts. The old man of twenty, thirty or forty years ago not only performed all of the duties of the "departments" above mentioned, and performed them well, but he was also past master of the gentle art that is the "only hope" of his present-day successor—that of teaching the cubs. I have been in the shops for 30 years and have known many successful foremen, most of whom were "leaders," not "drivers"; few were "terrors," and none "thumbed their noses at the proprietor." I have known foremen who did all the things that were bad and few of the things that were good, and by a strange coincidence these men were usually the unsuccessful ones.

Number of Old-Time Foremen

Judging by the number of shops and industries that are delivering the goods (which the newspapers do not mention), I believe there must still be a great many of the old-time foremen on the job or that living testimonials of their teaching ability are filling their shoes, while the number of industries that are failing in this respect (of which the aforesaid papers keep us fully informed) indicate that in too many instances the "efficiency departments," "planning departments," etc., are holding frantic gabfests, each trying to determine which of the others is to blame for lack of production.

The trouble is not that there is no material from which to evolve the old-time foreman, but that the men who possess the necessary qualifications are too modest. Egotism was never a characteristic of the successful mechanic; his work was performed efficiently, faithfully—and quietly, and the only reward he coveted, besides board and clothes for his family, was the consciousness of a good job well done. Unfortunately his place is now being frequently usurped by the modern faddist, whose divinity is the micrometer and who, in his fanatical pursuit of a degree of accuracy and efficiency that is for him of all persons impossible of attainment, loses sight of the necessity for immediate production.

The "engineering department" that lays down commercially impossible tolerances, the "planning department" that devises impractical methods of handling the work, and the "efficiency department" that insists upon rigid conformity to a system evolved usually by someone who never filled a workman's shoes and who therefore possesses at best a hazy knowledge obtained at second hand of the conditions under which the latter works and of how these conditions affect him, are chiefly the cause of the breakdown of some of our present-day necessary industries. Each of these departments strives to attain its own chimerical ideas, each wildly endeavors to shift the blame so glaringly in evidence, and each is intolerant of the conditions imposed upon it by the others. If the men back of them—the men upon whom the final responsibility must rest—would in each case select one of the old-time foremen, give him a big stick and authority to use it, and then go where the howls of the "departments" could not reach them, the problem would be in a fair way to being solved. This is the condition that must be met, "Entropy," on our march to Berlin, and *we're going to get there!*

The Slacker

By Berton Braley

Said Michael O'Leary to Patrick McCreery,
"You sure make me weary the way that you work;
Last week you lost one day, and this week—on Monday—
You laid off completely. Bedad, ye're a shirk!"
Said Patrick McCreery to Michael O'Leary,
"Well, what if I did?—and I did, it is true—
If I grab off a play-day or two around pay-day
I guess it's my business and nuthin' to you!"

Said Michael O'Leary to Patrick McCreery,
"Me son is a soldier who's fightin' in France;
He's got to have trifles like helmets and rifles,
Or else with the boches he won't stand a chance.
He needs to have batteries—guns that'll shatter his
Enemy's trenches before an attack—
And motors to carry his camp commissary
And ships that'll bring him the things he may lack.

"But when you are shirkin' yer job, or ain't workin',
You're holdin' him up on his arms and supplies;
For, get this straight, neighbor, when you slack your labor
You're doin' more harm than a half dozen spies.
There's need for the keenest of work—each machinist
And fireman and blacksmith should stick to the job
In war-time conditions to make the munitions
To help smash the Kaiser and all of his mob.

"And so," said O'Leary, "your ways make me weary;
You throw down me son as he fights Over There;
To loaf is a bum thing—you bet it means something
To me when you're slackin' from doin' your share!"
Said Patrick McCreery to Michael O'Leary,
"I never have thought of it that way before;
But now that I see it I sure will agree it
Ain't me that'll loaf on the job any more!"

WAR-TIME REPAIRS IN THE NAVY

III. General Repair Work

By Frank Stanley

The repair-ship's operations include the making of many small and medium-sized parts, such as connecting-rods, pump eccentrics and other members for motor-boat engines, pinions for deck winches, pump plungers, rods, etc. Another line of work handled is the overhauling of machine tools for different ships, and one subject covered in this installment is the planing and refitting of the bed, carriage, and head and foot stocks of an engine lathe from one of the battleships.

On our regular rounds of the machine shops below decks of the "Vestal" let us stop for a little while on the port gallery over the main shop and examine into the details of operations carried on there in lathes and milling machines. There are many examples of these two classes of tools in this part of the shop, besides a number of machines in the line of sensitive drilling machines, grinding machines, arbor presses and other appliances including the usual equipment of a small out thoroughly fitted-up toolroom which is located at the after end of the gallery.

The several milling machines are placed at an angle of about 30 deg. from the longitudinal axis of the ship to provide for clearance of machine, work and operators along the gallery passageway. These milling machines are kept busy on a varied line of small- and medium-sized repair jobs, though occasionally a large amount of machine work on new parts is manufactured on the milling-machine tables or between centers. Such parts as journal boxes, small connecting-rods, eccentric straps and the like are machined almost entirely on the milling machine with the aid of boring bars and cutters of one kind or another, facing tools and regular milling cutters of various types. Examples of this work are shown in the group of machine parts shown in the illustration, Fig. 20. The two coarse-pitch steel pinions at the right and left sides of the group are new deck-winch parts made to replace similar pinions of bronze that would break after only comparatively short use. The duty imposed upon deck machinery of this kind is naturally very severe, and it is also the case that for such service there is none too great an area of metal in the section between the tooth roots and the bottoms of the keyways. It is not surprising, therefore, that the pinions split or are stripped of a tooth now and then, especially when one considers the peculiar character of the load imposed under varying conditions of shock and stress, which is seldom, if ever, with anything like ideal operating conditions for toothed gearing.

After their experience with other metals, they are now trying for better results with tough steel pinions accurately cut and nicely fitted and keyed to the shaft. There may perhaps be a field for speculation as to whether, with the pinions break proof, some other member of the winch may not let go under justifiable circumstances due to working conditions with which the land mechanic has little familiarity. In any event these pinions are excellent examples of high-class gear cutting as carried out on the milling ma-

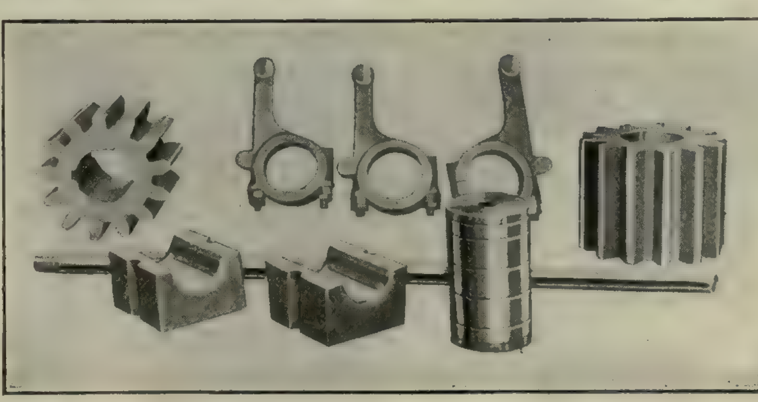
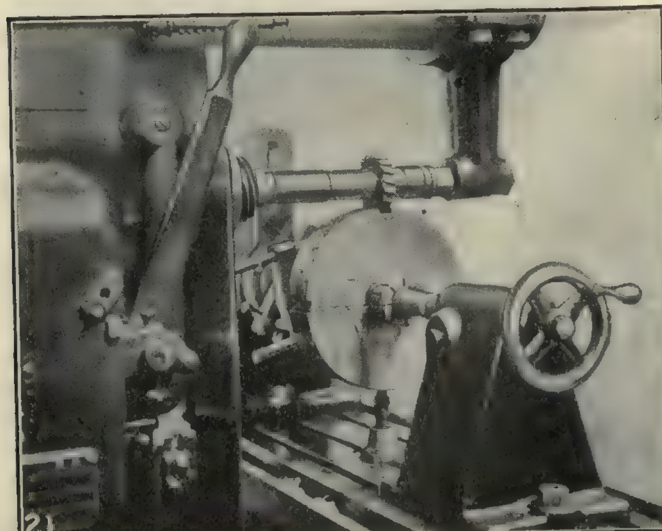


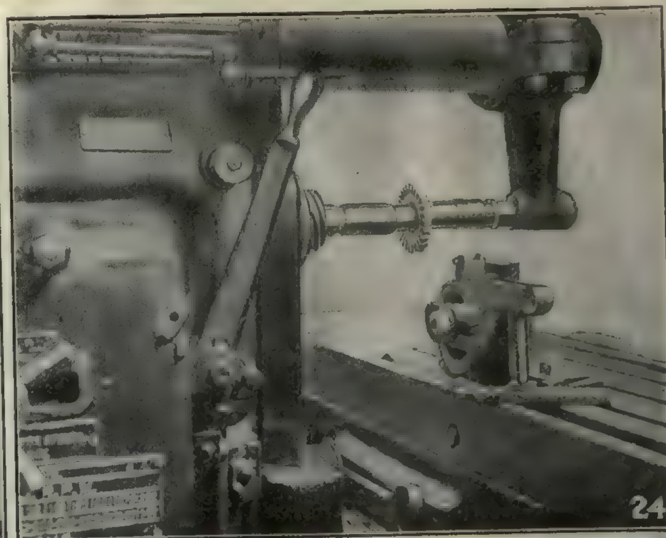
FIG. 20. WORK HANDLED IN LATHES AND MILLING MACHINES

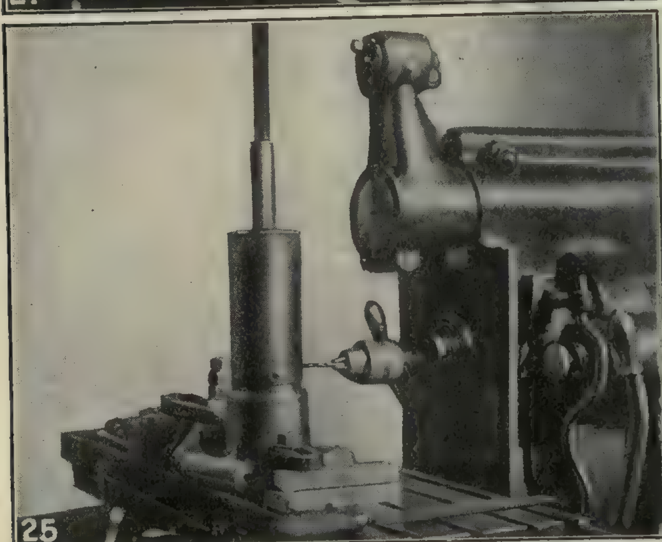
chine with the aid of the universal dividing head for indexing the work.

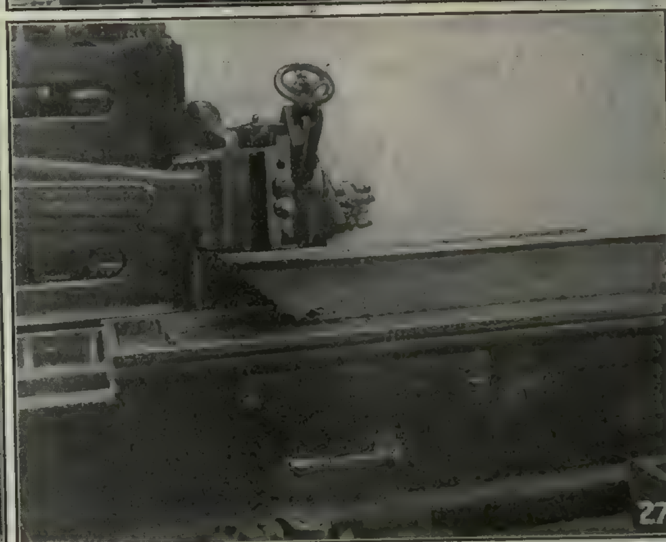
The two disks, Fig. 21, shown between centers on

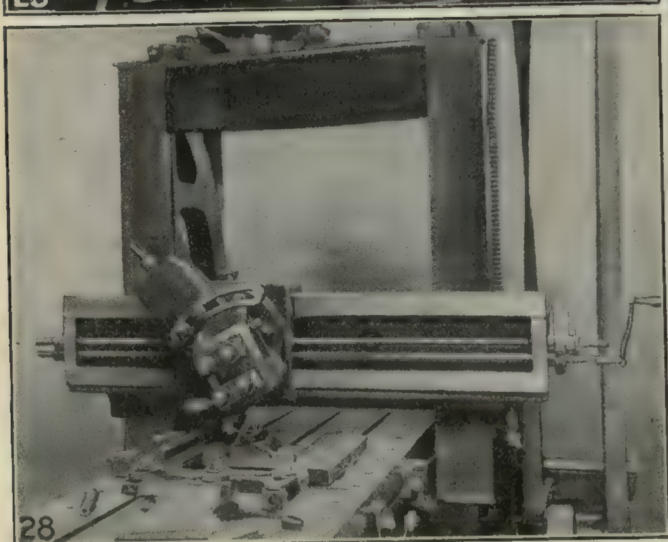
These disks were sawed from a 10-in. bar of high-grade steel, enough stock being left on each side for facing to thickness. Then they were chucked, rough

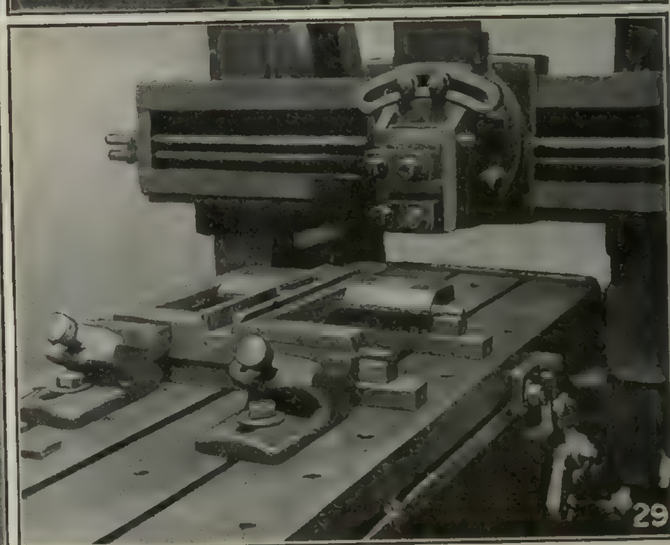












FIGS. 21, 24, 25, 27, 28 AND 29. VARIOUS REPAIR JOBS

Fig. 21—Milling slots in special disks. Fig. 24—The eccentric strap and rod on the milling machine. Fig. 25—An odd drilling job on the milling machine. Fig. 27—Planing the lathe bed. Fig. 28—Planing the carriage Vs. Fig. 29—Planing cross-slide

the milling-machine table are a pair from a lot of 16 made for a special purpose for one of the fighting ships. The disks are finished to the dimensions shown in Fig. 22, having four keyways and four slots.

faced on one side, bored and reamed, turned around and rough faced on the opposite side, placed on an expanding mandrel between the lathe centers and faced to thickness. Next they were placed on the rotary

table of the vertical slotter and the four keyways cut through the bore.

The disks were again mounted on an expanding arbor and placed upon the dividing-head centers on the milling machine for the cutting of the four equispaced

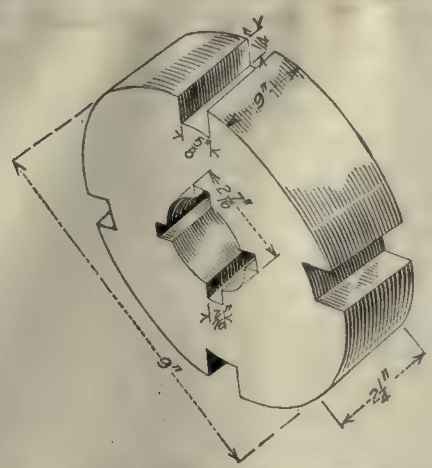


FIG. 22. THE SPECIAL DISKS

slots across the periphery. The first slot was located by lining off the center from one of the keyways in the bore before mounting the disk on the arbor. This established a common center line for one external slot and the corresponding keyway. Indexing the work by means of the dividing head then brought the other outside cuts into coincidence with the corresponding keyways in the bore.

Fig. 23 gives details of a bronze eccentric strap and rod for the pump used on the ship's motor boats, and Fig. 24 shows one of the milling-machine operations in finishing a part of this kind. Several nearly completed eccentric straps and rods are seen in the group in Fig. 20. These eccentric straps and rods are made on the "Vestal" in medium-sized lots, as they constitute a part that is called for with more or less regularity by the various ships for their motor-boat repairs. The eccentric strap and rod are bronze castings secured together by two 1/2-in. studs and nuts. The ends of rod and strap are first milled flat to form the joint surface; then the two parts are jigged by a simple plate affair and the studs set in and the two parts assembled for boring. The work is then placed on the lathe faceplate, where it is bored and faced for the eccentric, or sometimes it is held in the milling machine and faced and bored with a fly cutter or single-point tool carried in a boring bar in the milling-machine spindle. In the latter case the work is mounted on the side of an angle plate, as indicated in Fig. 24, with the bored opening resting over a locating hub and the outer end supported by means of a short jack located near the end boss. Here the 5/8-in. hole is put through with the aid of a spotting drill, through drill, boring tool and reamer, and the facing accomplished with end mill and counterbore. With the work set up in this manner the 1/2-in. slot is cut through the lugs at the top with a milling cutter, this being the operation specifically illustrated in Fig. 24.

Another job of similar character and for the same class of machinery is the boring of a boat-motor connecting-rod. Here, as before, the strap end has been first fitted up and secured in place by its studs, and the rod body is then grasped in the vise jaws and both ends bored in one setting, the table adjustment giving the center distance between crank- and wrist-pin bearing centers. The bar in the milling-machine spindle is used for a variety of work of this kind. It is provided with several crosswise holes for different cutters, though often single-point tools are found to be more serviceable.

Other work finished with boring bars on the milling machine is represented by the two boxes in the foreground of the group in Fig. 20. These boxes are a pair that have been rebabbitted, peened all over the babbitt surface to compress the metal thoroughly and then bored to size. The two box halves were set up together on the milling-machine table and secured by straps. The metal was bored out with the boring bar, two cuts being taken, a sixty-fourth or less being removed under the finishing cut. The boxes were squared on the table for boring by placing a parallel in one of the T-slots and locating the work against its projecting face. Sweeping out the annular oil channels at the end of the boxes and chipping the diagonal oil grooves from corner to corner completed the shop operations on the work.

The plunger shown at the right of the boxes is for a pump, and as illustrated was completed in the lathe ready for mounting upon its rod, which will be noticed lying horizontally in Fig. 20.

Another illustration is from a view taken in the same shop gallery, Fig. 25. This shows an operation

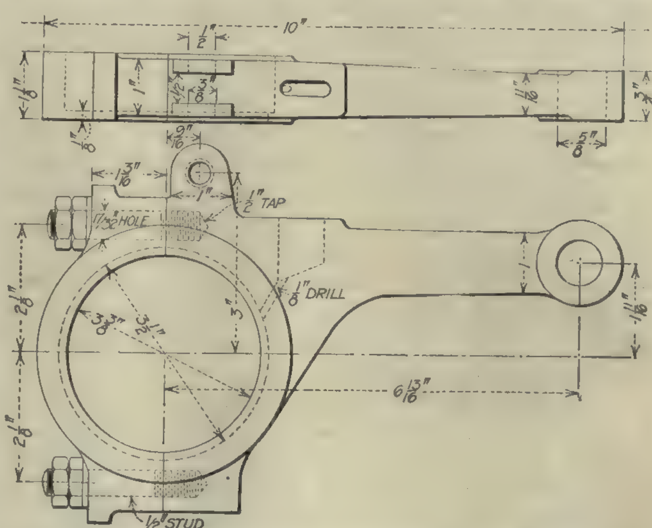


FIG. 23. A BRONZE PUMP ECCENTRIC STRAP AND ROD

in the milling machine, where a special instrument holder is set up on end on the table while a series of small holes is being drilled in the shell around the cylindrical body. It is a very awkward piece of work to hold, or would be, if it were to be handled under a drilling machine; but with the upright position in the milling machine the drilling operations can be completed without difficulty.

Before going into the main shop below the galleries it will be of interest to note something of the general arrangement of the machine equipment in the shops as a whole, and for this purpose Fig. 26 may be of value in showing the layout of the port and starboard galleries and the larger deck space of the lower or main machine shop.

As already noticed, there are situated on the port

gallery a number of lathes, light drilling machines, grinding machines for tool sharpening and the like, and these are placed on either side of the gallery deck between the toolroom and office inclosure. The tools are not drawn in detail, but their approximate positions are apparent from the explanatory notes as are also the locations of the items of equipment on the opposite or starboard gallery.

The latter include several small- and medium-sized lathes placed athwart ship, a turret lathe, a centering machine, radial and upright drilling machines, etc. The galleries have each a width of 16 ft., and their length, like that of the main shop, is about 51 ft. The breadth of the main shop is also about 51 ft. at the after bulkhead, this dimension diminishing somewhat forward because of the sloping lines of the hull.

The plan view of the main shop in Fig. 26 includes the principal tools, though a few of the smaller items have been purposely omitted to give a clearer view of the general machine arrangement.

Location of Machines

It will be gathered on examination of the shop plan that the vertical boring machine is located at the after end of the shop immediately over the longitudinal center line of the ship. The horizontal boring machine and the open side planer are placed fore and aft as near the center line as possible, while the majority of the other machines are placed athwart ship.

Tool location on ship board is rather more complex than arranging machines ashore. While matters of lighting, convenience of machine operation, and available space for handling work must be kept in mind just as with similar equipment in the conventional repair and jobbing shop, there enters the complication of a floor, or deck rather, that is oftentimes far from level in any direction, and constantly changing its angle of inclination and direction of slope as well. Fortunately with independent-motor drives the perplexing factor in the way of overhead and countershafting is obviated.

Some reference has been made in an earlier article to the peculiar features involved in installing machine tools on a repair ship. Undoubtedly there is much to be learned yet in respect to various details of the undertaking. The fact that it is the intention to use such floating-shop equipment so far as possible with the vessel anchored at a naval base eliminates much conjecture as to whether a particular tool should be placed this, that or the other way to produce the best results. Moreover there is bound to be more or less work under way at certain times with the vessel at sea, and it is hoped that it may eventually be possible to show by actual tests just what effect is produced on different tools when operated under rough weather conditions.

On the fighting ships that are more or less always at sea such machine-shop equipment as they carry is likely to be in service a great deal of the time regardless of wind and wave. Consequently it is not surprising that once in a while a lathe or some other tool is sent to the repair ship for general overhauling.

Some of the illustrations show a few of the operations recently performed by the "Vestal" in putting into shape a 14-in. engine lathe from one of the battleships.

The headstock of this lathe was stripped of boxes, spindle and gearing preparatory to being fitted with new boxes, planed on the bottom and rescraped to its seat on the bed. Similar operations were of course necessary on the bottom of the tailstock.

The "Vestal," by the way, receives a great many pieces of electrical equipment for rewinding, truing up and otherwise putting into shape for service, and the electrical shop, which is one of the most important of the departments on the repair ship, is never without ample work to keep its force busily employed.

It was found that the shears of the bed were so badly worn that they required planing all over, necessitating planing the head and foot stocks, as indicated above,

FIG. 26. GENERAL SHOP LAYOUT

1—24-in. vertical lathe. 2—10-in. slotting machine. 3—48-in. radial drilling machine. 4—30-in. x 30-in. x 6-ft. planing machine. 5—Stairway. 6—36-in. lathe. 7—Open-side planing machine. 8—Horizontal boring machine. 9—24-in. shaping machine. 10—Stairway. 11—Bench. 12—Cylindrical grinding machine. 13—Radial drilling machine. 14—6-ft. vertical boring machine. 15—42-in. gap lathe. 16—Lathe. 17—Lathe. 18—Office. 19—Passage. 20—Bench. 21—Stairway. 22—Bench. 23, 25—Stairways. 26—Tool room. 27, 28—Benches

planing the carriage and scraping in of all parts. The bed, of 6-ft. length, is shown in Fig. 27, on the platen of the open-side planer with the work practically completed so far as concerns the planing of the Vs. Naturally only light cuts were required, but to bring the ways to correct form, templets were used, principally of the half- or one-side type, to secure the exact distance between the Vs.

Long, straight edges available made it possible to test the shears for straightness and absence of wind in any direction.

Fig. 28 shows the carriage Vs being replaned. The carriage is shown resting bottom up on the platen of the planing machine. The planing of the Vs was accomplished with the aid of the same type of templets, but male instead of female, as those referred to previously.

The planing of the top of the carriage, that is, along the cross-slide guide, was done with the work mounted, as in Fig. 29, on four cylindrical plugs which were seated in V-blocks on parallels and which supported the carriage by its finished Vs, so that the planing of the guide was carried out in reference to the Vs only, thus assuring accurate results.

The planing of the Vs in the bottom of the head and foot stocks was accomplished with the aid of V-blocks, the head and foot stocks being fitted with a special spindle or mandrel on which they were swung bottom side up with the mandrel in the V-blocks. This brought the Vs parallel with the spindle axis and parallel with each other in the head and foot stocks, thus simplifying the scraping operations.

Triple Convention of Supply and Machinery Trades of the United States

A WAR convention, at which were represented the National Supply and Machinery Dealers, the Southern Supply and Machinery Dealers and the American Supply and Manufacturers' Association, was opened at the Hollenden Hotel, Cleveland, Ohio, at 10:30 o'clock on Wednesday, May 15. W. H. Pattison, ex-president of the National Supply and Machinery Dealers' Association, presided. Over a thousand men representing every state in the Union and comprising a large percentage of the machinery, tool and supply industries of the country were present.

The invocation was spoken by the Rev. Andrew B. Meldrum, pastor of the First Presbyterian Church of Cleveland. Following the invocation, Mr. Pattison introduced James Rattray of the Guaranty Trust Co. of New York, who spoke on post-war problems.

It is only by forcing the unconditional surrender of German autocracy that we can hope for a permanent and satisfactory peace, and as we are constructing our war machine for the purpose of accomplishing that great result we should likewise prepare for the future upon the same basis.

When peace comes there will be a cessation of public borrowing and an end of excessive Government expenditure, but Government control will likely continue during the period of readjustment. Thereafter valuable assistance can be rendered by the Government in developing our resources, and it is to be hoped that when control ends real coöperation will begin.

The Labor Problem

The labor problem will be one of the gravest after the war. The immediate effect of peace will be the cessation of war industry, and the shutting down of plants will throw many at least temporarily out of employment. As demobilization proceeds this army of unemployed will be considerably augmented if business activity in other directions is not stimulated. Immigration from Europe may still further aggravate the situation unless restrictions are adopted or other conditions enforced there that will induce labor to remain at home.

At the time of the Civil War we had vast tracts of undeveloped territory, and the migration to the West that followed the war solved the problem of surplus labor. Today conditions are different, and although our need for increased agricultural production is great it is more likely to be obtained by improved agricultural machinery than by large additions to farm labor. With improved means of transportation the whole world is now as readily accessible as was the interior of our country after the Civil War. To maintain and develop our foreign trade, emigration will be necessary, and to some extent that should act as a corrective of our labor troubles.

Reserve stocks of all commodities have been depleted, and the necessity for production will be the real solution of our labor problem. There must of course be a period of readjustment, but much of the plant that has been provided for war purposes can be adapted to the requirements of peace, and if our plans are properly laid the period of readjustment can be materially shortened.

After the war taxation must be heavy for some time to meet interest on and the amortization of our indebtedness; but as we have no external indebtedness this taxation will not lead to any actual depletion of our resources, although it will involve some changes of ownership. Owners of Government bonds will receive in payment of principal and interest the revenue obtained by taxation for that purpose, and as these bonds are owned by over 20,000,000 people the burden of taxation will not be nearly so heavy as if the many were taxed to make payments to the few.

Leading English bankers have referred to our Federal Reserve system as ideal, and have discussed remodeling the English system on the same lines. The Federal Reserve system was established after the war in Europe broke out, and from the way in which it has functioned in abnormal times there is every reason to believe that it will be adequate for all peace requirements. Under the Federal Reserve Act our bankers are no longer at a disadvantage as compared with European bankers. They can now lend their credit in financing foreign trade through the acceptance of drafts. Branches may be established abroad. Rediscounting gives a basis for supplying the legitimate needs of business either through the banker's increased ability to extend credit or through the issue of Federal Reserve notes. The gold reserves of the country have been mobilized, and on May 3, 1918, the total gold held by our Federal Reserve banks was $1,859,940,000.

Domestic Trade

In domestic trade gold is only useful as a basis for credit, but in international trade it is indispensable for the settlement of balances. The international power that we possess in our gold reserves is enormous. We should neither hoard it nor use it to promote inflation or speculation, but rather should it be used for the benefit of mankind in carrying out our ideals of universal democracy. This can be done by using it for speeding up production at home and making loans to other nations to purchase our goods.

Our exports for the fiscal year ended June 30, 1914, were $2,364,579,148, and for the fiscal year ended June 30, 1917, $6,293,806,090. What are the prospects for maintaining this trade after the war? We are better equipped for producing, transporting and financing such business than ever before, but will that enable us to hold what we have obtained in the face of keen competition after the war? That there will be such competition is evident from the preparations that are being made in all European countries. The British Trade Corporation has been authorized with a capital of £10,000,000 to render financial assistance to exporters. It may also act as agent; carry on business as contractor, merchant or trader; promote or finance companies to engage in foreign trade; maintain information bureaus, and it is also inaugurating a scheme for the insurance of commercial credits.

A British manufacturers' corporation, consisting of about 1000 manufacturers, is also being formed for the purpose of mutual assistance in export trade. These corporations are typical of what is being done in every foreign country, and if the various plans materialize keen competition in foreign markets is inevitable. Similar corporations are being formed in this country, and branch banks and foreign trade banks are being established to provide the necessary financing.

After the war it is inevitable that there will be at least a temporary depression, but if we wish to make it severe the surest way is for leaders of industry and finance to talk depression and urge curtailment. Conversely, if we give assurances of unexampled prosperity an era of expansion with possibly even more disastrous results is inevitable. A safe and sane middle course is desirable, and if it is adopted peace should find us prepared to face the future with calm assurance that the difficulties of readjustment will not overwhelm us, and with confidence in our ability to emerge from the conflict a new and more powerful nation, seeking in our own betterment the well-being of the entire world.

G. H. Manning, of Knoxville, Tenn., president of the Southern Supply and Machinery Dealers' Association, was next called upon, but immediately surrendered the floor to Alvin M. Smith, of Richmond, Va., secretary of the association, who said: "This is the time to co-

operate. Not after the war, but now. We need the co-operation of every man in the supply and machinery business if our mdustry is going to be of the greatest value to the Government in the war and also if it is going to survive as an active influence to cope with the problems that must come with peace."

Before calling on H. W. Strong, president of the National Dealers' Association, Mr. Pattison introduced E. E. Strong, who was the president of the National Supply and Machinery Dealers' Association. Mr Strong said that the National Supply and Machinery Dealers' Association was organized in this hotel 13 years ago. It was a Cleveland idea, and the wonderful growth of the organization has more than justified the expectation of its founders. Great changes have taken place since then, when every man had a knife in his bootleg for his competitor, and he was sure the influence of association work will be extended as time goes on. He then spoke a few words of welcome to the visiting members, extending to them a welcome to the city. He explained that the fine weather on the opening day was but a sample of what had been arranged for the remainder of the week.

R. F. Valentine, president of the Manufacturers' Association of Cleveland, extended the heartiest welcome to the visitors.

The Labor Situation

H. E. Miles, president of the Council of National Defence, spoke on the labor situation as applied to war industries. Mr. Miles spoke with the sanction of Secretary of Labor Wilson and Samuel Gompers of the American Federation of Labor. He said: "I am glad that people in large groups can think of other things than the war, but for my part I can only think of our immediate duty, that of winning the war. To you machinery men I have but one thing to say. Take off your coats and win. This is a war of machines. When it is won, and it must be won, it will be by the machinery that you gentlemen make and sell. There is no time nor place for debate on the various issues of capital and labor. All elements in America must join as brothers in this great work, each with the greatest confidence in the other." Going into the question of labor Mr. Miles explained that the idea that there was abundant labor in the country for war work is a fallacy. Of the so-called skilled labor constantly applying for employment only 10 per cent. was capable of making good on war work. The labor turnover is an enormous problem and a great waste to the nation. The solution of the labor problem is the factory training school. For the period of the war there should be a closer division of labor, so that inexperienced hands could learn to do one small operation well and then cut down the time necessary to become efficient.

Viewpoint of War Service Committee

Farnham Yardly of New York, chairman of the War Service Committee of the American Supply and Machinery Manufacturers' Association, said:

It is my pleasure, Mr. Chairman and gentlemen, to acknowledge with thanks and appreciation the courtesy that you have extended our company to speak upon the business situation as we view it. The great change in the economic situation of our country, due to the war, and the enormous demand for material and men, has greatly affected the factories where our goods are made and has very considerably lowered their efficiency. Only those who have been in actual contact with the situation and know what the superintendents, foremen and others responsible for output have had to contend with can have any idea of the labor, thought and strain that have been necessary to keep quality and quantity up to the standard. In some cases it has not been possible to do it, but that it averages so well under the conditions and circumstances speaks well for them and they should be given great credit for their loyalty and able efforts.

Men and Material

This economic condition can be readily understood when we appreciate the fact that under normal conditions this country expends about $30,000,000,000 a year. Our war program calls for an additional expenditure of approximately $19,000,000,000, or nearly two-thirds of our normal demand. There are not enough men and materials in this country to supply the war needs and our normal needs, and as the business of the day is the winning of the war the normal need must be subordinated and priority must be given to the war need.

This war will be over when the dominant German military party is defeated, and not before, and we as loyal Americans must bend all of our energies and sacrifice all our personal inclinations to the end that we may hasten the day that peace will be declared.

A nation at war is a persistent buyer of commodities. At the outbreak of the European war several such buyers entered our market. Their buying led to an intensification of the market demands. Industrial plants, in laying plans for expansion to care for war contracts, went into the market bidding for capital in the form of buildings, machinery and raw materials, and also for labor. In order to get this additional supply it was necessary to pay higher prices. Industries not working on war contracts found that it was difficult to retain their skilled labor and to get raw material; as a result they were compelled to offer higher prices or reduce their output.

The demands upon available shipping for troop movement, combined with war losses, disrupted the machinery of distribution. Failure to provide railroad transportation adequate to meet the increasing needs of the country resulted in restricted supplies and increased cost.

It is evident that there will be a further shifting of labor and that those who are now employed on the so-called luxuries will find employment in the making of essentials. The Government will carefully scrutinize the consumption of raw material in order that there will be no waste of man power in the making of things that are not required for the business in which this country is now engaged. When peace is declared there will be a readjustment of the labor situation; labor will then be on a new basis and there will be a new standard of thought and living.

I am also of the opinion that many, both men and women, who have come from foreign countries will take the opportunity of going back to the old country and revisiting their families and homes. It must be borne in mind that there are thousands in this country who have been deprived for several years of the ordinary means of intercourse. These people are anxiously looking forward to the time when they can go back and ascertain the conditions of those whom they have left behind and of whom they have not heard during these long and trying years.

We are living in days that are without parallel and which present new problems with the rising of each sun. These problems must be met as best we can and with the thought that there is no sacrifice too great for us to make in order that decency may be assured for all time on this earth.

"Speed up your line and countershafting and decrease the sizes of shafting, pulleys, and the width of belts." This was the suggestion for decreasing the demand for steel for transmission purposes made by Melville W. Mix, president of the Dodge Manufacturing Co.

Increasing the speed will allow the use of smaller shaft-

ing, smaller pulleys and narrower belts. Shafting is one of the scarcest commodities, yet one of the most essential. New installations are being made along standardized lines. I want to urge standardization in this line. The transmission trade is pledged to win the war and will do its utmost toward that end.

Let me urge you jobbers under the circumstances to minimize the number of sizes of standard equipment carried in stock. It is advisable to operate along fewer lines. Standardize your sizes and get along with a lesser number. By increasing the speed you can often substitute a smaller size. Help out the manufacturers by making permissible changes when quick action is required. Frequent small orders are preferable to less frequent large ones.

This is not the time to speculate. The market will not be a wide one, but will be practically confined to the plants working on war orders. Keep track of the war orders in your district and trim your sails as close to the wind as possible, for that is the only way the country is going to have enough material to go around.

The material situation is bad. Government needs must have first consideration. Every kind of iron and steel has its place in the Government program. The shafting situation is in a class by itself. The supply of steel is far short of the demand. In a few months the Government requirements alone will be 130 per cent. of the aggregate production of the country. There is a steel line like the sugar line and the wheat line. We must all wait our turn. In the meantime we can all help by conserving. Increase the speed, decrease the tonnage required for shafting and pulleys. Thus we can help remove the load from the steel camel's back.

The whole situation is a difficult one from every angle, but we must accept the burden cheerfully and be ready to do our part. We must work together, pull together and understand each other.

Twist Drills, Reamers, Etc.

Richard T. Lane, sales manager of the Standard Tool Co., Cleveland, spoke on war conditions as applied to twist drills, reamers, etc., as follows:

Early in the war experience showed that tools are a prime necessity. The problems with which we are confronted do not differ fundamentally from those confronting producers of other lines of field products. Perhaps I can bring home to you the part played in war by twist drills and similar tools by giving a few illustrations with which I am familiar.

Take ships. Does the average American realize that we are now the largest shipbuilding nation in the world? Does he realize that Hog Island will soon be turning out a ship a day? Millions upon millions of holes will have to be drilled for this work.

Consider the airplane. The initial order for airplanes was 22,000 machines. Today the conservative estimate of the number of machines which will be needed before we are through is 100,000; and for 250 squadrons containing 4000 to 5000 machines $750,000 worth of small tools are required for the repair kits to go with these machines, hangars and repair shops.

Motor trucks. It required the combined capacity of all the truck factories two years to produce 15,000 trucks for the Allies. The initial United States order was three times that figure and the present requirements are estimated at 150,000 trucks.

Munitions. One Ohio concern having secured an order for 3000 to 4000 detonators, just a part of a shell, purchased $140,000 worth of small tools.

Artillery. People get their idea of artillery from the relics of 1812 mounted on the public square. The modern field gun with its breech mechanism, recoil device and other features is an intricate machine. The Government estimates for field artillery call for $6,000,000,000.

Rifles and machine guns. Millions of the former and tens of thousands of the latter are required. On one order from the Russian government one company sent in an order for $250,000 worth of milling cutters and later increased it to $700,000.

Railroad facilities. We read about the recent order of cars and $60,000,000 worth of locomotives and think that is quite an order, yet it is not three months' work for the Baldwin Locomotive Works. Their capacity when the war started was 1450 locomotives a year. Now it is 5000. They are turning out a finished locomotive down there every hour in the day.

If the increased demand for small tools had been uniform it would have been a comparatively simple problem, but it wasn't. On some sizes the demand has remained about the same; on others it has increased 400 and 500 times. Some sizes we carry in stock; others we order ahead for 14 months. Formerly we kept 30,000 sizes and kinds of tools in stock, but not so today. So anticipate your needs as much as possible. Do not wait until you are out of a thing before ordering. It is the man who has been taking small orders and has had the goods steadily dribbling through all the time that is selling the small tools today.

Belts and Belting Material

"It is no longer a question what belting is the best," said William Brooks Covell, president of the International Leather and Belting Co., New York. "We must keep the wheels turning at any cost. The Government is taking all the best grade of leather for its own purposes. The inferior leathers are already in demand and the Government hasn't scratched the surface of the leather demand. It is the duty of the belt manufacturers to make good as the War Board desires. My advice is to fill your racks. There can be no question of picking and choosing, the wheels must be kept turning."

A few figures were quoted by N. J. Clarke, secretary of the Upson Nut Co., to bring home to the audience the necessity of bolts and nuts in the war program.

One instance I want to bring to your attention, he said, is that of an order for 2000 hangars for housing airplanes, each with a capacity of four machines. This order required 6,000,000 ¾-in. machine bolts. On an order for artillery wheels 16,000,000 wheel bolts all of one size were ordered at one time. The freight-car order just placed requires 15,000 tons of rivets. On one order for 129,000,000 bolts the industry was able to furnish 25 per cent. of the order from stock by calling on all manufacturers. As you deplete your stock do not overlook the necessity of ordering for replacement under the priority number.

The Trade Acceptance

Ernest Du Brul of the Miller, Du Brul & Peters Manufacturing Co., Cincinnati, gave an interesting exposition of the trade acceptance in the following:

A trade acceptance, in a few words, is a signed memorandum given by the buyer to the seller stating that he owes a certain sum of money and intends to pay it at a certain time. The trade acceptance can also be called a draft, but trade acceptance sounds better. It is a strange thing that American business men should have such a fear of the draft or the note. They seem to think that they are under more obligation to honor a draft than to keep a verbal or tacit promise. They seem to forget that credit depends on one thing alone—how a man meets his obligations when due.

A trade acceptance is a bill of exchange. It is not a new thing. The trade acceptance was first used by the Venetian and Florentine bankers of the fifteenth century even to the exact phraseology, which still persists: "For value received in merchandise." Trade acceptances were used widely in this country before the Civil War. Single-name notes came into use as the results of the destruction of the Second National Bank by Andrew Jackson, and the last two-name paper disappeared when the country went on a cash basis during the Civil War.

The man who boasts that he is doing business on a cash basis confesses that he is inefficient. Credit is an asset and

a man is a business slacker if he has credit and does not use it.

The Federal Reserve Bank is a commercial trading proposition and must be kept so. It is elastic because it is commercial, and by reason of its elasticity it is able to stabilize the financial condition in times of strain and keep the business of the country on its feet. The Federal Reserve Bank must continue to deal only in commercial and short-time paper which depends upon the sale of merchandise and which is therefore self-liquidating.

The trade acceptance not only keeps the money flowing but actually creates new negotiable, liquid credit, which is as good as money for purposes of trade. Trade acceptances clear up all dispute as to money being used and they can be discontinued and cashed without the expense of notes.

The open-book-account system of credit in this country is nothing more or less than rotten inefficiency and finance. In selling goods get cash if you can. The next thing to cash is a trade acceptance which can be taken to the bank and turned into money. If your paper is strong or reindorsed insist on a preferential rate; you are entitled to it.

Patriotism and Endurance

"There will soon come in this war a time which will call for hard endurance," declared Charles W. Asbury of Philadelphia, president of the Hardware Manufacturing Organization for War Service. "It will be a time when every business man and manufacturer will have to search his soul and ask himself whether or not his motives are selfish or unselfish. Few people in the United States yet realize the magnitude of the job we have undertaken. This is no time for bickering and quibbling. The people in Washington are doing the best they know how, and every man and every industry in the country not only should but must sink the individual interest of his firm in a common organization of his industry as a whole so that it may be placed at the disposal of the Government as a unit." Mr. Asbury deprecated the presence in Washington of so many representatives of individual firms taking up the time of the Government, and urged that every industry organize a war board with offices in Washington to act as a point of contact between the industry and the Government. "The most highly trained technical men in every industry and the men in whom are represented years of experience in the various lines should be placed at the disposal of the Government to coördinate and direct the efforts of each industrial unit

"Your boy and my boy are 'over there.' When they send in a requisition for a thing we have got to get it, and get it quick."

H. W. Strong of the Strong, Carlisle & Hammond Co., president of the association, spoke as follows:

When we met in convention at Memphis it was only 10 days after the President's declaration that a state of war existed between this country and Germany. More than a year has passed and the conditions which at that time were so new and strange to us have become much more accentuated, and it is each day more evident that there is only one real problem in the world today, and that is the best and quickest method of defeating Germany. Whatever may have been the temper of the American people at the beginning of the war there is nothing more absolutely certain than that suspicion and distrust of the methods of the Germans came into existence in the fall of 1914 and with each succeeding demonstration of the premeditated and officially directed cruelty, lust and bestiality of which they were guilty the suspicion and distrust grew into the certainty that it was not Germany alone but the essence of paganism that England, France and Italy were fighting, and with this knowledge came the conviction that there could be but one side on which we as Americans could feel at home.

Since then we have seen our people turn from a long period of peace to a most determined attitude which has enabled us to get our war machinery under way so that today we have an efficient fighting force in France and Flanders and which is gathering momentum every day. The utmost effort we can make is none too great for the great cause in which we are privileged to fight, and any assistance we can lend is not only a privilege but a duty.

On Apr. 2 we sent to the Secretary of the Navy and the Secretary of War a letter reading as follows:

"This association offers its services and coöperation to the War Department of our national Government in the present crisis. Our thought is that we could be of practical value in the event that certain merchandise was needed and that your department wishes aid in locating such merchandise. Our motive is purely patriotic, and our hope is to be of practical assistance in locating needed merchandise which may be very scarce, but which our facilities would enable us to locate at the expense of the association, through telegraphic inquiry among our members and others whom we know to be handling the lines of merchandise in question. As an indication of the goods handled by the members of this association we mention the following representative lines: (a) Mechanics' tools, both hand and large tools of a great variety of styles, kinds and sizes; (b) shovels and all contractors' tools, such as are used in excavating and construction work; (c) machinery for the transmission of power, such as pulleys, shafting, leather and other kinds of belting, etc.; (d) all kinds of edged tools; (e) steam, gas and water pipe and valves and fittings for same; (f) all styles and sizes of screws, nails, studs, etc.; (g) machine tools (lathes, planers, drill presses, milling machines, shaping machines, etc.); (h) engines and boilers and various packings and fittings for same; (i) engineers' tools, such as stocks and dies for threading pipe, wrenches, etc.

"The lines of merchandise handled by the members are catalogued by them in books ranging from 800 to 2000 pages, illustrating, describing and pricing such merchandise, and the indexes of these catalogs contain sometimes as many as 3000 different articles carried in stock.

Our Motive

"We repeat that our motive is to be of aid to the Government, and we have hesitated to send this message lest it be construed as an effort to promote the sale of goods by our members. That is the furthest from our thoughts, as we are indifferent to it, but only desirous of rendering a substantial, helpful service."

To this offer we had replies acknowledging our suggestions of assistance and we have throughout the year been able to secure for the army and the navy a great amount of material in the way of small tools and supplies as well as machine tools. The response from the membership to these inquiries from the War Department has been very prompt and has given evidence of the hearty interest of our members in the war and their desire to support the administration in every material way.

Realizing that we have not as yet begun to make any of the sacrifices which our allies have been making for nearly four years and realizing that our efforts as a nation have not been as yet sufficient to make us feel boastful in any degree, still we cannot help but feel an enormous confidence in the valor and effectiveness of our boys who have gone to France. In a letter received the other day from a friend, a captain in the medical service, who has been in the British army in France for the past year and who is now with the American Expeditionary Force, he said: "The great consolation in the midst of much disappointment is the fact that the man who hasn't boasted, the man about whom you do not hear much, has made good, and that man is the common soldier. He has experienced hardships and everything that came his way without a murmur and when he was put up where the shells were breaking around him and saw his pals getting killed beside him, instead of getting his goat it just made him mad and he stuck it out and cried for more."

Since the acquisition by Germany of the iron, coal, man-

ganese, copper and oil deposits of southern Russia as well as her access to the wheat field of Ukrainia no man can say how much their power of aggression and particularly how much their power of resistance has been increased: we only know that it has been increased enormously and that it will require a tremendous amount of effort to see through the undertaking upon which we have entered. In order to carry on the struggle with the greatest energy it behooves us all to attend to our business with greater care than at any time in the past and to endeavor so to manage our affairs that we can give the Government the greatest amount of financial aid as well as the most cordial and determined support in every way. Although times like the present make extra demands on every one of us there is now even more necessity than ever before for association work.

With the tendency to put the business of the country on a war footing all strictly nonessential lines which may be carried by the supply trade should in my belief be either abandoned or materially reduced until after the war. In the city of Cleveland alone there are probably several hundred thousand dollars tied up in stocks in the various supply houses for which the demand is not great enough to warrant such an investment. If these stocks are sold out and the inventory allowed to run down so that the capital can be used in other lines which are directly contributing to the war needs of the country it will be of direct assistance to the Government.

There can be no room for doubt as to the economic soundness of our position. The supply business has developed because of the imperative need for supply depots which can distribute at a low overhead cost the products of hundreds of different manufacturers, and I see no reason why this fundamental function of ours should be suspended completely or in part because of war conditions. As a matter of fact the more intensely our customers are operating their plants the more necessity for us to supply their immediate requirements without delay, which will be possible only if the members of this association are in position to keep up their stock of supplies. I would urge upon my successor the advisability of appointing a committee to present to the administration some workable method whereby supply dealers may secure reasonable delivery from manufacturers of the various lines which they carry in stock and which are sold at the present time almost exclusively to manufacturers who are working on war orders.

National Pipe and Supplies Association

Preceding the triple convention separate conventions were held at the same place by the National Pipe and Supplies Association, the National Supply and Machinery Dealers' Association, the American Supply and Machinery Manufacturers' Association and the Southern Supply and Machinery Dealers' Association.

L. C. Huesman of the Central Supply Co., Indianapolis, was reëlected president of the National Supply and Pipe Association, and George C. Denny of Savannah, Ga., and Rollin S. Woodruff of New Haven, Conn., were reëlected first and second vice presidents respectively. George F. McIlvaine of Pittsburgh will continue as secretary-treasurer, this being his ninth consecutive term.

In a resolution which was immediately telegraphed to President Wilson the association recorded its loyalty to the administration, urged carrying the war to a successful conclusion and pledged its membership, resources and organization to that end.

The American Supply and Machinery Manufacturers' Association elected as its president Melville W. Mix of the Dodge Manufacturing Co., Mishawaka, George T. Daley of the Oliver Iron and Steel Co. and Muir B. Snow of the Detroit Twist Drill Co. were elected vice presidents, while F. D. Mitchell of New York was continued as secretary-treasurer.

Papers were read by H. F. Kramer of Pittsburgh and H. W. Strong of the National Supply and Machinery Dealers. J. D. Nicklis of Manning, Maxwell & Moore, New York, was elected president of the National Supply and Machinery Dealers' Association. Anton Vonnegut of the Vonnegut Machinery Co., Indianapolis, and Crannell Morgan of the Hardware and Supply Co., Akron, Ohio, were elected vice presidents, and Thomas A. Fernley of Philadelphia was continued as secretary-treasurer.

Southern Supply and Machinery Dealers

W. P. Simpson, president of the C. T. Patterson Co. Ltd., New Orleans, was elected president of the Southern Supply and Machinery Dealers' Association. Other officers elected were first vice president, W. J. Schaefer; second vice president, J. H. Haslam; secretary and treasurer, Alvin M. Smith of the Smith-Courtney Co., Richmond, Va.

The Southern Dealers adopted a resolution supporting the administration in the conduct of the war. The speakers were W. E. Manning, vice president of the Youngstown Sheet and Tube Co.; N. J. Clarke of the Upson Nut Co.; M. A. Gladding of E. C. Atkins & Co., E. G. Strong of Oklahoma, Alvin M. Smith and others.

Charles W. Beaver of Yale & Towne Manufacturing Co. addressed the convention upon the relation of export and domestic trade.

The Sales Question in Belgium

By Henri Benedictus

The article by Robert G. Pilkington under the above heading has just come to my notice and I will gladly give him such information as I possess, hoping that it may be of interest to him.

I have been strongly advocating that American and British manufacturers from now on should make arrangements for the sale of machine tools in Belgium, and the same arguments which I have previously put forward also apply to other goods of first necessity as well as machine tools.

At present several commissions are being formed by the Belgian government to assist in the reconstruction of Belgium. These commissions will probably have the power to buy new equipment and material, and they will do so on the same basis as the British government is doing during the war; that is to say, they will protect any established agencies. The various manufacturers should therefore make their arrangements now in order to be able to get their share of the business as soon as the opportunity presents itself.

I am firm in my belief that it is not only necessary but imperative that American and English manufacturers should be represented by native houses in Belgium after the war. I will not repeat my reasons given in previous articles, but I will give an additional one, perhaps the most important. During the war British, French, American, Dutch and Scandinavian dealers have been doing a tremendous business, and in some of these countries large organizations have been formed with a view to promoting business after the war, and most of them desire to cover Belgian territory. After having secured abundant dividends for their shareholders during the war, they desire to continue to fill the pockets

of the latter by reaping whatever spoils the enemy may have left in my unfortunate country. Are the American and British manufacturers going to allow this? And is this the object for which the generous and brave men of Great Britain and America are fighting? Is it not but fair that if any profits are to be made in the Belgian market after the war they should be made by Belgians who have suffered so severely and who remain in the country and contribute to its redemption. One Dutch firm of machine-tool dealers is especially prominent in its efforts to appropriate the Belgian business after the war, and I am afraid that a certain American association of machine-tool makers is just as eager to brush aside the Belgian dealer and reap the benefits of Belgium's sacrifices. I feel sure, however, that no firm of high standing in America or in England will be a party to such a scheme.

Mr. Pilkington asks if arrangements can be made now. I am sure they can, as a number of Belgian firms have done exactly the same as I have, namely, shifted their headquarters for the duration of the war to either London, Paris, Amsterdam or Rotterdam, and some are even in provincial towns in England, France or Holland. Of course a very great number of houses have had no time or opportunity to come away, but I believe that they are able to get in touch with the outside world through the intermediary of neutral countries. The British and German authorities allow the exchange of purely commercial correspondence between Belgium and the allied countries through the medium of neutrals, but letters should contain only references to business matters. Most of the firms established temporarily in England I know have retained their organizations in Belgium, and taking as an example my own business I know I could take it up after the war exactly where I left it in September, 1914. It is today practically as it was then, having retained the services of my principal assistants, although of course I am not doing any business whatever at the present time there. I have every reason to believe that the same conditions apply to most of the important Belgian houses.

In confirmation of the above I will say that a number of American manufacturers have already concluded arrangements with Belgium after the war, and from this Mr. Pilkington will be able to judge that my views are not purely academic.

As regards taking out patents, I will say that these are regularly granted by the Belgian government at Havre, and applications should be made to the Ministère de L'Interieur at Ste. Adresse, Le Havre. A reliable Antwerp patent agency is established in Havre through which Mr. Pilkington could have the formalities accomplished, the name of the firm being Jacques Gevers, Sente Alphonse Karr, Ste. Adresse, Le Havre.

I hope I have given all the information required and will be glad to give any further details.

Practical Patriotism

By E. A. Dixie

We Americans have the reputation of being very Patriotic. A few days ago there was a story in the daily press to the effect that a certain United States Naval officer failed to rise while the National Anthem was being played in another room in the club. He pleaded that there is a Navy regulation sustaining his action. The other members of the club, however, insisted that he stand and they succeeded in "mussing him up" before they were able to do so.

There is an old adage which says: "A man convinced against his will is of the same opinion still." Did the Naval Officer have any more reverence for the Anthem after he was compelled to stand than he had before? Were the men who made him stand any more Patriotic than he?

It is an easy thing for a dozen men to make one man do pretty much what they wish. It does not require Patriotism or bravery, but reverse the conditions and you may have an example of either, or both Patriotism and bravery.

Many of the most prominent Prussian spies were very punctilious in the matter of standing while the National Anthem was played or sung; it made them appear Patriotic. But the fact that they were not truly American Patriots is proved by the fact that many of these standees are now resting at the Government's expense in Internment Camps.

At a certain Ship Yard they are building wooden ships. Each ship is built by a gang and each gang is pitted against every other gang to see which can make the greatest speed.

One of the ships is being built by a gang of Italians; the other ships are being built by composite gangs representing many nationalities, the bulk being Americans.

Wages Paid

On Ship Work men are paid straight time for eight hours' work, overtime is paid for at the rate of time and a half, and Sunday work at the rate of double time.

As I said before, one of the ships is being built by what the average Patriotic citizen would call a gang of "Wops." It is highly probable that many of this gang would not know the National Anthem if they heard it. But even if they did and all stood up when it was played what tangible good would it do either them or the country? Beyond suffering a little inconvenience for a few minutes they would be none the worse, but it would not do any good and would not prove their Patriotism. There are, however, many *practical* ways of showing Patriotism.

The method chosen by this gang of Italians was this:

They went in a body to the Superintendent of the yard and asked whether they could be permitted to work SEVEN days a week at *straight* time in order that they might expedite the completion of the Ship. They did not attempt at no cost to themselves to go through the motions of alleged Patriotism, but were anxious to give a practical demonstration of genuine Patriotism that cost them real money in loss of overtime pay—a demonstration that would give to the country tangible value in the shape of a finished ship to carry supplies to other real Patriots who are fighting for you and them and me.

The other gangs in that yard are going along as before. Even with this example in front of them the gangs building the other ships have not come forward and asked for a similar privilege. They are, I suppose, possessed of the same brand of Patriotism as the club members who stood the Naval Officer against the wall. To many, Patriotism is great so long as it costs nothing.

The Milling-Machine Vise as a Special Milling Fixture

BY HUGO F. PUSEP

In the present-day concentration of effort toward the maximum productive effect, the production engineer and the tool designer sometimes overshoot the mark, and time is lost through failure to recognize the value and utitlity of common, everyday tools. This article calls attention to several ways in which the milling-machine vise may be made serviceable in place of the more expensive special fixture.

THE machine shops are facing an unprecedented demand for production, and the time has come when it is no longer a question of how to design the most efficient jigs and fixtures, but how to get the most out of the present shop equipment when the quantity of identical pieces does not warrant the outlay for special equipment. It is unquestionably true that well-designed fixtures will increase the output of milling machines to the limit, provided there is enough work of the repetition character to pay for these fixtures. Very often production is held up for weeks because the designing and tool-making departments are far behind in supplying the machine shop with the necessary special equipment.

In many instances a very inexpensive addition to the standard milling-machine equipment will boost production to a considerable extent, and it is sometimes hard to understand why the various department heads do not display more ingenuity. Perhaps the reason for this is that all orders and planning must pass through a predetermined course. By the time the job reaches the department head, he has only to follow instructions as to what machine to use, the order of operations and the symbol number of fixtures which are to be furnished for every operation by the tool department. The average department foreman's duties, therefore, are to see that the order of operations received by him are carried out in the shortest possible time to the standard of finish required and within specified limits of accuracy.

The Small and Medium Sized Shops

In a large establishment where individual orders run into tens or hundreds of thousands of pieces and follow each other without interruption, this system is certainly productive of results, as it places the responsibility in a central department where it is easy to detect and follow up any defects in the system. There are, however, a great number of small and medium sized machine shops engaged in general manufacturing where the shop foreman has nearly complete charge and is supposed to suggest and put into practice any improvements in methods, and also to cause the installation of new fixtures in order to increase the production. Right here it might be said that to set up a milling machine for short jobs very often takes as long as the machining of the job itself. With this in mind it is hoped that the short cuts illustrated in this article for doing certain classes of milling machine work by the aid of inexpensive accessories to the present equipment may prove of value to many machine shops.

On analysis it becomes apparent that true efficiency in any operation consists largely in cutting down the time of changing from job to job, the elimination or shortening of all handling, clamping and releasing time, and the time of advancing the cutter to the operations. The old idea of the operator rushing around trying to increase the output of his machine, as a form of real efficiency has long since been relegated to the scrap heap. An operator on one machine might be working very efficiently with less physical exertion than his shop neighbor whose record of output would be at the expense of greater physical energy. This is more noticeable in small shops where the setting up for operations is left to the resourcefulness of the individual operator.

The V-Block in Milling-Machine Work

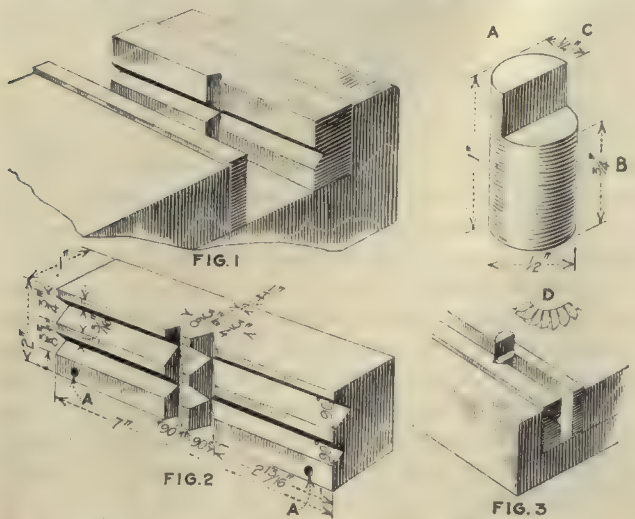
Two-thirds of all milling jobs in which the work section is circular require some form of V-block to hold them securely for the milling operation; in other words the job could be done quicker and with more certainty if the V-block were used. In most shops the machinist uses makeshift methods in clamping work for milling rather than utilize the unwieldy cast-iron blocks which represent the V-block equipment in nine cases out of ten.

The usefulness of the milling-machine vise can be greatly increased by removing the hardened fixed jaw and replacing it with a jaw having vertical and horizontal V-grooves cut on its face, as shown in Fig. 1. A dimensioned sketch of a jaw having two vertical and two horizontal Vs, is shown in Fig. 2, and a jaw thus made will securely grip any round stock from $\frac{3}{16}$ in. up to 1 in. It has the further advantage that it need not be removed after once put in place, the width and position of the Vs being such that flat stock can be gripped in any position without interference.

This auxiliary vise jaw should be made of a good grade of tool steel. After the Vs have been milled and the screw holes transferred through the solid end of the vise body, two dowel-pin holes should be drilled, as shown at A. Enough stock can be left in these holes so that they can be lapped to size after the jaw has been hardened and ground. The principal reason for the dowels is that while making the jaw it is just as easy to make it so that when a job comes along, which is not merely a "good enough" job but one which has to be kept to a thousandth, the vise jaw can be depended upon. The jaw is ground (after hardening) on bottom edge, both faces, and the two sets of Vs. After it has been doweled in place and secured with screws the top edge is ground level with the movable jaw, thus completing the job.

It is common practice for the milling-machine opera-

tor, when given a simple job of slotting screws immediately after completing a vise job, to remove the vice from the table and replace it with the dividing head; not because any dividing is required in slotting screws, but because of the more efficient holding power of the dividing head chuck. With a vise equipped with the jaw, shown in Fig. 2, the operator could change from his previous job to the screw-slotting operation without loss of time by merely changing milling cutters.



FIGS. 1 TO 3. THREE KINDS OF VISE JAWS

Fig. 1—Milling-machine vise with V jaws. Fig. 2—Dimensioned sketch of jaw with two Vs. Fig. 3—Milling a flat on a round piece

After the first screw has been brought central with the slotting saw the operation is carried on as fast as the operator can feed the cutter, remove the slotted screw and replace it with a new one. The screws are of course held between the V of the fixed jaw and the movable plain one.

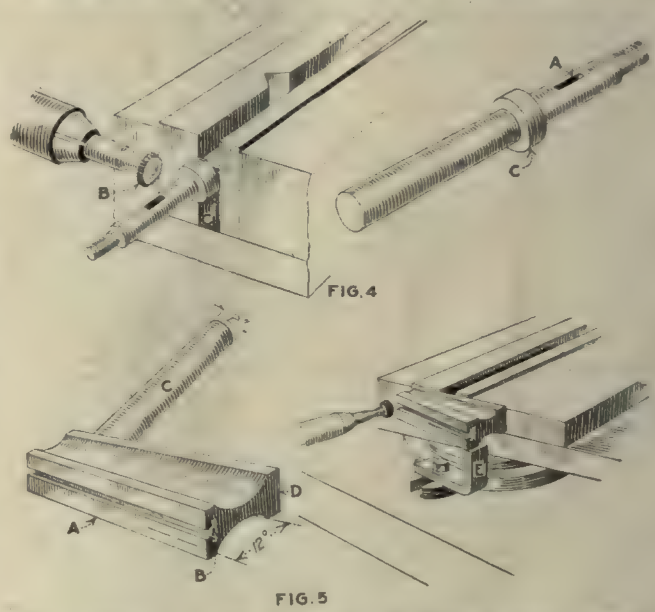
Fig. 3 illustrates an interesting job of milling a flat on the end of a short cylindrical piece, which is shown at *A*. The dimensions *B* and *C* had to be kept to a close limit, and as there were a large number of these pieces to be machined, the problem of individual measurement was eliminated entirely, as will be seen by looking at the sketch. Here the job is squared by the V of the fixed jaw and gripped by the movable jaw. A piece of $\frac{7}{16}$-in. drill rod $1\frac{1}{8}$ in. long is dropped into the V before the work is placed in position, thus raising it sufficiently above the vise jaws for the milling cutter *D* to clear them and also locating all pieces so that they are machined exactly the same distance from the bottom of the vise.

The results from this set-up were most satisfactory. After the machine was adjusted to mill the first piece to within the limits allowed, all other pieces were exact duplicates.

The Woodruff keyway in small shafts, as at *A*, Fig. 4, is usually cut between dividing-head centers, or resting on a parallel in the machine vise. Both of these methods have defects, as it is difficult to have every shaft interchangeable; but with the method here shown all guesswork is eliminated. Every shaft will be identical as regards the depth of the keyway when the cutter *B* has been fed to the right depth on the first shaft and the graduated collar on the elevating shaft of the milling machine knee set at zero. It can be clearly seen how the position of the keyway is gaged in relation to the collar *C* by making the end of vise jaws act as a positive stop. To any mechanic familiar with milling-machine work of this character the great saving of time on quantity work with this method of holding and locating must at once become apparent.

Not all milling fixtures are unnecessary; there are many jobs which could not be economically accomplished except in an expensive milling fixture. On the other hand, if a milling fixture has for its main components a couple of V-blocks set on a cast-iron base with a swing clamp on top for holding the piece to be milled, there is no reason why a machine vise could not be equipped more cheaply to accomplish the same purpose.

The job represented in Fig. 5 consists of a steel casting, the cylindrical part of which had been finished in the lathe. It now remained to finish the face *A* and the T-slot *B*. Both of these were to be kept to fairly close limits, but with the principal requirement as specified in the shop order that all of the pieces should be interchangeable as regards the relation of face *A* and the T-slot to the cylinder part *C* and finished face *D*. How all these conditions were met will appear from the sketch. The method is very simple and requires no detailed description with the exception of the angle iron *E*, which serves as the stop in locating all pieces alike. As will appear from the sketch it is held by one of the regular vise bolts, and was made of a scrap piece of $\frac{1}{2}$ x $1\frac{1}{2}$-in. wrought iron bent up to shape in the blacksmith's shop, one end being drilled $\frac{21}{32}$ in. for the accommodation of the bolt. A cut was taken over the locating end after it was in place to bring it to right height and parallel to the milling-machine table. The production record from this



FIGS. 4 AND 5. VISE USED AS A FIXTURE FOR CUTTING KEYWAY AND CUTTING T-SLOT AT AN ANGLE

simple set-up could favorably be compared to any record by an expensive milling fixture. It might be said that a special V-jaw had to be made for this job to accommodate the 2-in. diameter part *C*, but although the cost of making it was very small in comparison with results obtained it could not conscientiously be charged against this job alone because it was utilized for similar work after the job just described had been completed.

The sketch in Fig. 6 demonstrates clearly how an expensive milling fixture was dispensed with in milling the cam step *G*, where a detailed line drawing of the piece is shown. After the $\frac{7}{8}$-in. cylindrical part and the $\frac{1}{2}$-in. reamed hole had been finished and the cam faced off it remained to devise a method of accurately locating and milling the step. From a suggestion of one of the lesser lights in the shop the method shown in the sketch was adopted and proved a complete success.

A milling fixture had already been ordered, and the estimate of the engineering department put the cost of this at something like $45; this order was cancelled when a cheaper way of machining was found. The piece is gripped between the V-jaw *A* and the plain jaw *B* of the milling-machine vise. A ground plug *C* being inserted in the $\frac{1}{2}$-in. reamed hole of the lever end it is accurately located against the feeler block *D*, which is held between the top of the stop *E* and

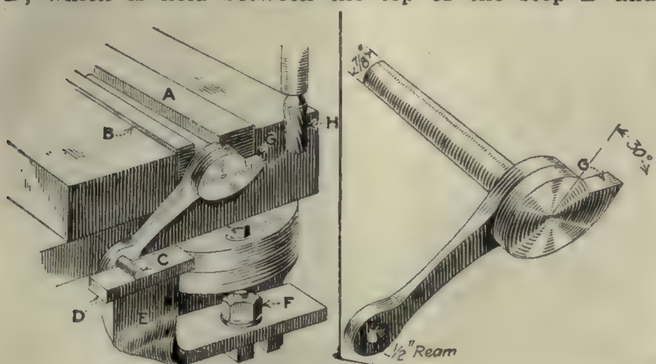


FIG. 6

FIG. 6. SIMPLE FIXTURE FOR CUTTING STEP ON A CAM

the plug *C*. The angle iron *E* is held securely by the washer and nut *F* of one of the regular vise bolts. In setting up the vertical milling machine for this job a $\frac{7}{8}$-in. ground plug was held in the vise jaws, the angle iron *E* bolted in place, and a cut taken over its projecting end, provision being made for the accommodation of the hardened and ground feeler block *D*. A height gage was used for measuring from the $\frac{7}{8}$-in. plug to the top of the angle iron stop, the correct height of the latter in conjunction with the feeler block being easily found by figuring out the sine of 30 deg. on the length of the lever. The height gage is also used to obtain the height of step *G* when setting the end mill *H* for the first piece. The necessity for the feeler block *D* is obvious from the fact that with its use it is possible to actually feel the contact of the plug *C;* besides the setting up of the job is much simplified. After hardening, the block *D* was left slightly over size in grinding and was then gradually reduced in size till the inspector pronounced the pieces coming from the milling machine to be within the desired degree of accuracy.

What has been said in the preceding paragraphs has been in connection with the V-jaw in milling-machine work. From the examples given it can easily be seen by the practical mechanic to what other uses this form of vise jaw can be put, it being impossible to enumerate all the jobs to which it is adapted. Some modifications in form of the jaw may be necessary for special jobs, but the equipment of at least one milling-machine vise in the shop, whether it be the toolroom or the production department, with the V-jaw illustrated in Fig. 2 of this article, will be sufficient to change the set convictions of any department head as to how certain milling jobs are to be most economically held for machining.

Standardization of Screw Threads

All those who are interested in the standardization of machine parts, and this means practically all the designers and manufacturers of machinery, will be glad to know of House Bill 10,852, which was recently brought up for discussion in the House of Representatives by Mr. Ashbrook of Ohio, although it is quite probable that Representative Tilson from Connecticut had much to do with its preparation.

Be it enacted, etc., That a commission is hereby created, to be known as the commission for the standardization of screw threads, hereinafter referred to as the commission, which shall be composed of five commissioners, one of whom shall be the director of the Bureau of Standards, who shall be chairman of the commission; one a commissioned officer of the army, to be appointed by the Secretary of War; one a commissioned officer of the navy, to be appointed by the Secretary of the Navy; and two to be appointed by the Secretary of Commerce, one of whom shall be chosen from the nominations made by the American Society of Mechanical Engineers and one from nominations made by the Society of Automotive Engineers.

Sec. 2. That it shall be the duty of said commission to ascertain and establish standards for screw threads which shall be submitted to the Secretary of War, the Secretary of the Navy and the Secretary of Commerce for their acceptance and approval. Such standards when thus accepted and approved shall be adopted and used in the several manufacturing plants under the control of the War and Navy Departments, and so far as practicable in all specifications for screw threads in proposals for manufactured articles, parts or materials to be used under the direction of these departments.

Sec. 3. That the Secretary of Commerce shall promulgate such standards for use by the public and cause the same to be published as a public document.

Sec. 4. That the commission shall serve without compensation, but nothing herein shall be held to affect the pay of the commissioners appointed from the army and navy or of the director of the Bureau of Standards.

Sec. 5. That the commission may adopt rules and regulations in regard to its procedure and the conduct of its business.

Sec. 6. That the commission shall cease and terminate at the end of one year from the date of its appointment.

Objection was made to the idea of having members appointed by the American Society of Mechanical Engineers and the Society of Automotive Engineers, some contending that it was only necessary to have representatives from the Bureau of Standards and the Army and Navy Departments. After considerable discussion, however, in which it was brought out that the Bureau of Standards approved the appointment of representatives from the two societies named, the bill, with slight modifications, was approved for passage.

In view of the work done by the Committee of the American Society of Mechanical Engineers on Screw Thread Tolerances during the past five years it is quite probable that many of their conclusions will be accepted and incorporated in the proposed standards as soon as the new committee can convene and begin work. The report of this Committee of the American Society of Mechanical Engineers is the result of long and exhaustive experiments.


U.S. ARMY ORDNANCE
NOT Just
Hats Off
To The Flag
BUT Sleeves
Up For It!

The Worcester Spring Meeting of the A.S.M.E.

The two papers here presented were read at the spring meeting of the American Society of Mechanical Engineers at Worcester, Mass., June 4-7, 1918. The first takes up work in connection with the adjustment and standardization of precision apparatus incidental to the testing of munition gages, while the second takes up the molding of parts made from hard rubber and phenolic products.

The Elastic Indentation of Steel Balls Under Pressure

BY C. A. BRIGGS, W. C. CHAPIN AND H. G. HEIL

A summary of the results of experiments conducted by the Bureau of Standards at Washington for the purpose of studying the amount of distortion of flattening of rounded surfaces in contact under varying pressures with a view to determining to what extent this action might affect the adjustment of precision apparatus used in the testing of gages for munitions work.

IN THE adjustment and standardization of precision apparatus at the Bureau of Standards incidental to the test of munition gages the subjects of the effect of pressure on the dimensions of steel balls and length standards having rounded ends came up for consideration. After a preliminary study of the matter it was concluded that the distortion of the steel balls between the contacts and the elastic compression of the portion of the rounded ends not directly in contact with the measuring surfaces was very small, a conclusion that appeared inconsistent with some of the results that had been obtained in actual measurements. This directed attention from the main portion of the steel-ball or rounded surface to the elastic indentation of the surfaces immediately in contact with each other. In order to settle the question experiments were undertaken, the outcome of which form the substance of this report, and while limited in scope they were so successful in giving consistent results and data of apparently wider application than that originally intended that a brief report recording the information obtained is summarized in this article. The fact that the effect of high pressures was of no immediate interest in relation to the problem and that to extend the investigation to greater pressures would have required time that was needed for other matters only low pressures were employed.

The maximum pressure used on steel balls bearing against glass plates was 20 lb., which pressure was used on balls $\frac{3}{4}$ and 1 in. in diameter. On smaller balls the maximum pressure used was 10 lb. The results, therefore, do not represent the same conditions as when high pressures are used, such as occur in the Brinell hardness test of materials, where the stresses are above the elastic limit; or pressures such that the indented area includes a solid angle large enough to invalidate the assumption frequently held when the angle is small that the sine and angle are equal. However, the results obtained do give accurate information of the effect of pressures on the measured diameters of spherical surfaces of steel or other materials which are employed in standardizing gages, and also appears to give information of practical value as to what occurs in ball bearings.

The experiment was performed by observing and measuring with a micrometer microscope the area of contact made by flat and spherical surfaces in contact with each other under varying pressures. This area of contact was viewed as the central spot in the Newton's ring system formed when a glass surface was in contact with a polished surface of steel or with another glass surface. The amount of indentation was obtained from the measured diameters by a simple, easily derived computation, which it is not necessary or advantageous to give here.

The different combinations of surfaces available for observation and use in the experiments were a steel sphere pressing against a flat glass surface, a spherical glass surface pressing against a flat steel surface, and a spherical glass surface pressing against a flat glass surface.

General Equation Obtained from Plotted Results

From an examination of the results for each pair of surfaces in contact, plotted on logarithmic paper, and from general reasoning based on the nature of the phenomena, a general equation was worked out for the purpose of correlating all of the results. It is not expedient to expand this report by giving all of the various considerations which lead to the particular form assumed for this general equation, but it may be stated that after the constants of the general equation had been determined from the experimental data the experimental values were reobtained by computations from the general equation, and the agreement between the computed and experimental values was very good;

in fact the agreement was so satisfactory that it was considered unnecessary to take additional data from the same material as had been contemplated.

In case of steel against steel it was of course not possible to observe the area of contact, owing to the opaque nature of both contact surfaces, so that the values of steel against steel were obtained by the use of the general formula which had been found to fit all the various surfaces and materials used in the experiments that have been constructed up to this time.

It will be observed in the equations which follow that a quantity called the indentation modulus is used to express the elastic property which determines the indentation. It was originally intended to use Young's modulus as representing in a general way the elastic properties. However, on looking up the elastic constants of glass it was found that a problem of very similar nature had been worked out by Hertz from

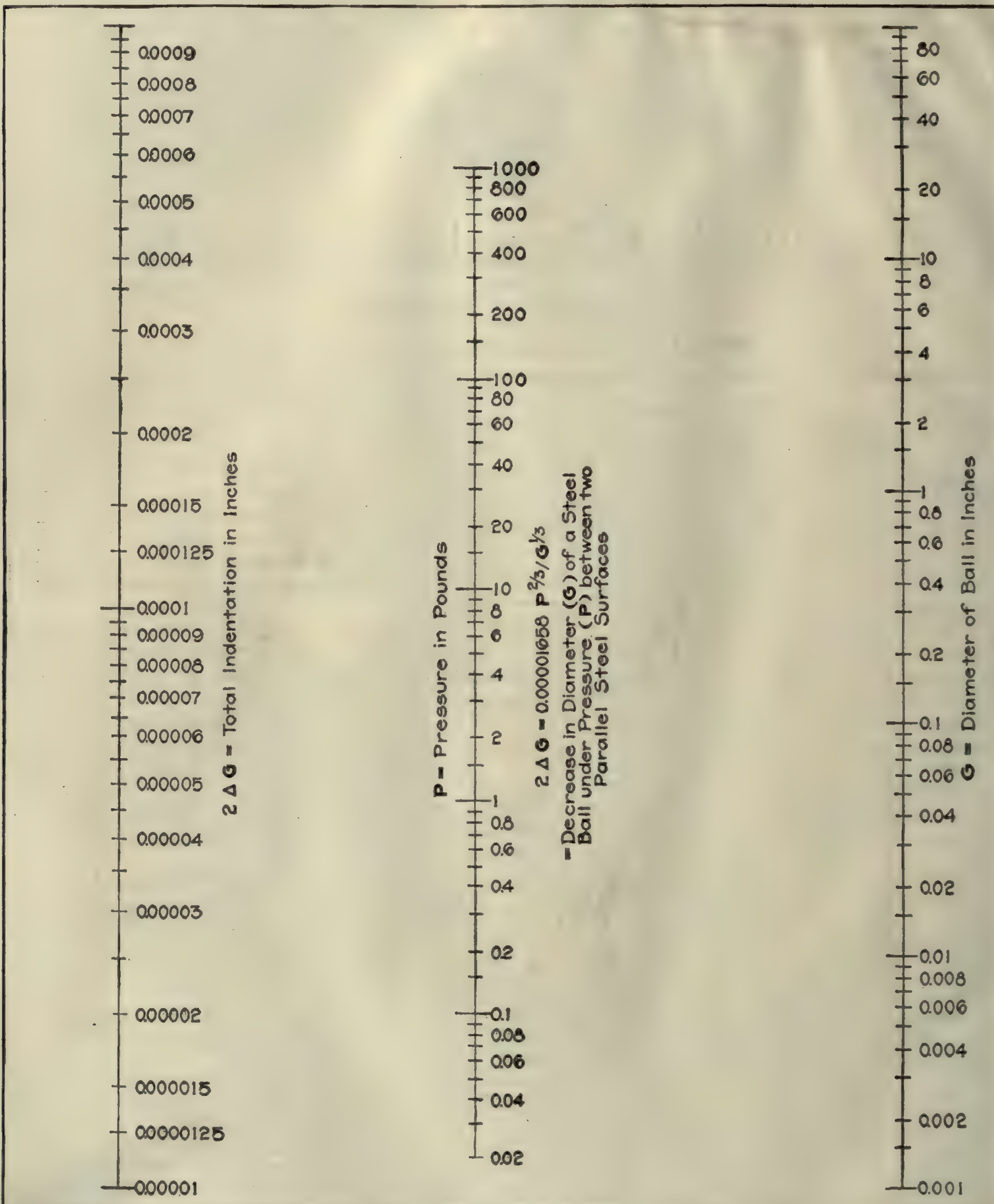


FIG. 1. INDENTATION OF STEEL BALLS

theoretical considerations, which gave practically the same form of equation as was derived in the present experiments, and in which the elastic property effective in determining the indentation was found by Hertz to

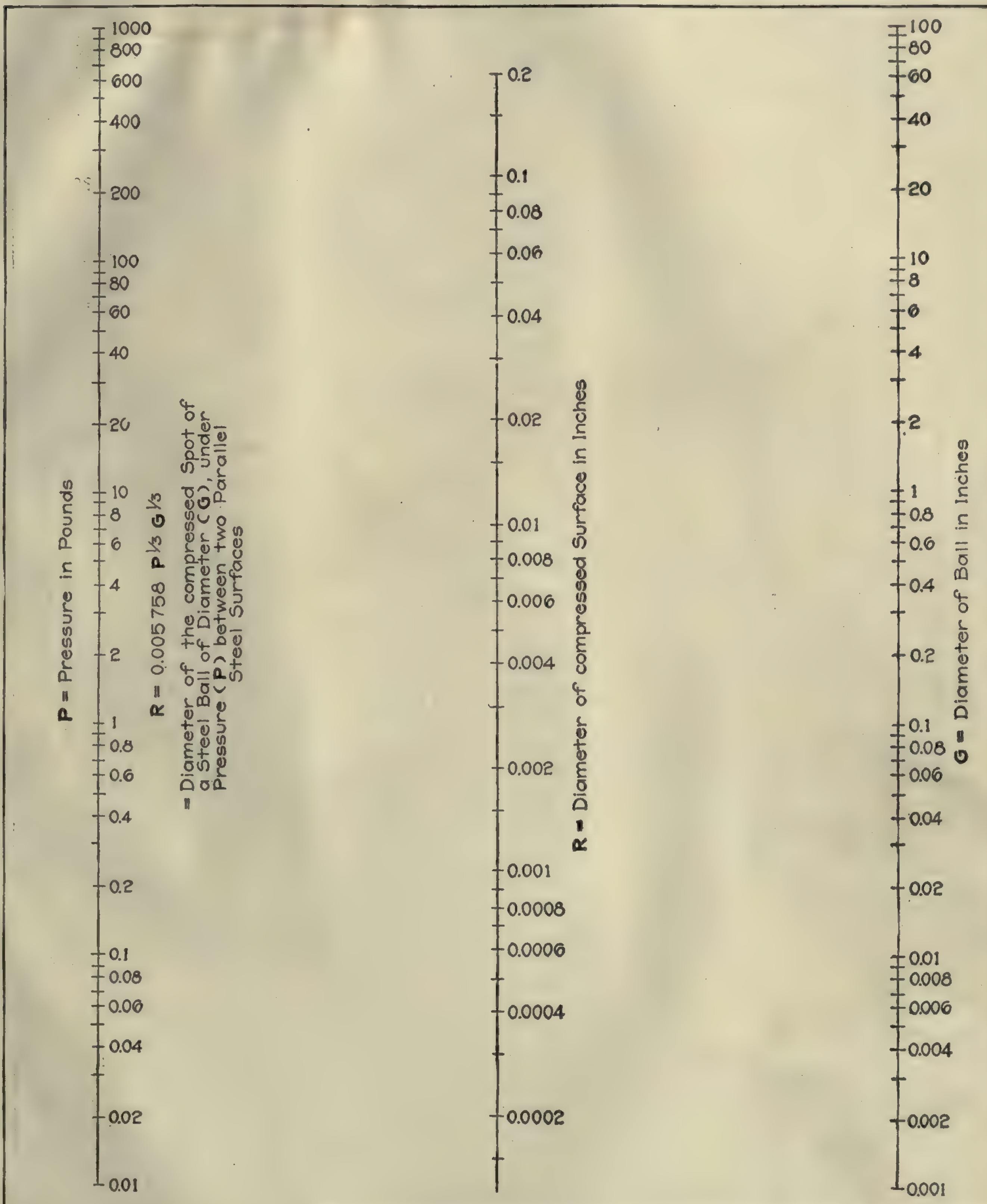


FIG. 2. DIAMETER OF INDENTED SPOT

be a function of Young's modulus and Poisson's ratio, and which was called the "Indentation Modulus."

It had not been necessary in this matter to concern ourselves with the manner in which the indentation is distributed between the surfaces in contact, so no further reference will be made to this subject.

A very interesting feature which can be noted on examining the results is that the indentation is not linear with the pressures, but is proportional to the two-thirds power of the pressures. This is a fact of importance in connection with the design of ball bearings, as it indicates what effects are produced on the

distribution of the load by slight variations in the size of the balls in a bearing.

For steel against steel, which appears to demand most attention, the results are given in the form of computation charts, by means of which numerical values can be obtained quickly for any particular case covered by the equations.

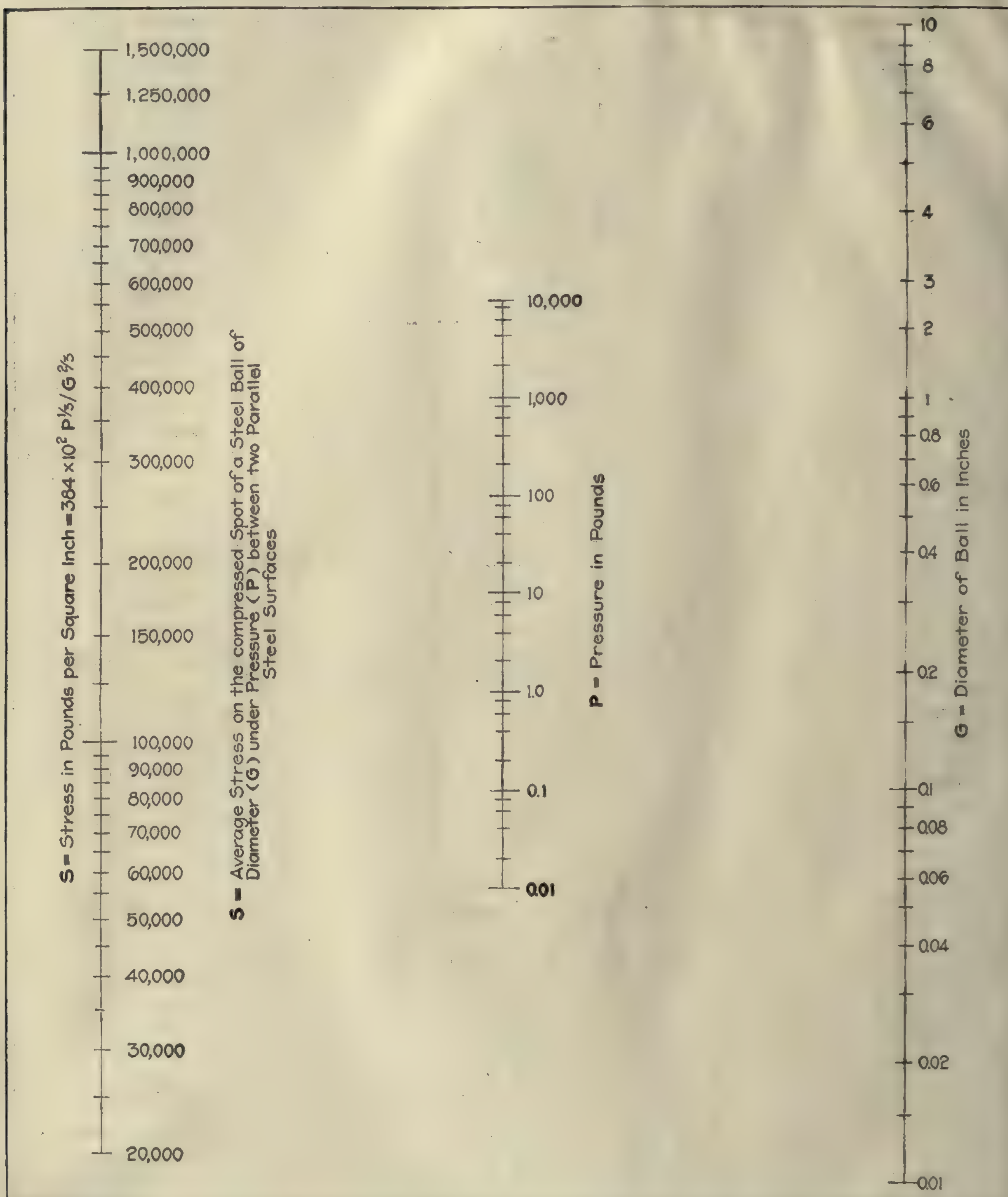


FIG. 3. PRESSURE PER UNIT OF AREA OF INDENTED SPOT

In reference to future experiments those which seem of most practical interest would be the elastic indentation of spherical surfaces in contact with cylindrical surfaces, and cylindrical surfaces in contact with cylindrical surfaces; such as are represented by many forms of ball and roller bearings in everyday use. It would be also of interest to extend the experiments already made by employing higher pressures.

The elastic coefficients for the materials used in the experiment of this report were obtained from tabular data. If in the future it becomes desirable to obtain

information on the indentation of surfaces with great precision, experiments should be performed on materials that have had their properties carefully measured, in order to fix with exactitude the values of Young's modulus and Poisson's ratio for the particular steel and glass used in the experiment.

The results of the experiments are summarized in the following equations:

1. *General Equation for Indentation*—

$$\Delta G = 0.518 P^{\frac{2}{3}} \left[\frac{G_1 + G_2}{G_1 G_2}\right]^{\frac{1}{3}} \left[\frac{1}{E'_1} + \frac{1}{E'_2}\right]^{\frac{2}{3}}$$

where ΔG = the mutual indentation between the surfaces in contact; P = the pressure acting between the two surfaces; G_1 and G_2 = the radii of curvature of the two surfaces; E'_1 and E'_2 = the indentation moduli of the surfaces G_1 and G_2.

The indentation modulus is given by the expression

$$E' = \frac{E}{1 - u^2}$$

where E = Young's modulus; u = Poisson's ratio.

2. *Indentation for Steel Balls Between Flat Steel Surfaces*

$$2\Delta G = 0.0000166 \frac{P^{\frac{2}{3}}}{G^{\frac{1}{3}}}$$

where $2\Delta G$ is given in inches.

[*Graphical Solution Fig. 1*]

3. *Diameter of Area of Contact Between the Surface, Steel Against Steel*

$$R = 0.00576\ P^{\frac{1}{3}}\ G^{\frac{1}{3}},$$

where R is given in inches.

If the general equation is desired for R it can be derived easily from equation (1).

[*Graphical Solution Fig. 2*]

4. *Average Pressure Over the Area of Contact, for Steel Against Steel*

$$S = 38.400 \frac{P^{\frac{1}{3}}}{G^{\frac{2}{3}}}$$

where S is given in pounds per square inch.

If the general equation for S is desired it can be developed from equation (1).

[*Graphical Solution Fig. 3*]

Using the Charts—A straight line placed across any of the charts will strike readings on the vertical scales which are a solution of the corresponding equation. With these charts, when any two of the three quantities of the equation are given, these quantities will establish two points which determine a straight line, and the value of the third quantity will be given by the intersection of the straight line on the corresponding vertical scale.

Electric Heating of Molds*

By HAROLD E. WHITE

In forming parts made from hard rubber and the various condensation products now available the standard procedure has been to employ metal molds filled with the material, which are placed between steam-heated plates attached respectively to the upper and lower platens of a hydraulic press. Difficulties encountered by the author in the use of this method led him to devise the one described in the paper, in which the heating is done electrically. Various advantages of the new method are pointed out, and it is stated that it can probably be utilized successfully in the production of die castings of readily fusible metal and also in drawing the temper of hardened-steel parts.

SYNTHETIC molding materials are being used on an increasingly extensive scale not only for parts of electrical machinery, but for many other useful articles. The purpose of this paper is to describe a novel method for applying heat to the molds in which such parts are formed which I believe will be of general interest and of considerable utility under certain conditions. The earliest example of such a material is perhaps hard rubber or vulcanite. More recent examples are the phenolic condensation products sold under various trade names. All of these materials are alike in that a moderate degree of heat causes them to soften sufficiently to take the form of the mold, while a higher degree of heat causes them to undergo chemical changes that harden them into a highly resistant condition. In general, the phenolic condensation products are superior to the older rubber products, except where a high degree of elasticity is essential. The phenolic condensation products are much more resistant to chemical action and in some preparations are much stronger mechanically.

Manufacture of parts made of this material on a small scale under my observation led to the development of the new method of production which is described. While it is not believed that this method can replace those used in factories which specialize on these materials, it would appear nevertheless that it can be used with success in almost any machine shop equipped with a hydraulic press, or even an arbor press if the articles are small, provided alternating current is available.

At first an attempt was made to use the standard method of production, which was to place the filled molds between two steam-heated plates attached respectively to the upper and lower platens of a hydraulic press. Live steam at about 110 lb. per square inch was admitted to these plates until the pieces were fully hardened. Then cold water was circulated through the same plates until the mold was cold, after which the mold was taken out and refilled for another piece.

Under these conditions production was slow and frequently interrupted altogether. The slowness of production was due to the heat not being transmitted rapidly enough from the hot plates to the mold because the steam was often wet and the plates had a lower temperature than the boiler pressure would indicate.

*Read at the spring meeting of the American Society of Mechanical Engineers held at Worcester, Mass., June, 1918.

These difficulties were accentuated by the fact that most of the molds were long and slender, so that they had but a small part of their surface in contact with the hot plates and a large part in contact with the air. The heating and cooling of the fittings alternately carrying the steam and the cooling water resulted in frequent leaks, especially in the flexible piping, the use of which was necessitated by the movement of the upper platen of the press.

During one of these periods of interruption recourse was had to a method of electrical heating with such good results that the use of steam was abandoned altogether. In brief the method consisted in magnetizing the molds with alternating current at 60 cycles. As these molds are always made of steel and generally hardened they will heat up rapidly under these condi-

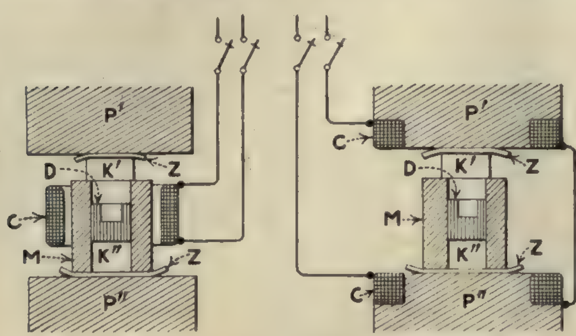


FIG. 1 FIG. 2

FIGS. 1 AND 2. METHODS OF ARRANGING THE COILS
Fig. 1—Elementary arrangement of heating coil. Fig. 2—Improved arrangement with coils above and below.

tions, owing to induced electric currents in the various parts of the molds and also in some measure to hysteresis losses, especially in the hardened parts.

The method first used was simple in the extreme. The coil was made of 100 turns of No. 6 asbestos-covered wire, and when in operation its terminals were connected by a switch directly to the 220-volt supply line. With molds weighing 10 to 15 lb. a curing temperature could be reached, starting cold, in from 3 to 5 minutes. It should be understood that under the conditions of working the magnetizing coil remains quite cool.

The heat is developed in the interior, though mostly near the surface, of the molds. If the current is left on indefinitely a temperature destructive of the molding material results. This necessitates finding some way by which a definite result may be secured. Generally it is sufficient to make trial pieces, noting the time of heating of each by a watch or clock. After observing the right time it can be repeated indefinitely for other pieces. A good method of gaging the temperature of the molds is to observe the color of sulphur when melted in contact with the mold. The brick-red color which sulphur shows at 180 deg. to 200 deg. C. gives a good indication, but it is hard to keep the sulphur in place. A better material is a cane-sugar syrup with a little blue litmus, which clings to the hot molds and chars to a tobacco brown when the temperature limit has been reached. When the proper temperature has been reached the switch is opened and the mold cools off slowly, during which time the final hardening of its contents takes place.

A study of the heating action in detail is interesting. Referring to Fig. 1, P' and P'' are the cast-iron platens of the press, M the matrix, and K' and K'' the plugs by which the molding material D is pressed in the matrix. C is the current-carrying coil. Since the magnetic field is the means of carrying the energy to the mold it will be seen by those familiar with electromagnetism that the part of the mold in the plane of the coil heats most rapidly. The ends of the mold in contact with the platens lose heat rapidly, so that it was found well to protect them against such loss by asbestos or pasteboard sheets at Z. Next several coils of different proportions were made, long ones for the longer molds and flatter ones for the shorter ones.

It was found inconvenient to lift the hot molds from the interior of the coils, so a further improvement was made in which the coils were subdivided into two halves and mounted as shown in Fig. 2, in which letters designate the same parts as in Fig. 1. This arrangement gives good heating throughout the mold regardless of the shape. In fact there is a little greater heating at the ends, which compensates for loss by conduction. The plates P', P'' were fitted with laminated-iron sections so that a path for the magnetic flux in them, which would not develop heat, could be provided. Fig. 3 is an illustration of the press fitted with these coils. It is evident that the molds could be put into or removed from the press thus fitted as readily as from an ordinary press.

In all of these arrangements the magnetic return circuit consists of leakage through the air and through the massive parts of the press, in all of which the magnetism is so diffused that the energy loss is small. This is clear from the fact that such losses are a function of the square of the magnetic density and the electrical conductivity of the material. Cast iron, being of low conductivity, losses in the heavy parts of the press are necessarily very small. Cast iron would not be a good material from which to make the molds. It is evident that the thermal efficiency of this method is comparatively high, and I have good reason to believe that more than half of the heat which is developed makes it appearance in the mold. By the induction method of heating it is possible to pile several thin molds on top of each other and heat them all at once, which cannot be done by any other method. By this means one press can be made to produce several articles simultaneously.

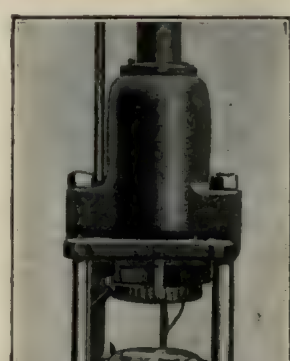


FIG. 3. COILS AS SHOWN IN FIG. 2

In making molded insulation the cost of molds is frequently very great. By the induction method of heating, the cheapest mold can be used, since it is never necessary to shape it so as to admit steam to it or so as to favor the flow of heat into it from any external source.

Many electrical engineers would regard the low power factor at which such devices operate as a serious

drawback. However, I regard it as an important advantage in that a steadying effect on the circuit is produced, so that whether a large mold or a small mold or no mold at all is placed in the coil no harmful result will follow, the large size of wire used being sufficient for the current at all times. Measured in terms of value received for the outlay and freedom from trouble and general convenience the process was entirely satisfactory. A press having a better magnetic circuit which would have operated at a power factor comparable to that of an induction motor could have been made at a greater cost, but the extra cost would have exceeded the saving possible during the time the above apparatus was in use, which was about one year.

It is believed that other uses might be made of this process; for example, die castings of readily fusible metal might be made economically on a small scale; or hardened-steel parts might be tempered, in which case the temper could be drawn without overheating sharp angles and cutting edges.

Bending Short Rods Having Threaded Ends

By J. V. Hunter

Western Editor *American Machinist*

There are many shops that have occasion to bend short rods with threaded ends, or long rods with the bend so close to the threaded portion that the operation must be performed after threading; otherwise there would be no chance to get the die up to work.

In one shop these rods, one of which is shown at *A*, Fig. 1, were formerly bent by hand, the smith using a woooden mallet to avoid injuring the threads, the first turn being made over the horn of the anvil and the bend completed on a former.

As our requirements ran well into the thousands, this method was naturally too slow, and in casting about for a more efficient means of production, the bending fixture shown in Fig. 1 was finally evolved. A base *B* with its upper edge made to conform to the shape of the finished piece carries the two levers *C* and *D*. Firmly attached to lever *C* is a former *E* and a roller *F*. A jaw *H* is attached to lever *D*, which in construction was firmly clamped in closed position, and a pocket, half in the jaw and half in the base, was formed by drilling and tapping to fit the threaded end of the piece to be bent. In operation the lever *C* is thrown back, striking the end of lever *D* and opening the threaded pocket for the reception of the work. As lever *C* moves forward jaw *H* grips the threads on the hot rod, but as the pocket is fitted to them, it does not injure them. Continuing its movement, roller *F* carries the work around the formed surface until the final bend is accomplished by direct pressure delivered by former *E*. The helical spring shown exerts sufficient pressure upon jaw *H* to hold the work in position during the bending operation. This fixture was entirely constructed in the blacksmith shop, and in use is bolted to an anvil as in Figs. 2 and 3 which show the fixture respectively in open and closed positions.

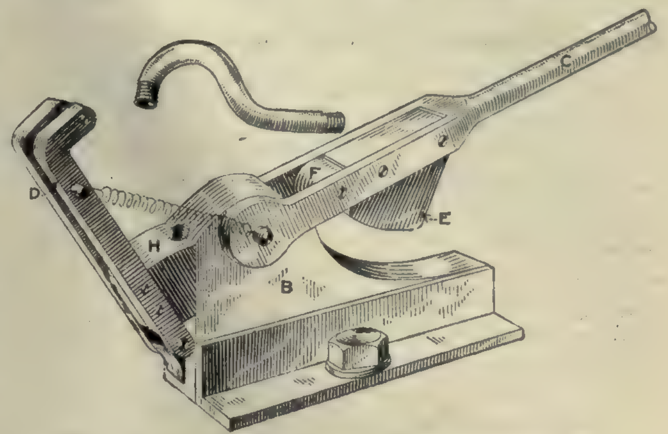


FIG. 1. THE WORK AND THE FIXTURE

With this fixture it was found possible to reduce the working time on a given number of pieces to one-fifth of that required by the hand method.

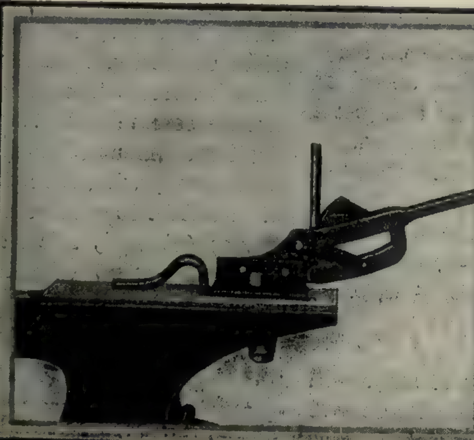


FIG. 2. THE FIXTURE OPEN

FIG. 3. THE FIXTURE CLOSED

Help for the Engineering Council

The Engineering Council is engaged in numerous activities directly or indirectly connected with the war, for the engineering profession of America. There are a large number of committees for handling various problems, and these committees often require assistance in securing details or the making of special investigations for some particular service. It is the desire of the council to have a record of the men who may be available to render such assistance to these committees when the occasion arises.

Engineers of varied experience who can devote more or less time to this work are requested to write to Alfred D. Flynn, secretary of the Engineering Council, 29 West 39th St., New York, and register their willingness to be of service in this connection. Each communication should outline the experience and the way in which the registrant can probably be of the most service. These volunteers are not likely to be called upon very frequently, but it may happen that the special qualifications of the engineer may make his services in demand.

SIDELIGHTS

EDITED BY E. C. PORTER

The expenditures of the United States Government for the fiscal year 1918 are now estimated at from $15,000,000,000 to $18,000,000,000, a sum equal to the entire federal expenditures from 1776 to 1917.

* * *

The International Trade Mark Bureau for the registration of trademarks of producers and manufacturers in the 11 northern countries of North America, Central America and the West Indies has been opened at Havana, Cuba, under the direction of Dr. Mario Diaz, Irizar. According to advices from Washington, American companies and firms sending machinery and other products to Latin America under the protection of trademarks would do well to get in touch with the Havana bureau.

* * *

The Rockefeller Foundation, through its president, George E. Vincent, has just issued a 50-page booklet giving a review of its war work, public-health activities and medical-education projects in 1917. A summary of expenditure for all purposes during 1917 is as follows: War work, $5,944,968.53; public health, $682,686.37; medical education and research, $3,629,335.40; various philanthropies designated by the founder, $942,251.42; miscellaneous, $149,988.50; administration, $105,666.28, making a grand total of $11,457,086.36.

* * *

During April $13,988,619 were paid out to farmers of the United States by the Federal land banks on long-time, first-mortgage loans, according to a statement of the Federal Farm Loan Board. The Federal land bank of St. Paul closed loans during the month amounting to $2,870,000. The other banks made loans as follows: Omaha, $1,912,300; Spokane, $1,586,380; Houston, $1,514,844; New Orleans, $1,198,955; St. Louis, $1,016,035; Wichita, $768,900; Louisville, $756,700; Columbia, $737,605; Berkeley, $569,700; Baltimore, $538,100; Springfield, $518,800.

* * *

America's first quantity output of concrete ships will be a fleet of tankers for the fuel-oil trade. There will be 14 of them, totaling 105,000 tons. Completed plans for these additions to the American merchant marine were announced recently by the concrete division of the shipping board. The concrete-ship program has also been enlarged to provide for the construction of four smaller vessels totaling 12,500 tons. Contracts placed to date call for 18 concrete ships, totaling 117,500 tons. Eight of the projected fleet will be built in shipyards of the Pacific coast; the others in Atlantic yards.

* * *

The Michigan State Auto School has opened an airplane-mechanics' course for the purpose of training men as aviation mechanics or as production men for airplane-engine factories. The course occupies two months, and includes assembling, repairing and operating airplane engines, as well as constructing and maintaining the machine. Students are given practical work in overhauling and rebuilding machines which have been in service. The airplane instruction is under the direction of a Curtiss expert, who is at the head of this branch of the faculty.

* * *

Charles A. Otis, president of the Cleveland Chamber of Commerce, has been appointed by the War Industries Board to make a survey of the industrial resources of the country. He will work out a zoning system for all war industries in coöperation with the War Department. The scheme contemplates organizing the industries in each zone so that, as nearly as possible, all products may be finished in the zone of origin. Each zone under the plan will have as its center a large manufacturing city. Plans, specifications and other war information will be sent from the War Industries Board to the zone centers, where orders will be distributed to the proper factories. Officials of the board say the plan will speed up war work greatly. The survey will enable the Government to determine the facilities of individual plants. Long hauls and delay in assembling will be eliminated.

* * *

The recommendations made by the Balfour Committee for promoting and safeguarding British trade after the war include (1) the largest possible production by employers and work-people; (2) continued prohibition of importation of enemy goods; (3) financial help where necessary for development of sources of supply vital to national defense, and Government control of alien interests in such sources; (4) safeguards against hostile commercial penetration; (5) encouragement by the Government of combination and coöperation of manufacturers, with a modification of the hostile attitude of the state toward combinations in marketing overseas trade; (6) early relaxation of control of capital issues; (7) full review of principle on which income tax is based; (8) preferential treatment of British dominions; (9) denunciation of existing commercial treaties.

* * *

Neville Island, in the Ohio River, near Pittsburgh, Penn., has been selected by the War Department as the site for the great Government ordnance plant to be built and operated in the interior. The island is seven miles long and not more than a mile wide. At one end is the Neville furnace of the Carnegie Steel Co., a subsidiary of the United States Steel Corporation. Railroads occupy the river banks paralleling the island, the New York Central on one side and the Pennsylvania on the other. Negotiations for a second large ordnance plant for the Government are said to be nearing completion. The War Department and the Midvale Steel Co. are reported to be in substantial agreement on the expansion of the company's plant at Nicetown, near Philadelphia, for making heavy ordnance. The Midvale company has long been engaged on large war orders, but under the new arrangement, it is said, the capacity of the plant will be more than doubled.

A Thread-Grinding Fixture

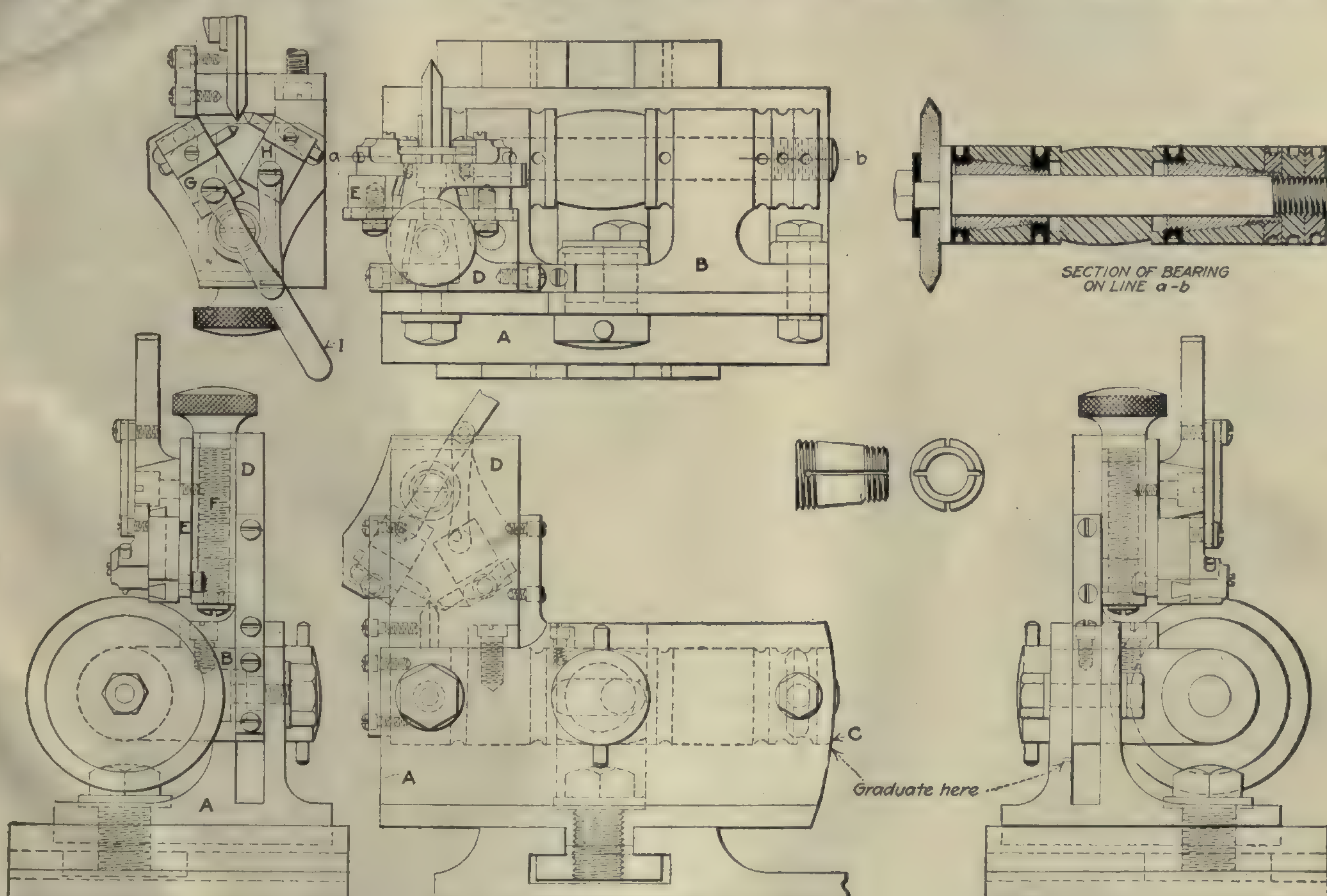
By J. W. Collins

The illustration shows a fixture for grinding threads that can be used on the compound rest of any lathe. The body *A* of the fixture has a rib planed to fit the toolpost slot, and is provided with a collar-head bolt and square nut for clamping the fixture in position. The bracket *B* carrying the wheel spindle swivels upon part *A*, the axis of the swivel being horizontal at right angles to the center line of the wheel spindle and opposite to the vertical center line of the wheel.

Means are provided for swiveling this bracket and for clamping it in whatever position may be necessary to make the plane of the wheel conform to the angle of the thread being ground; and as the axis upon which this movement takes place is coincident with the center of the wheel it follows that this adjustment does not affect the relative center positions of the wheel and the work to be ground.

One edge *C* of the swiveling bracket is finished and graduated so that the thread angle being known, it is but the work of a moment to tilt the wheel to a corresponding angle.

The bracket *B* has an extension *D* parallel to the vertical plane of the wheel, this extension carrying a slide *E* which is adjusted vertically by means of the screw *F*. Upon the face of this slide are mounted two smaller slides *G* and *H* with their lines of travel 30 deg. either side of the line of travel of the slide upon which they are mounted. These smaller slides are arranged to carry diamond toolholders directly over the center of the grinding wheel. They take their movement from the compound lever *I*, which causes first one diamond and then the other to pass over the angular surface of the wheel.



FIXTURE FOR GRINDING THREADS

As the part upon which the slide is mounted is integral with the wheel-carrying bracket, swiveling the latter about its axis does not affect the positions of the diamonds in relation to the wheel; therefore when once set the tools are always in position for truing the wheel.

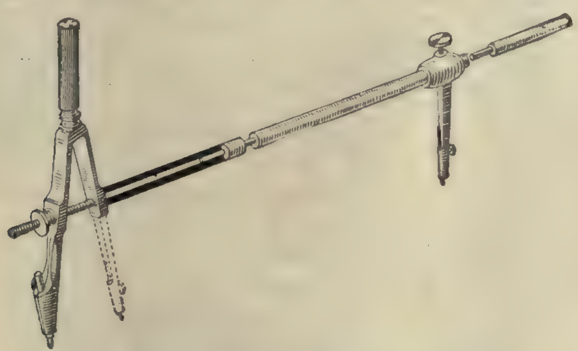
The wheel spindle runs in tapered split-shell bearings providing ready means of adjustment to compensate for wear.

An Adjustable-Beam Compass

By Robert Liebrich

The manner of converting a bow pencil into a very acceptable adjustable-beam compass is shown in the illustration. First, remove the screw from the bow pencil by driving out the pin which holds it in place. Secure a piece of wire of the same diameter as the screw, and a piece of tubing the inside diameter of which is a tight fit on the wire and of the length desired for the beam of the compass. Drive the wire a short distance into the tube and solder it in place. Cut off the wire so that a length equal to the length of the old screw projects from the tube, and cut a thread upon this projecting end to take the adjusting nut.

Saw off the leg carrying the needle point, as shown in the drawing. Make a sleeve to fit over the tube



ADJUSTABLE BEAM COMPASS

which forms the beam, drilling and tapping it on one side for the binding screw and on the other for the sawed-off portion of the compass leg, which should be worked down and threaded to fit and afterward soldered in place to prevent it from turning around.

Fasten the adjusting screw in place by drilling through the wire and inserting the pin as in the old screw. Extensions for the beam can be made from pieces of the tube and wire put together, as shown at the right, the wire being soldered into the tube sections and the projecting end polished to a fairly tight push fit in the end of the tube.

Built-Up Electric Cable

By T. M. R. Von Keler

A clever method of making combination iron and aluminum electric cable of high tensile strength and great elasticity is described in the *Elektrotechniker Zeitung* by E. G. Fischinger of Dresden. A rope of oiled paper 3.5-mm. diameter is covered with a strip of galvanized sheet iron 7.5-mm. wide and 0.3-mm. thick, wound on in right-hand spiral. The sheet-iron spiral is in turn wound in an opposite direction with six galvanized-iron wires of 3.9-mm. diameter. Finally 12 aluminum wires of 4.1-mm. diameter each are wound in right-hand spiral around the galvanized-iron rope. Setting fire to the oiled paper, the core burns out and leaves a hollow spirally wound cable, light in weight

BUILT-UP ELECTRIC CABLE

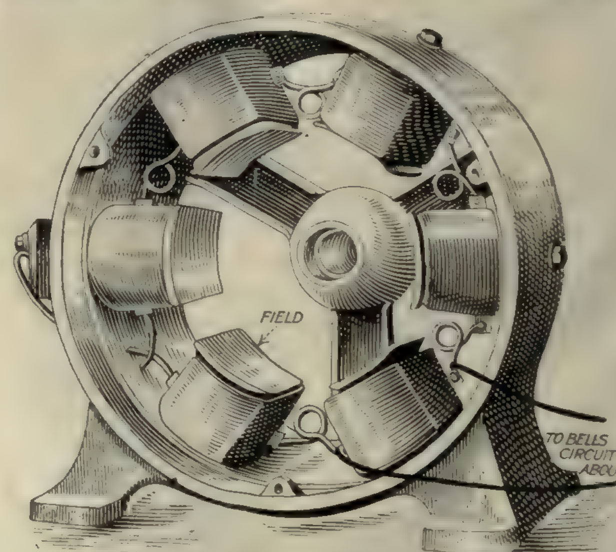
but with great strength to resist wind and temperature changes. It is 1.35 times as strong as pure aluminum wire of the same diameter. The illustration shows the method of construction.

Operating Signal Bells from a Generator

By H. D. Martindale

Thinking it might be of advantage to other shops, we wish to report a little arrangement that we rigged up the other day in our shop, which has given very satisfactory results.

We all know what trouble signal bells give on a battery circuit due to the battery getting weak and becoming a constant source of trouble. We have a six-pole direct-current generator from which we take power for our shop. On each side of one of the field poles we connected a wire, which in turn is connected through a double pole switch to our signal-bell circuit, as shown



BELL CONNECTION FROM DYNAMO

in the illustration. This arrangement does not reduce the efficiency of the generator to any appreciable extent, and it will ring as many bells as it is desired to put on. It has also eliminated all the battery trouble which we have had in the past.

The President's Readjustment and Reconstruction Commission—IV

By WINGROVE BATHON
Washington Representative McGraw-Hill Co., Inc.

Following the presentation in McGraw-Hill engineering publications of a concrete plan for a proposed readjustment and reconstruction commission to be appointed NOW *by the President of the United States, to deal* NOW *with problems which will be presented to American industry after the war, it has become known in Washington administrative circles in an unofficial manner that a plan for a readjustment and reconstruction agency is under consideration.*

IT IS permitted to say here publicly for the first time that the Council of National Defence has been studying the subject of readjustment and reconstruction for a long time, with a view to coördinating various Government activities in Washington which have had readjustment and reconstruction for their objects. When President Wilson recently set up the War Industries Board under the chairmanship of Mr. Bernard M. Baruch as a separate agency, divorcing it from the Council of National Defence, the latter organization was left with little work to do, and with few prominent men remaining in its personnel.

There is reason to believe that the Council of National Defence has resolved to undertake the work of readjustment and reconstruction if permitted to do so by President Wilson, and there is also reason to believe that the President will assent, under the urging of Secretary of War Baker, chairman of the council, acting in behalf of himself and the other five members of President Wilson's cabinet who compose the Council of National Defence.

A Logical Step

In Washington official circles there is an impression that this would be a logical step, inasmuch as a number of cabinet officials have begun making public details of readjustment and reconstruction ideals upon which their own departments and bureaus have been separately at work, following the advocacy of such a readjustment and reconstruction agency in the McGraw-Hill engineering publications; and there is ground in Washington not only for the impression but for the strong belief that if the Council of National Defence is authorized by the President to begin work on readjustment and reconstruction problems, W. S. Gifford, Director of the Council, will not only set to work at once to coördinate all the work being done separately in the various departments, but will undoubtedly call into consultation and activity at Washington men in private industry of the type suggested in the first article in this series, which was put forth as a method of crystallizing opinion in favor of a readjustment and reconstruction agency and obtaining action to create one. In other words, it is expected in Washington that if the President assents, the Council of National Defence will be newly created by the appointment of a large number of committees of important men of the type suggested in the first article in this series, taken from the ranks of private endeavor, to solve now the after-the-war industrial problems of this country, as England is now doing, and a description of which is published in another part of this issue of this publication.

Before this is published the question of what character of readjustment and reconstruction agency shall be established may have been settled. It is possible that when the news announcement of the Government's intentions in this respect is made it will have been found that after due consideration it might be more wise to commit the work of readjustment and reconstruction to an agency other than the Council of National Defence; but the subject is now being discussed on all sides in Washington, and letters and telegrams from all over the country are being received in Washington urging the creation of such an agency at once.

A Letter of Indorsement

From Philip H. Gadsden, chairman of the National Committee on Public Utility Conditions, comes a letter strongly indorsing the idea of action. The National Committee on Public Utility Conditions, which includes E. K. Hall, H. H. Crowell and A. S. Hills, executive secretary, represents in Washington the National Electric Light Association, the American Electric Railway Association, the American Gas Institute and the National Commercial Gas Association. Mr. Gadsden says:

"It is coming, I think, to be more and more generally realized that the problems which the industrial world will have to face after the war in the readjustment of our economic life will be more serious than even the problems which we are now called upon to meet. Your suggestion, therefore, that the President at this time appoint a commission on readjustment and reconstruction, in my judgment, is a very timely one.

A Lesson From the War

"The great lesson which this war has impressed upon everyone is the efficiency resulting from great concentration of capital and labor. The benefits derived by the nation for war purposes in the mobilization of practically all the industries of the country will not be lost sight of when peace comes. To deal properly with such a radical change in our economic policy will call for all the wisdom at our command. Nothing could aid so much in the proper solution of such a problem as a thorough and comprehensive study of it in advance, such as you suggest."

From the Permutit company, engaged in water rectification and general sanitation in New York, comes this letter signed by Samuel Robert, president of the company: "As we see it there can hardly be room

for doubt as to both the usefulness, and indeed the necessity, for the work of the nature referred to and that this work should be done as quickly and as thoroughly as possible. We can think of no better way to prepare the groundwork essential to the proper accomplishment of this vital project (vital to the future benefit of the industries of this great country) than by having a commission appointed as quickly as possible for the express purpose of investigating the necessary steps needed to prepare for its accomplishment, and then to put into effect as thoroughly as possible the means needed for its fulfillment. We are in hearty accord with this movement."

From Charles F. Lang, president of the Lakewood Engineering Co., Cleveland, Ohio, comes this letter: "While our company is working night and day on war service for the Government and is constantly endeavoring to expand its usefulness in this direction all our planning is being done with a view to world-trade conditions after the war, for we feel that we but dimly realize the demands which world trade will make upon American manufacturers in the reconstruction period immediately following the war. And we also recognize the period of tremendous readjustment which must take place in our own country. National conditions and national ideals are entering a violent revolution rather than a slow evolution, and I sincerely trust that the very constructive program suggested by you will receive serious consideration and prompt action on the part of the Government, for the problems involved are not merely national, but they are world problems; and individual thinking by individual business men is hopeless—the nation must think and plan as a nation."

Letter From Mr. Filene

From the great merchandising house of William Filene Sons Co., Boston, Mass., comes this letter, signed by Edward A. Filene, its president, who is chairman of the War Shipping Committee of the Chamber of Commerce of the United States: "I am in entire agreement with your suggestion that such preparation should be under way. Unless there is created a governmental agency for this undertaking, an agency thoroughly representative of all classes and interests, these problems will be taken up separately by the various classes and interests. If the bulk of the reconstruction planning is left to separate classes and interests, we shall come to the end of the war with a series of reconstruction programs. Business will have a program; labor will have a program; agricultural interests will have a program; banking interests will have a program, and all other vital interests will have some kind of a program. And at the very moment when unity of purpose and promptness of action will be vital to the welfare of the country we shall be obliged to pay the price of costly delay incident to the harmonizing of these several programs of reconstruction. It is clearly the wise policy to create a Government commission so thoroughly representative of all classes and interests that it will command the support of all classes and interests. If such a commission collates its facts, formulates its conclusions and submits them in advance to the most exhaustive criticism from all possible angles we shall be able to get most of the work of compromise out of the way by the end of the war and arrive at the time of action with a unity of purpose and policy otherwise impossible. I realize the question of tactics and timeliness involved in any proposal today not related to the immediate job of prosecuting the war; and yet the war will end some day, and whether that time be one year or 20 years from now, the time will be none too long for the analysis of the complicated problems that underlie the return of our social, industrial and political life from a war basis."

National Research Council to Become a Permanent Body

The National Research Council is to become a permanent body in order to coördinate the developments of the various sciences. Organized in 1916 at the request of the president of the National Academy of Sciences under a congressional charter, it has demonstrated its capacity for larger service. The National Academy of Sciences is therefore requested by the President to perpetuate the National Research Council, whose duties are outlined as follows:

1. In general to stimulate research in the mathematical, physical and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts, with the object of increasing knowledge, of strengthening the national defence and of contributing in other ways to the public welfare.

2. To survey the larger possibilities of science, to formulate comprehensive projects of research and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

3. To promote coöperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication and stimulate progress; but in all coöperative undertakings to give encouragement to individual initiative as fundamentally important to the advancement of science.

4. To serve as a means of bringing American and foreign investigators into active coöperation with the scientific and technical services of the War and Navy departments and with those of the civil branches of the Government.

5. To direct the attention of scientific and technical investigators to the present importance of military and industrial problems in connection with the war, and to aid in the solution of these problems by organizing specific researches.

6. To gather and collate scientific and technical information at home and abroad in coöperation with governmental and other agencies, and to render such information available to duly accredited persons.

Effective prosecution of the council's work requires the cordial collaboration of the scientific and technical branches of the Government, both military and civil. To this end representatives of the Government, upon the nomination of the National Academy of Sciences, will be designated by the president as members of the council as heretofore, and the heads of the departments immediately concerned will continue to coöperate in every way that may be required.

EDITORIALS

The Duty of the Engineer

NEVER was there such a need for high-grade, experienced engineers, and never has there been such an opportunity for men of this kind to serve their country and the cause of humanity in general. And yet in too many cases men of this caliber have held back because of personal reasons.

It is not easy to give up a large salary and to accustom oneself to a lower living standard, especially when we are approaching the meridian of life. But we must not forget that thousands of our boys are giving up good positions, often sacrificing the future, for $30 a month and the prospect of mud and trenches, not to mention danger, wounds and, possibly, death.

The country needs the brains and the experience of its best men as never before. It offers them as good a monetary return for their services as the laws permit and it has the right to demand that these services be given freely. For unless the country is made secure against the German idea, the large salaries and comfortable positions will be of little value.

We must not forget that hundreds of capable officers are devoting their lives to the cause at a salary which would be insignificant in any private business. Can the engineer allow himself to appear less patriotic, less devoted to his country, less willing to make his sacrifice than the man in khaki?

Every engineer in this great country of ours should ask himself earnestly and honestly whether he is doing his best in this crisis; whether he cannot be of more value in some government position than where he is at present. It is much more pleasant to stay at home and salve the conscience with the belief that he is on war work. But the real question is, "Could I be of more service elsewhere?"

The machine-tool program alone will need many capable engineers. The more of them we have the fewer mistakes we shall make in the selection and distribution of machines. And unless the industry can and will supply the men it must refrain from criticising mistakes made by those who are probably doing the best they know.

We have opposed and still oppose the practice of granting military commissions to civilian engineers. It is unfair to the real army man and a handicap to the engineer. But present conditions seem to make this procedure necessary, and as long as this is the case personal prejudice must not stand in the way of rendering service. If it can be shown that you can be of more real service in the army organization, that is the place for you to be.

The Ordnance and other departments are looking for good men, for men who can secure results which will expedite all the work which must be done. Every engineer should stand ready to help to the utmost of his ability. His special qualifications should be known to the department. And should he be asked to help in any capacity he should not let personal prejudice or preference keep him from going into the service.

This is the age of engineering and the engineer must come into his own. But he must be as ready for service as the men in the trenches whenever the captain calls for volunteers for some dangerous mission. The engineer deserves a high place in the councils of the country and in every community. But this can only come from a willingness to serve to the best of his ability in whatever line the service may be needed.

The Rights of the Public

NOTHING is more significant of the advent of newer and broader ideas regarding the duty of the individual to the community than the action of the American Society of Mechanical Engineers in voting to rewrite its code of ethics. The unanimity with which the action was taken indicates the quickening of the spirit, of the feeling of public responsibility and of real fellowship, which has been accelerated by the war.

The same attitude of mind is beginning to manifest itself in the conduct of business, and it is sure to grow. The war is teaching us that no individual is independent of the community or of the world; that no country can survive without the concerted action of all, regardless of individual success or profit.

When it becomes the custom to consider the effect on the public in planning new enterprises, in erecting new factories and in other commercial undertakings, we shall have a much more agreeable world to live in, and the community will be much more desirable in every way. Nor must it be thought that this means the giving up of our individuality. It means instead that each of us will be more thoroughly alive to his individual opportunities and will get far more satisfaction by being able to use them for the general good.

Order Your Coal Now

WE ARE asked to urge every reader of the *American Machinist* who has not already done so to order his coal for next winter now. Only by anticipating the demand and keeping the mines running as full as possible during the summer can another coal famine be averted.

The work of the steel mills and the factories which supply the shipyards and all sorts of munitions must not be retarded. Their supply of coal must be kept going all through the year, and it is often impossible for them to order for a long period ahead.

Scores of ships were unable to leave their docks last winter because they had no coal in their bunkers, and the comfort and health of our boys on the other side was jeopardized thereby. That condition must not occur again, and it can be prevented only by moving domestic coal during the summer. It is clearly our duty to do what we can to relieve this situation.

The President's Letter to Workers and Employers

FOR more than a year it has been our pride that not our armies and navies only but our whole people are engaged in a righteous war. We have said repeatedly that industry plays as essential and honorable a role in this great struggle as do our military armaments. We all recognize the truth of this, but we must also see its necessary implications—namely, that industry, doing a vital task for the nation, must receive the support and assistance of the nation. We must recognize that it is a natural demand—almost a right of anyone serving his country, whether employer or employee, to know that his service is being used in the most effective manner possible. In the case of labor this wholesome desire has been not a little thwarted owing to the changed conditions which war has created in the labor market.

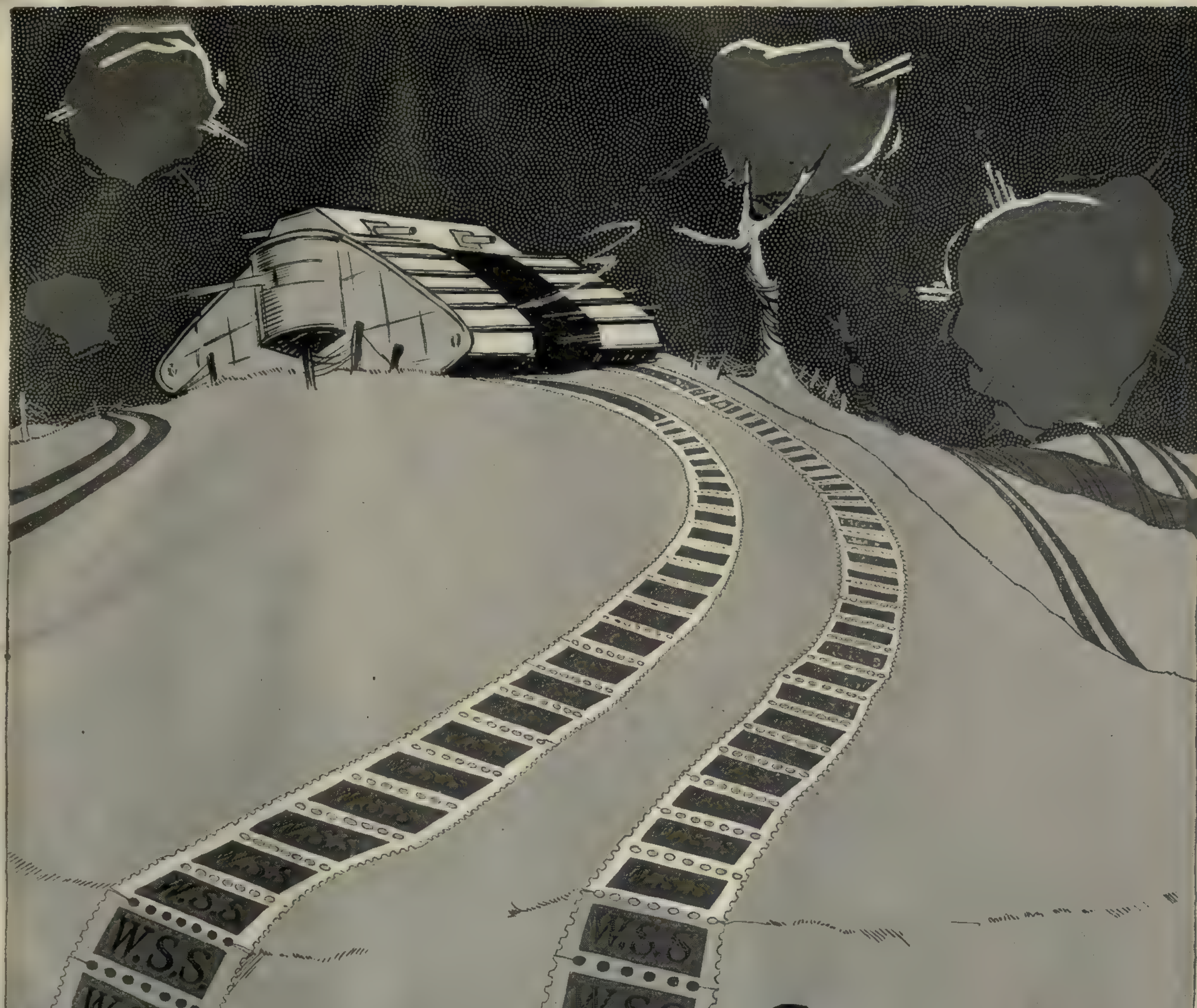
There has been much confusion as to essential products. There has been ignorance of conditions—men have gone hundreds of miles in search of a job and wages which they might have found at their doors. Employers holding Government contracts of the highest importance have competed for workers with holders of similar contracts, and even with the Government itself, and have conducted expensive campaigns for recruiting labor in sections where the supply of labor was already exhausted. California draws its unskilled labor from as far east as Buffalo, and New York from as far west as the Mississippi. Thus labor has been induced to move fruitlessly from one place to another, congesting the railways and losing both time and money.

Such a condition is unfair alike to employer and employee, but most of all to the nation itself, whose existence is threatened by any decrease in its productive power. It is obvious that this situation can be clarified and equalized by a central agency—the United States Employment Service of the Department of Labor, with the counsel of the War Labor Policies Board, as the voice of all the industrial agencies of the Government. Such a central agency must have sole direction of all recruiting of civilian workers in war work; and, in taking over this great responsibility, must at the same time have power to assure to essential industry an adequate supply of labor even to the extent of withdrawing workers from nonessential production. It must also protect labor from insincere and thoughtless appeals made to it under the plea of patriotism, and assure it that when it is asked to volunteer in some priority industry the need is real.

Therefore, I, Woodrow Wilson, President of the United States of America, solemnly urge all employers engaged in war work to refrain after Aug. 1, 1918, from recruiting unskilled labor in any manner except through this central agency. I urge labor to respond as loyally as heretofore to any calls issued by this agency for voluntary enlistment in essential industry. And I ask them both alike to remember that no sacrifice will have been in vain if we are able to prove beyond all question that the highest and best form of efficiency is the spontaneous coöperation of a free people.

WOODROW WILSON.

THE WHITE HOUSE, June 17, 1918.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Stamps
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way to
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This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist"

Duff Heavy-Duty Turret Lathe

In the illustrations two views are shown of the new heavy-duty, 26-in. turret lathe built by the Duff Manufacturing Co., Pittsburgh, Penn., for the heavy work encountered in machining ammunition and other such work. It is said to be new in design, incorporating many improvements over the conventional type of boring and turning lathe, resulting in stout construction that is able to withstand severe and unusual strains. The control of the machine is accessible at all times to the operator, thus reducing to a minimum the amount of actual labor required in operation. The length over all is 13 ft. 7 in. and the swing over the ways is 27 in. Mounted on the top of the headstock is a 20-hp. motor from which power is transmitted to a driving gear $10\frac{1}{2}$ in. in diameter (constant speed 1000 r.p.m.) at the rear of the headstock by means of a silent chain drive, and thence through a train of gears to the spindle.

Twelve mechanical changes of speed are provided for—open and reverse—giving a range of from 6 to 1 on low gear and 174 to 1 on high gear. Located just behind the chuck at the top of the headstock is the starting, stopping and reversing lever.

The spindle is a hammered steel forging, heat treated and ground, and at the rear is placed a ball thrust bearing. To insure lubrication of the spindle a well is provided in the cap from which wicks lead, covering the full length of the bearing. The hole through the spindle is $7\frac{1}{8}$ in. in diameter and the chuck is 20 in. in diameter and of the compound, three-jaw, universal type.

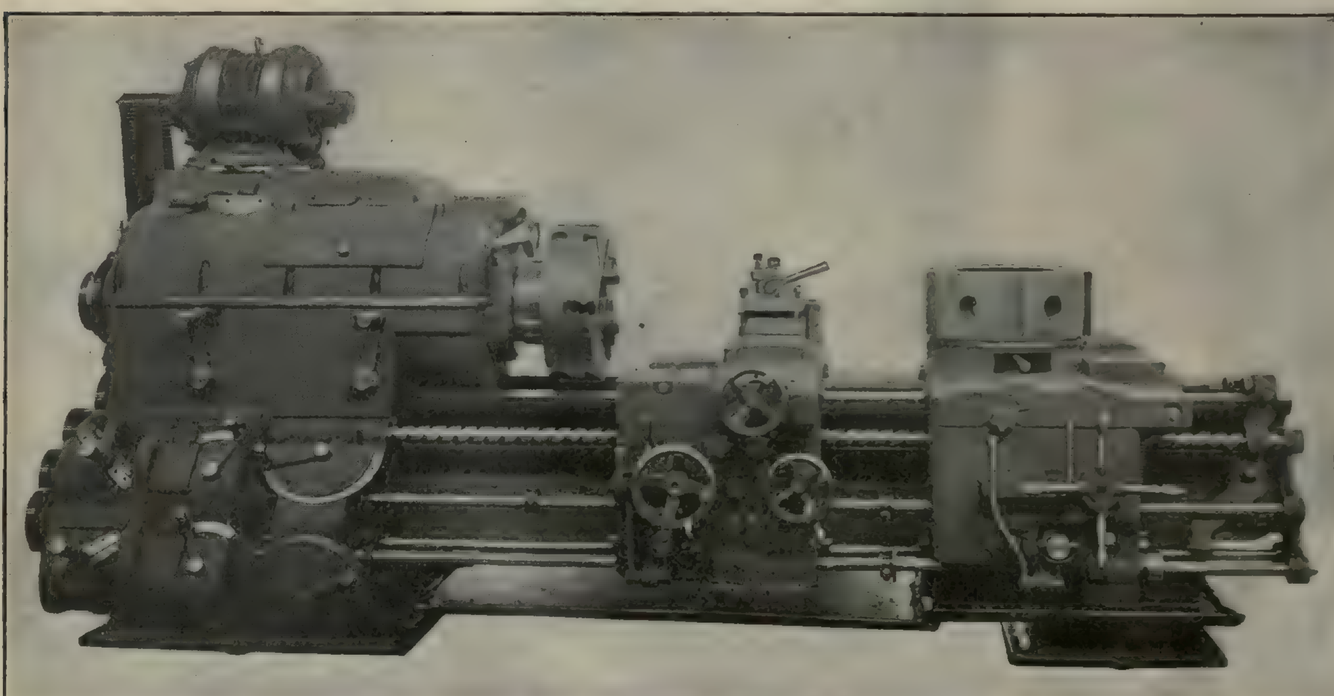


FIG. 1. DUFF, 26-IN. HEAVY-DUTY TURRET LATHE

Length over all, 13 ft. 7 in.; swing over ways, 27 in.; motor, 20 hp.; diameter of driving pulley, $10\frac{1}{2}$ in.; speed of driving pulley, 1000 r.p.m.; diameter of hole through spindle $7\frac{1}{8}$ in.; chuck, 20-in.; diameter of tool holes in turret, $3\frac{1}{2}$ in.; distance across turret flats, 21 in.; speeds, 12. Also built as an engine lathe with speeds up to 12, feeds up to 10, with hole through spindle up to 10 in., and any length of bed

The turret is of the broad-faced, hollow, hexagon type, containing tool holes $3\frac{1}{2}$ in. in diameter and measuring 21 in. in diameter across the flats. The turret rests on a base 30 in. in length, and is clamped thereto by means of the handle shown at the base of the turret. This clamp handle permits a clamp over the

entire surface of the turret base. The turret carriage has a travel of 45 in. and is of the automatic indexing type.

The geared feed changes of the turret are absolutely independent of the toolpost feeds, resulting in the advantage that a very fine feed can be used for boring or facing, and at the same time a very coarse feed can be used for the toolpost. The long lever provided at the left of the turret apron is the quick-return lever, which provides for the operation of the turret forward with the same speed that is obtained in reversing. The feed lever is located to the right of the quick-return lever. A large pilot wheel is used on the turret apron for operating the turret backward and forward by hand. Adjustable, automatic knockout stops are provided. Feeds can also be engaged or tripped as desired, by hand operation by use of the feed lever shown on the turret apron.

The toolpost carriage has front and rear tool slides with power and hand feed in both directions. Either

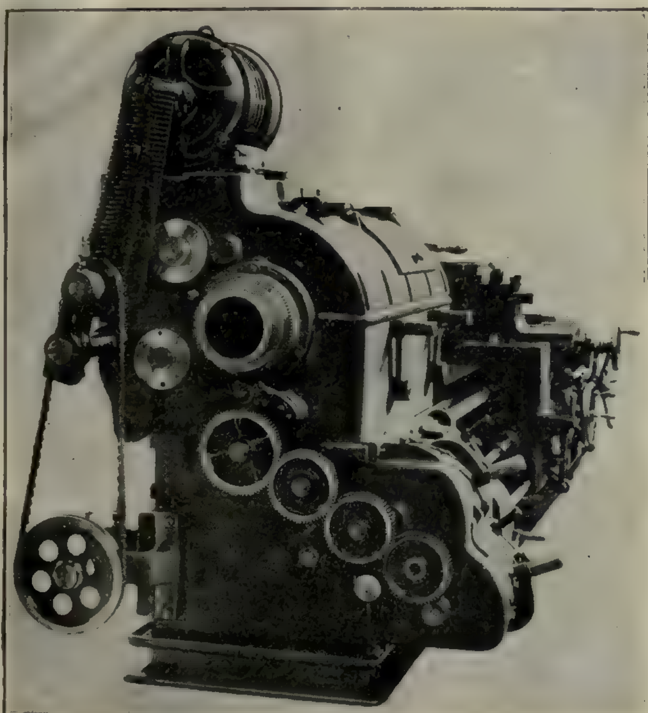


FIG. 2. END VIEW OF DUFF LATHE

toolpost can be clamped and locked in any one of a number of positions—they operate entirely independent of each other. The toolposts are of the side-carriage type and can pass completely by the chuck, permitting greatly increased capacity in relative swing over the carriage, increasing the range of chucking work accommodated, and also permitting the toolpost to be out of the way when using the tools in the turret, it being possible to bring the turret head up close to the chuck. The carriage can be clamped to the bed to hold it in a fixed position.

The toolpost feeds are independent of the feeds to the turret. The feed changes for the toolpost carriage are so arranged that it is possible to instantly shift from any heavy roughing feed to a proper finishing feed, all feeds being reversible. Adjustable automatic trip-off stops are provided Feeds can be engaged or tripped at will by hand through the use of the lever handle at the right of the quick-return lever. Three handwheels are provided on the apron, one each for adjusting the two toolposts, and one for advancing or reversing the carriage.

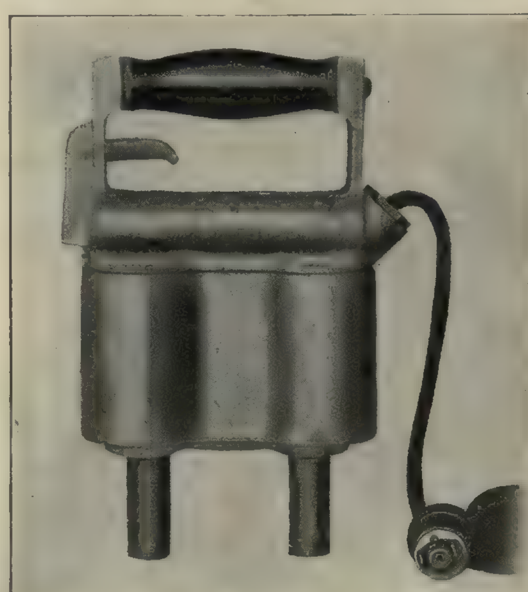
One of the most notable features is the system of lubrication. This is taken care of by a single pump located at the rear of the headstock and driven by the lathe motor. By means of this pump every point in the machine demanding lubrication is automatically taken care of.

The machine has been made as fool proof as possible, the danger of stripping gears through changing spindle speeds while the lathe is in operation being eliminated by the use of a safety governor, which works automatically, unlocking and allowing the changing of spindle speeds only when the machine has been thrown out of motion. Another feature is the use of a knockout box containing a train of gears, acting on the feed shafts, and controlled by two handles, which are used for reversing the feed shafts.

This machine can be built as an engine lathe, and as such it will handle up to and including 15-in. shells. It can be furnished with any number of speeds up to 12, with any number of feeds up to 10, with any size of spindle hole up to 10 in., and with any length of bed.

Cutler-Hammer Hand Magnet

The illustration shows the latest type of hand magnet being manufactured by the Cutler-Hammer Manufacturing Co., Milwaukee, Wis. The device is for use on 110- or 220-volt direct-current circuit and is furnished complete with 5 ft. of reinforced flexible cord and standard separable attachment plug. It is used for handling



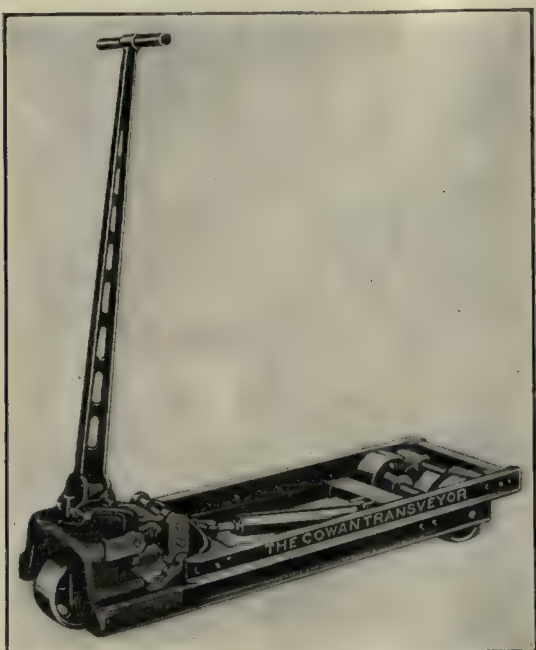
CUTLER-HAMMER HAND MAGNET

small parts of iron or steel in quantities, for separating small iron or steel parts from brass, recovering nails from sweepings, and other like usages. The circuit for the coils is opened or closed by means of the large trigger seen directly beneath the handle, this operating a quick make-and-break snap switch concealed in the cast-aluminum yoke cover. Magnetic coil switch connections, etc., are all covered by two aluminum castings, the upper

one forming the handle support, switch cover and yoke cover, while the lower covers the coils and leaves only the soft iron poles projecting. This device is designed for ordinary intermittent service, that is, it is magnetized or demagnetized as desired, but in case they are needed magnets for continuous service can be furnished.

Cowan Model G Transveyor

The illustration shows the latest addition to the line of transveyors manufactured by the Cowan Truck Co., Holyoke, Mass. This is known as the company's Model "G" machine. The leverage of the handle is such that the

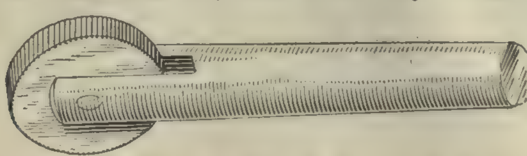


COWAN MODEL G TRANSVEYOR

maximum load can be elevated by one man, and several sizes are made with capacities from 1000 to 3000 lb. An improved locking device is incorporated, designed chiefly to safeguard against the load becoming unseated when trucking over uneven floors. It is claimed that the ease and quickness with which the truck can be operated make it particularly desirable.

"Sectostyle" for Section Lining

The illustration shows the working end of the "Sectostyle," which is a new instrument for draftsmen, that has been placed upon the market by the American Sales Co., 311 West 59th St., New York City. This device



"SECTOSTYLE" FOR SECTION LINING

consists of a handle with a pivoted tooth and wheel which the draftsman impresses into the paper on some convenient part of the drawing which is to be cross-hatched, the instrument being held in the hand and moved along the edge of a tee square or triangle in a like manner to that in which a pencil is used. By applying a slight pressure a series of short parallel lines are produced, which serve as a guide for spacing the lines. The guide lines are almost invisible except when being actually used, and do not appear in any reproduction of the drawing. Various spacing of the cross-hatching lines can be obtained by skipping a certain number of the guide lines, and this is done almost automatically after two or three lines have been drawn. It is also said that by using carbon paper and the edge or corner of the toothed wheel that dotted lines may be produced. The handle of the instrument is of german silver and the toothed wheel of tool steel.

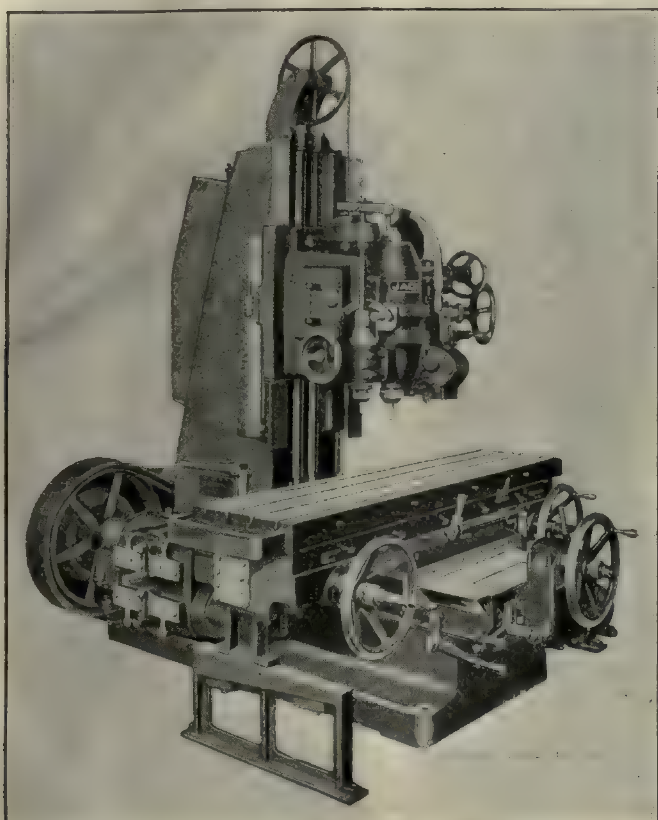
Jackson No. 10 Duplex Typeless Die-Sinking Machine

The machine illustrated is one of the recent products of the Jackson Machine Tool Co., Jackson, Mich., and is known as the company's No. 10 duplex typeless die-sinking machine. It is for use in machining drop-forging dies, ranging in size from the smallest up to those weighing four or five thousand pounds. It is claimed that the machine will finish intricate shapes with little or no hand labor. The base carries the cross-rail, which in turn carries the table. The column is bolted to the base and carries the head. The cross-rail, table and head are provided with both hand and power feeds in all directions, rapid traverse power feed being also furnished. The power feed is automatically disengaged when the rapid traverse is thrown into operation, an interlocking device preventing the rapid traverse being thrown in for the same direction as the feed. All auxiliary devices, such as the speed-changing, feed-changing and reverse mechanism, are assembled on separate brackets, or frames, to allow quick removal. The head carries three cutting tools and is counterweighted with weights somewhat heavier than the head. This feature of construction takes up lost motion and makes it necessary to operate the feeding mechanism to advance the cutters into the work. The large spindle is located at the center, the small spindle at the left and the cherry-tool mechanism at the right.

The cherry tool and the mechanism for operating it are claimed to be the novel features of the machine. The tools are made in the form of semicircular disks and usually have a thickness small in comparison with the diameter. The sides of the cutter have a taper in order that draft will be formed in the depression in the die block. Cutting teeth are formed on the periphery and sides of the cutter. Projecting from what corresponds to the flat edge of the semicircular disk is a round shank which is inserted and secured in the toolholder, which is a flat piece of steel, triangular in shape, having a flat surface at the apex of its lower corner. In this flat surface is the hole in which the shank of the cutter is inserted. On each side of the toolholder and integral with it is a curved strip moving in circular guides in the cherry-tool housing. The center of these guides coincides with the center of the cherry-tool cutter. The holder is given an oscillating motion by means of a connecting-rod attached to a projection from its upper edge, and also has a small vertical movement so timed that the cutter is lifted from the metal on its return stroke and again lowered on its cutting stroke. When the cutter is inserted in the cutter holder, the plane of the semi-disklike cutter being in the same plane as that of the toolholder, the cutter is given an oscillat-

ing motion along with that of the toolholder, the center of the oscillation being the center of the semicircular disk cutter. When in operation the cutter starts on its forward or cutting stroke; it at the same time lowers into a position for removing metal from the die block. When near the end of the cutting stroke the cutter rises out of its cutting position and remains up until it again starts on its cutting stroke.

The cutter may be fed by hand or power vertically downward into its cut or longitudinally in the direction of the axis of the cutter, and is raised and lowered on its return and cutting strokes by means of a cam locat-



JACKSON NO. 10 DUPLEX TYPELESS DIE-SINKING MACHINE

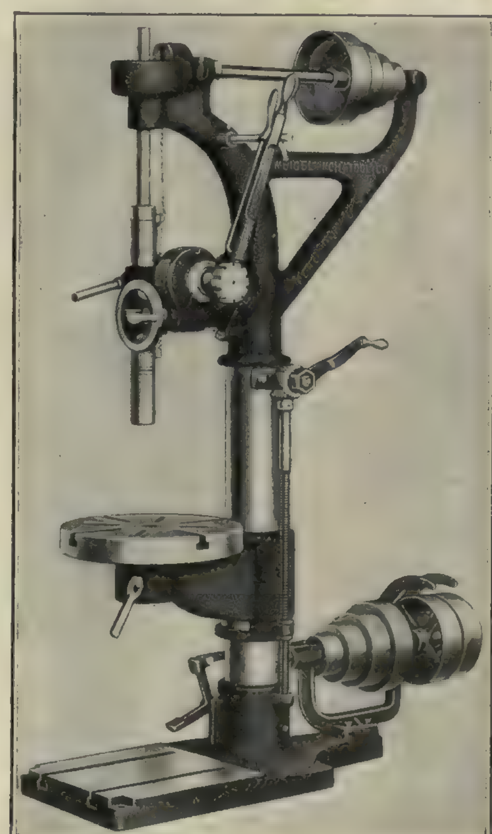
Vertical movement of head, 27 in.; center of spindle to face of column, 18$\frac{1}{2}$ in.; maximum distance from table to end of spindle, 30 in.; taper hole in large spindle, No. 13 B. & S.; speeds of large spindle, nine, 40 to 413 r.p.m.; speeds of small spindle, nine, 80 to 826 r.p.m.; strokes per minute of cherrying tool, nine, 13 to 138; vertical feeds, nine, 0.0002 to 0.0031 in. per spindle revolution; horizontal feeds, nine, 0.0014 to 0.0187 in. per spindle revolution; vertical feeds per stroke of cherrying tool, nine, 0.0007 to 0.0093 in.; horizontal feeds per stroke of cherrying tool, nine, 0.0043 to 0.0562 in.; cross travel, 18 in.; longitudinal travel, 56 in.; working surface of table, 18 x 72 in.; diameter of driving pulley, 20 in.; face of driving pulley, 4$\frac{1}{2}$ in.; net weight, 12,000 lb.

ed inside of the head. Its action is such that the cam lifts the cutter out of its cutting position and a strong spring pulls the cutter into it. The strength of the spring, however, is such that the cutter cannot be overloaded by taking too heavy a cut, for before any damage can be done to it the spring will yield and a shallower cut will be taken.

The large spindle has a taper journal at the lower end and a self-aligning radial ball bearing at the upper end. The lower end is provided with a No. 13 B. & S. taper hole and a chuck for holding straight-shank cutters. The small spindle is mounted on cone bearings and equipped with a chuck for holding straight-shank cutters formed partly in the lower end of the spindle and partly by a draw-in collet and nut threaded onto the lower end of the spindle. A box-shaped bracket bolted to the side of the base contains the speed-changing mechanism, while the feed-changing mechanism is of similar design and construction, and is located on the opposite side of the base. Power is transmitted through a friction-clutch pulley 25 in. in diameter with a 4$\frac{1}{2}$-in. face, the machine being furnished for belt or motor drive as desired. All control levers may be reached from the operator's position at the front of the machine, and automatic stops are provided to prevent overtravel of any of the moving members.

Weigel 20-In. Drilling Machine

The illustration shows a 20-in. vertical drilling machine that has recently been placed on the market by the Weigel Machine Tool Co., Peru, Ind. The base is ribbed and braced beneath to prevent springing under heavy work and is provided with two T-slots for clamp-



WEIGEL 20-IN. WHEEL AND LEVER DRILL

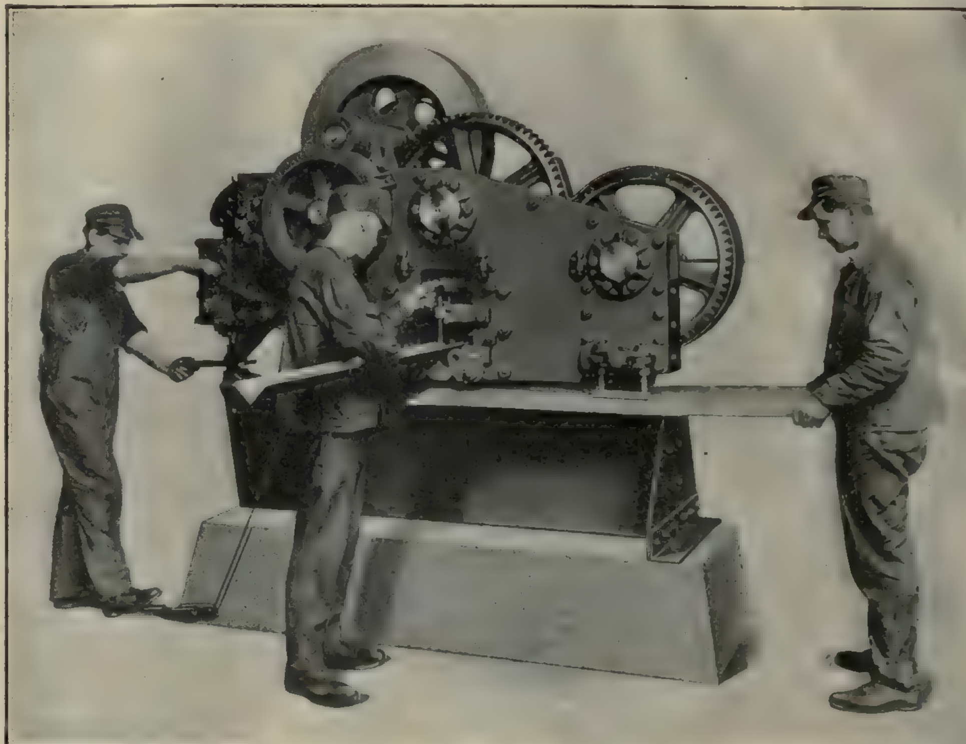
Maximum height with spindle extended, 6 ft. 3$\frac{3}{4}$ in.; height to top of cone, 5 ft. 10$\frac{3}{4}$ in.; drills to center of 20$\frac{1}{2}$ in. circle; distance from base to spindle, 37$\frac{1}{2}$ in.; distance from table to spindle, 19$\frac{3}{8}$ in.; traverse of table on column, 17 in.; traverse of spindle, 8 in.; taper in spindle, Morse No. 3; diameter of table, 16$\frac{1}{2}$ in.; diameter of spindle above sleeve, 1$\frac{5}{16}$ in.; diameter of spindle in sleeve, 1$\frac{7}{16}$ in.; diameter of sleeve, 2$\frac{1}{4}$ in.; diameter of column, 5$\frac{1}{2}$ in.; ratio of bevel gears, 2 to 3; diameter of large step on cone, 9 in.; diameter of small step on cone, 4 in.; face of cone pulleys, 2$\frac{1}{4}$ in.; weight on skids, 700 lb.

ing work. The column is also braced and split bearings are used for the upper driving shaft in order that adjustment may be made in case of wear. The head is stationary, the spindle being operated either by means of a handwheel or lever as desired. Means are provided for taking up wear in the spindle, which is made of steel ground to size. End thrust on the spindle is carried on ball bearings, while the spindle sleeve is ground to size and fitted with bronze bushings. The table arm has an enlarged circular support for the table

and is raised and lowered by means of a screw and pair of miter gears operated by means of a crank. Where large work is handled, which can be more conveniently placed on the base, the table can be swung around the column out of the way. The shifter is located at the base of the machine convenient to the operator's foot.

Buffalo Universal Slitting Shear

The Buffalo Forge Co., Buffalo, N. Y., is now manufacturing the No. 25 universal slitting shear shown in the illustrations. This machine is of such construction that shearing, punching and cutting operations can be carried on simultaneously, and is made entirely of steel plate instead of cast iron, which is used for most machines. The machine is built for either belt or motor drive, and all gears are machine cut from steel, while all bearings are bronze bushed. Plates of any width or length may be slit, and sheets, channels, I-beams or other special sections may be punched, while angles and Ts may be cut and mitered. By the use of special knives channel beams and other rolled sections may be cut. The machine is operated by a foot treadle or hand lever, and any one of the three operations may be performed independently of the other two. Fig. 1 shows a general view of the machine, Fig. 2 a close view of the shear, Fig. 3 a close view of the punch and Fig. 4 a close view of the bar cutter. On the punch end, in addition to the gag operated either by foot or by hand, a second gag operated by a handle is used in place of the customary handwheel for bringing the punch down on the work, so as to locate center marks, etc. The shear engagement is by means of a jaw clutch, and the stripper is adjusted by means of two gears operated through a crank and pinion. Fig. 4 shows the adjustment of the stops which are used for mitering.

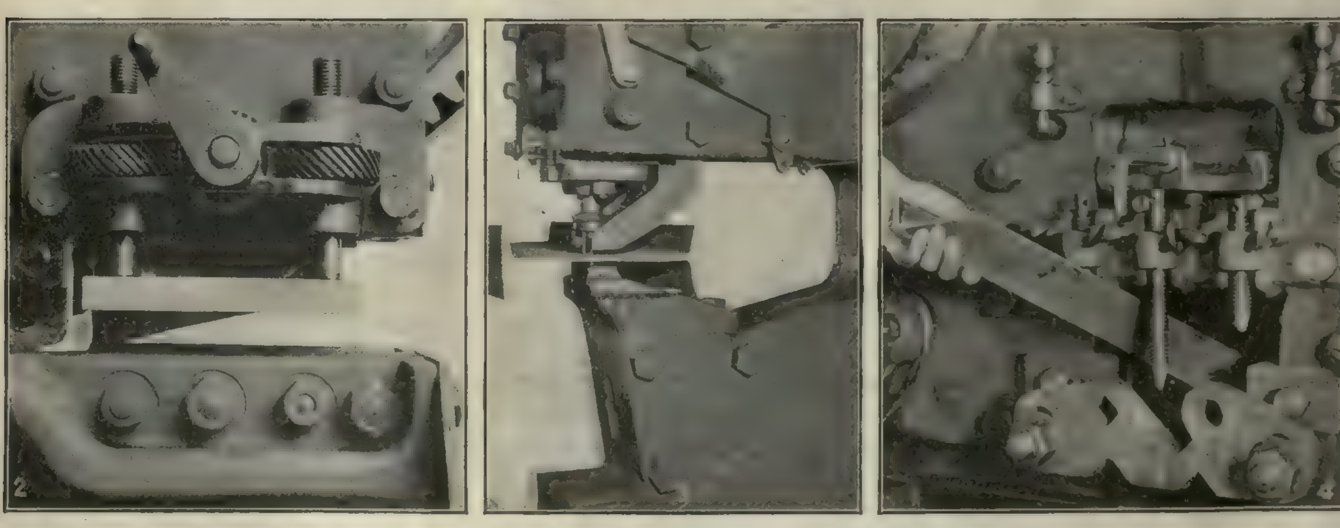


BUFFALO NO. 25 COMBINATION SLITTING SHEAR, PUNCH AND BAR CUTTER

Shear: Capacity, plates up to ⅝ in. thick and flats up to 3 x ¾ in.; length of knives, 8 in.; strokes per minute, 25. Bar Cutter: Angles squared, 4 x ½ in.; angles mitered, 2½ x 5/16 in.: Ts, 3½ x ⅜ in.; rounds, 1½ in.; squares, 1¼ in.; I-beams, 6 in.; channels, 6 in.; strokes per minute, 25. Punch: Capacity, up to 1-in. hole in ⅝-in. plate; stroke, 1 in.; strokes per minute, 25. Horsepower required, 5; motor recommended, 7½ hp.; revolutions per minute of high-speed shaft, 350.

Ulrich Index Clip for Rolled Drawings

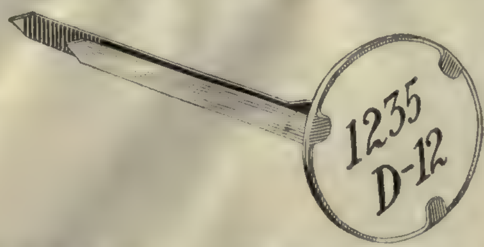
The clip or tag illustrated is one of the recent products of the Ulrich Planfiling Equipment Co., Jamestown, N. Y., and is used on rolled drawings or papers to prevent unrolling and also for indexing or recognition purposes. As will be noted the device consists of a round holder having three small projections, by means of which a small, round pasteboard card for indexing in-



FIGS. 2 TO 4. DETAILS OF THE COMBINATION SHEAR AND PUNCH

Fig. 2—A close-up view of the shear. Fig 3—A close-up view of the punch with I-beam in place. Fig. 4—The bar cutter

formation is held. Fastened to the back is a bent portion which slips over the edge of the rolled drawing, holding it firmly. The rolled drawing may then be filled in such a manner that the end shows, and any particular one can be quickly recognized by the information



ULRICH INDEX CLIP FOR ROLLED DRAWINGS

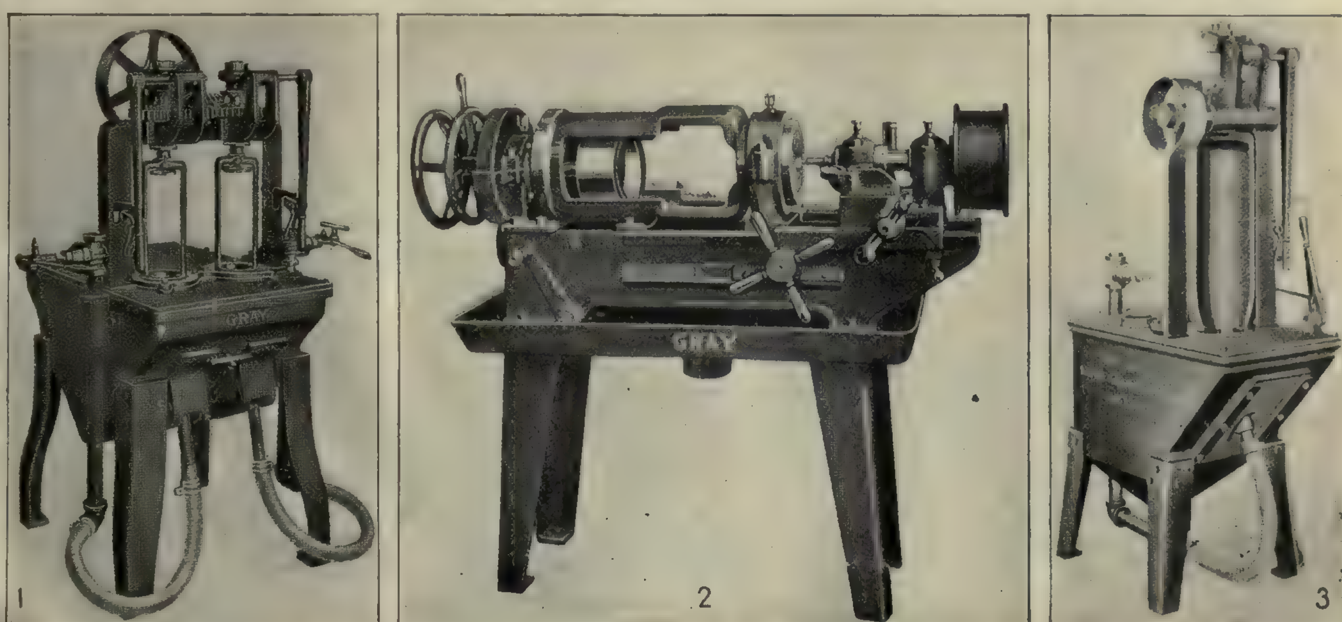
inscribed on the index card. The device can also be used in other similar indexing work. The company also manufactures a line of filing cabinet, drawers and other devices of this kind.

Gray Shell Machinery

The Gray Machine Tool Co., Inc., 2661-2665 Main St., Buffalo, N. Y., is now manufacturing a considerable line of machinery adapted for use in the manufacture of shells. A number of the different machines are shown in the illustrations. Fig. 1 shows a blast machine for cleaning the inside of 75-mm. shells with steel grit or steel shot. This machine is similar in operation to those used in sandblasting and is equipped with a large hopper and two shell holders and nozzle arrangements. After the shell is placed in position it is lowered so that the nozzle is inside of the mouth of the shell which revolves while in this position, the drive being imparted through miter and spur gears. The abrasive is drawn from the hopper by an air blast and cleans the inside of the shell in a few moments during which operation the operator is unloading and loading at the second station, the operation being thus rendered practically continuous. The two shell holders operate independently of one another and the drive is from a pulley 12 in. in diameter running at a speed of 100 r.p.m. The machine is said to be practically dust proof and to have a production of 60 or more shells an hour. The shipping weight is about 800 pounds.

Fig. 3 shows another shell-blast machine which is made in sizes suitable for cleaning 4.5-in., 5-in., 6-in. and 8-in. shells. This is a single-station machine, the shell being placed nose down over the nozzle and revolved while the blast is at work. The capacity of the machine is said to be from 30 to 50 shells an hour and its shipping weight approximately 700 pounds.

Fig. 2 shows the company's Size A thread-milling machine which is for milling the threads in the nose of 3-in., 75-mm., 4.5-in., 4.7-in. and 5-in. shells, at the same time trimming the fuse seat and making this surface true with the threaded hole. The work and cutter are driven by separate belts from the line shaft, clutches being provided in order to eliminate the countershaft. The lead on the thread is produced by moving the work spindle endwise as it revolves. A threaded sleeve on the spindle revolves in a nut, the latter being held stationary while the thread is being cut. During the facing operation this nut is locked to the spindle and revolves with it. The work-spindle bearings are extended to allow a maximum traverse of 2 in., the direction of rotation of the work spindle being such that the work travels away from the cutter while being operated upon. A special feature of the machine is the two-speed arrangement operated through gearing which allows the spindle to be driven at the proper speed for milling, or at a much higher speed for facing. The toolholder is mounted on the cutter slide and fitted to receive a $\frac{3}{8}$-in. square tool that can be ground to any shape desired All shaft bearings are bronze bushed and the main bearings are of cast iron polished and scraped to fit, compression grease cups being supplied throughout for lubrication. The cutter spindle is 2 in. in diameter



FIGS. 1 TO 3. THREE SHELL MACHINES MADE BY THE GRAY MACHINE TOOL CO.
Fig. 1—Machine for cleaning the inside of 75-mm. shells. Fig. 2—Size A thread-milling machine. Shells handled, 3-in., 75-mm., 4.5-in., 4.7-in., and 5-in.; weight, 1100 lb., floor space, 4 ft. 6 in. by 2 ft. 6 in.; work drive pulley, 8 in. in diameter for 3-in. belt; cutter-drive pulley, 9 in. in diameter for $3\frac{1}{2}$-in. belt; pump-drive pulley, 4 in. in diameter for 1-in. belt. Fig. 3—Shell-blast machine

and runs in adjustable bronze bushings, the front end being bored to receive a taper-shank cutter arbor, a draw-in rod being also provided. In chucking the work the front end of the shell is located by a conical ring while the rear end is held by another conical ring, which

FIG. 4. WASHING MACHINE FOR SHELLS UP TO 6 IN. IN DIAMETER

is pushed forward by a screw and handwheel at the tail end of the spindle. Lubricant is supplied to the cutter by a pump bolted to the back of the oil pan and driven by a belt from the line shaft. When so ordered additional

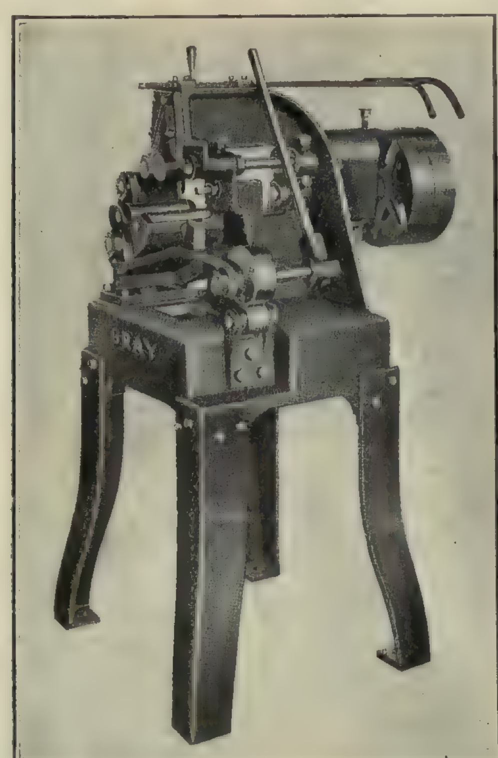


FIG. 5. SIZE A KNURLING AND BOURRELET-ROLLING MACHINE

parts can be supplied which permit the machine to be used for either the nose or base end of the shell, the change being easily made. Two other milling machines are made, Size B adapted for use on 6-in. and 155-mm. shells and Size C for use on 8-in., 9.2-in., 9.7-in. and 12-in. shells.

Fig. 4 shows a shell-washing machine that will handle shells 6 in. and smaller in diameter. This machine can also be supplied for larger shells if so ordered. It consists of a cast-iron tank with a rotary pump bolted at the back and pipes to two shell cups inside of the cover. Steam pipes for heating the cleaning liquid can be incorporated if desired. The capacity of the tank is approximately 40 gal., and it is divided into two compartments so that the dirt and cuttings remain in the first compartment while the water only can get back into the pump.

Fig. 5 shows the Size A knurling and bourrelet-rolling machine. This machine is designed for knurling the copper band groove on 3-in. and 75-mm. shells. With the two spindles and two knurls, as shown, the machine will double or cross knurl, but the machine as ordinarily supplied has but one spindle for a single knurling tool. In operation the machine is placed on the two lower rollers, the base is pushed against the stop, a lever is pulled and the work is done. It is claimed that the machine will knurl 3-in. shells as fast as they can be fed to it. For rolling the bourrelet a rolling tool is placed on the spindle in place of the knurl and a different set of rollers carry the shell. All tools and rollers are made of cast steel and are hardened. The drive is from the line shaft to a pair of tight and loose pulleys 12 in. in diameter with a 3-in. face, running at 325 r.p.m. The machine, as shown in the illustration, weighs approximately 700 pounds.

Howard L. Coburn, Prominent Civil Engineer, Dies

Howard L. Coburn, widely known as a civil engineer who had built more than 100 of the big dams in this and other countries, died recently in the Stern Sanitarium from pneumonia. Mr. Coburn was 52 years old and was born in Patten, Me. He was graduated from the Massachusetts Institute of Technology in 1887, and up to his death had been associated in its development. Immediately after his graduation Mr. Coburn designed some of the largest cotton mills and power plants in New England, and until 1904 he devoted himself to that phase of his profession. Coming to New York he became chief engineer and director of the Ambursen Construction Co., 61 Broadway, and in that capacity began the building of dams.

One of the most important of his works was the construction of the Guayabal Dam for the United States Irrigation Service in Porto Rico. He also put the Bassano Dam across the Bow River in Alberta for the Canadian Pacific Railway, and the Jordan River Dam on Vancouver Island, B. C. In this country he built the Shoshone and Laprelle dams in Wyoming, the dam at Akron, Ohio, and the Pittsfield Dam, located at Pittsfield, Massachusetts.

In addition to this work he was associated as consulting engineer with Henry L. Doherty & Co., E. W. Clarke & Co. and H. M. Byllesby & Co. Mr. Coburn was a member of the American Society of Civil Engineers, American Society of Mechanical Engineers, the Engineers' clubs of New York and Boston and the Technology Club. Mr. Coburn was unmarried and his only surviving relatives are three sisters.

The S. A. E. Meeting at Dayton, Ohio

SPECIAL CORRESPONDENCE

In view of the great amount of work being done along automotive lines in connection with the war the summer meeting of the Society of Automotive Engineers becomes doubly important. This meeting was almost entirely devoted to war work and very interesting exhibits were included.

THE summer meeting of the Society of Automotive Engineers in Dayton, Ohio, on June 17 and 18 was a great success from every point of view. The attendance was large, including men from Maine to California and from Florida to the extreme northern states. The weather was clear with a good air most of the time and nothing was left undone by the local committee to make the visitors have a good time.

It was a war meeting in every sense of the word, because every automotive problem has become a war problem as well. This was evidenced by the airplane and the tractor, together with the producing of fuel and the various details of construction of each.

The Liberty Motor

The meeting, it may be said, centered around the Liberty motor, and the notable part of the exhibit were two 12-cylinder Liberty motors, one complete and the other only partially assembled, with the parts displayed for inspection. There were also Liberty motors in a number of battleplanes, which flew at frequent intervals, as well as in two De Haviland battle planes which were in the exhibition hall.

Both the committee and the Government officials are to be congratulated for securing and for allowing this exhibition, which gave the visiting engineers an opportunity of seeing for themselves that both motors and planes are actually being manufactured and in fair quantities. The war is not going to be won by secrecy, but by the manufacturing of more of every implement of war than the enemy can possibly produce. The sooner we recognize this the sooner we shall have that surplus of material which will win the war.

The exhibit contained in addition to the Liberty motor two Hispaño-Suiza motors, a La Rhone, a Rolls-Royce, a Mercèdes, a Benz and a Renault; in addition there was a Mercèdes motor in a captured German Rumpler airplane. Then there was a French Spad, of which we might have had several hundred but for the canceling of an order last fall; a De Haviland battleplane and the original Wright machine as rebuilt owing to damaged parts. Besides this there were wings, ailerons, rudders and other members of the De Haviland machine and a working exhibit of propeller making, all from the Wright-Dayton plant. There was also an exhibition of machine-gun shooting between the propeller blades in a De Haviland battleplane.

Air exhibitions were frequent, one of a squadron in formation flying being particularly impressive. Stunt flying was also shown, and there was scarcely a time when some machine from one of the various fields could not be seen, while the whir of the Liberty motor became a common sound. A dirigible from the Goodyear plant in Akron about 200 miles away also made its appearance.

Another very interesting exhibit was that of army tractors of various sizes, mostly of the caterpillar type. These varied from a small machine which dragged a 3-in. gun over ploughed fields and up steep hills to a very heavy tractor with a 6-in. howitzer as a trailer. This machine pushed over good-sized trees after the manner of the tanks. A four-wheel-drive truck also showed its ability to climb hills. All were camouflaged.

No papers were available at the meeting owing to delays in censorship, but the subjects included "Petroleum Refining," by C. W. Stratford; "Heavy Fuel Engines," by C. E. Sargent and P. L. Scott; "Conventional Propeller Design," by F. W. Caldwell; "Present-Day Problems in Aeronautics," by W. B. Stout; "Airplanes of Today," by Fay L. Faurote; "Airplane-Engine Headers," by Archibald Block; "Comparison of Modern Aviation Engines," by Herbert Chase, and a symposium on "Tractor Development," by C. M. Eason, Dean Parrett, D. P. Davies and R. O. Hendrickson. A report on the International Aircraft Conference was made by C. M. Manly, while E. H. Ehrman told what had been done in standardizing screw threads, and a report was also made by Coker F. Clarkson.

The great event of the meeting was the dinner in honor of Orville Wright, who, as usual, acknowledged in silence the hearty welcome accorded to him. There were about 1200 persons present. President Kettering acted as toastmaster in his usual breezy fashion, and the speakers included General Kenly, Howard E. Coffin, Lieutenant Miozzi, of the Italian Aviation Commission; Colonel Deeds, Lieut.-Colonel Vincent and Dr. Stratton.

Quantity Versus Perfection

The trend of the speeches was to show what had been accomplished in both motors and planes. They emphasized the fact that what was needed was quantity production rather than perfection. When it is considered that practically all the criticism of the aircraft program has been in this connection, that we should have built the Spads which could have been in production months ago, this could hardly be called a defense or an explanation of the delays which have occurred.

It is interesting to know, however, that production on both motors and planes is progressing favorably, the former amounting to several hundred a week and the latter increasing rapidly. Motors from stock are placed in new machines that are flown without difficulty. A recent case was that of a large flying boat built at the naval aircraft factory in Philadelphia and carrying two motors. After a short trial over the river it flew to Hampton Roads, 280 miles away, without a single miss of either motor.

The work of training aviators is also of interest. There are over 150,000 men at the training camps, including mechanics. And when we read of an occasional fatality it is well to remember that students are now averaging 220,000 miles a day at all the schools, over eight times around the earth every day.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Shell-Turning Attachment

R. J. Whalen, 328 Fourth St., Elyria, Ohio

"American Machinist," June 6, 1918

This attachment is designed to be attached to any standard steam or air hammer or mechanical forging press in which the lower die is fixed. It is built at present for 4.7-in., 155-mm., 8-in. and 240-mm. shells. The machine consists of a carriage traveling on ways and carrying a four-jawed collet chuck. This is operated by means of an external nut which is turned by means of a detachable pin. The spindle is revolved by means of an air-operated motor while the carriage is fed forward by means of the handwheel. The speed of the motor increases as the shell is pushed into the dies and the entire operation is said to consume but about 35 seconds.

Knife-edge Squares

Taft-Peirce Manufacturing Co., Woonsocket, R. I.

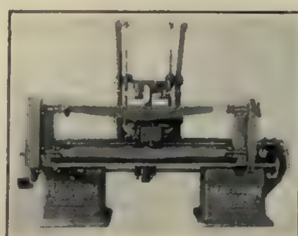
"American Machinist," June 6, 1918

These universal squares are made in two sizes, 2 x 2½ x ⅜ in. and 2½ x 3 x 7/16 in. They are hardened, ground and lapped to size. The knife edges are lapped square with the flat faces so that each tool has several squares that can be used. The surplus stock is removed from the center of the tool and insulating pieces are inserted which not only make a very substantial grip but decrease the weight of the tool.

Lathe, Airplane Strut No. 216

C. Mattison Machine Works, Beloit, Wis.

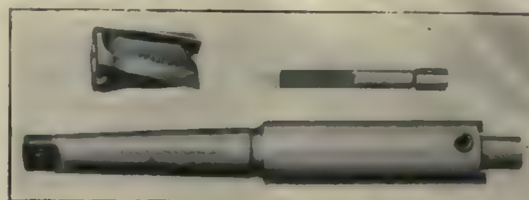
"American Machinist," June 6, 1918



This machine is especially for airplane strut work and is provided with a double end drive which is claimed to be advantageous for long work. A double-rocker type of carriage is used and feeds in both directions obviate any loss of time in shifting the carriage to the starting point. Three feeds are provided varying from 7½ to 30 in. per minute. Standard machine takes work up to 6 ft. long, but larger sizes can be furnished. Floor space, 4 x 11 ft., shipping weight, 4500 lb.

Counterboring and Spot-Facing Tools

Cleveland Milling Machine Co., Cleveland, Ohio



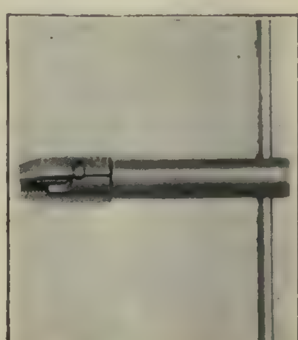
"American Machinist," June 6, 1918

The cutters are driven by two face keys. The pilots are made of high-carbon steel, heat treated and ground to fit the hole in the shank. The holder is made in eight different sizes and a number of cutters and pilots are made for each size. The complete set includes cutters from ¾ to 5 in. in diameter, while the pilot heads range from ½ to 1¼ in. in diameter. The holders are made with Morse taper shanks, which vary in size from No. 1 to No. 6.

Stud Driver

Giern & Anholtt, 33-43 St. Aubin Ave., Detroit, Mich.

"American Machinist," June 6, 1918

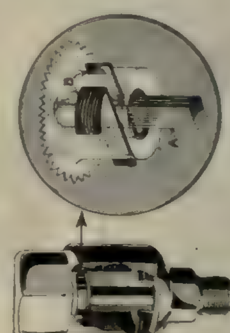


A hand-operated stud driver. The tool shown has been cut away in order that the construction may be seen. The stud is screwed into the outside, or tubular, portion which is held on the handle by means of an inclined slot working on a pin in the handle. Due to the action of screwing the stud into place the handle is advanced by means of this slot and pin and holds the stud firmly. On reversing the motion of the handle the pin moves in the slot and releases the pressure on the stud, thus allowing the driver to be unscrewed.

Grease Cup

Dawson Manufacturing Co., 4928 Broadway, Chicago, Ill.

"American Machinist," June 6, 1918

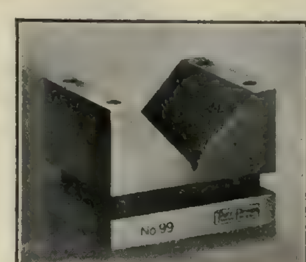


A feature of this grease cup is the device which prevents the cap from unscrewing, due to vibration. The lower, or stationary, part of the cup is provided with a square rod *A* fixed in place, and this projects up between two springs *B* which are secured in the cap. These two springs grip the flat sides of the rod, and while the top may be easily unscrewed the springs exert sufficient pressure to prevent its unscrewing accidently. Another feature of the device is that the square rod enters a round hole before the threads engage insuring the cap being lined up when being put in place and preventing the crossing of threads. The cup is made in six styles with inside diameters of from 13/16 to 1¼ in.

V-Blocks

Taft-Peirce Manufacturing Co., Woonsocket, R. I.

"American Machinist," June 6, 1918

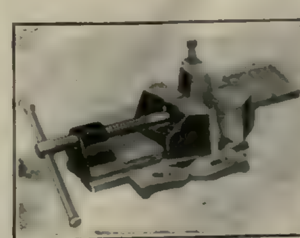


The illustration shows one of a set of V-blocks which are approximately 2⅞ in. high, 4 in. wide and 2⅞ in. long. The V is 2⅝ in. wide at the top and the clearance groove at the bottom ⅛ in. wide. These blocks are made in pairs only and are numbered. They are made of tool steel, hardened and ground all over. The top is left clear for work by providing wide grooves in sides and ends for clamping purposes.

Vise, Combination

Germanow-Simon Co., 58 Mill St., Rochester, N. Y.

"American Machinist," June 6, 1918



This device includes a vise, a V-block, an adjustable angle plate and a removable steel clamp for holding work in the Vs. The jaws extend 1½ in. beyond either side of the base. Made in two sizes with dimensions as follows: No. 1 Vise: Length of base, 12¾ in.; width of base 5 in.; extreme height, 5 in.; depth of jaws, 2½ in.; width of jaws, 8 in.; opening of jaws, 5 in.; capacity of clamp, 2 in.; weight, about 75 lb. No. 2 Vise: Length of base, 15¾ in.; width of base, 7 in.; extreme height, 6 in.; depth of jaws, 3 in.; width of jaws, 9 in.; opening of jaws, 7 in.; capacity of clamp, 3½ in.; weight, 105 lb.

Patent Applied For

Personals

M. O. Griffith is now general foreman of the Santa Fe Railroad shops at Clives, N. M., succeeding **J. A. Klasner.**

S. Heckathorne has been made master mechanic of the Anthony & Northern R. R., with office at Pratt, Kan., succeeding **S. C. Raff.**

Henry Reiff has been apointed machine-shop foreman of the Erie railroad shop, with office at Marion, Ohio, succeeding **J. Strawser.**

T. Stewart, formerly master mechanic of the Baltimore & Ohio R. R. at Connellsville, Penn., has been transferred as master mechanic to Cumberland, Penn.

T. Hambley has been appointed master mechanic of the Canadian Pacific R. R., with office at North Bay, succeeding **C. Gribben** transferred to St. John, N. B.

T. J. Bell is now superintendent foreman of the car department of the Erie R. R., with offices at Cleveland, Ohio, succeeding **M. Eagan,** who resigned recently.

G. H. Berry has been appointed assistant master mechanic of the South Louisville shops of the Louisville & Nashville R. R., succeeding **B. E. Dupont,** recently transferred.

T. V. Beardmore has been appointed locomotive foreman on the Canadian Pacific, with office at Schreiber in the Algoma district, succeeding **R. Gardner,** who has resigned.

John L. Smith, formerly master mechanic of the Pittsburgh, Shawmut & Northern R. R., with office at St. Mary's, Penn., has been made superintendent of motive power and equipment.

Arthur B. Babbitt, at present the head of the department of drawing and design at Wentworth Institute, Bost n, Mass., will become general manager of the Kent Machine Co., Kent, Ohio, on July 1.

W. Wright, formerly division master mechanic of the Canadian Pacific R. R., at Toronto, Ont., has been transferred as division master mechanic to Brownsville Junction, Me., to succeed **C. Powers,** who was transferred to Toronto.

G. F. Johnson, formerly general master mechanic of the Chicago, Burlington & Quincy R. R., with office at Lincoln, Neb., was recently appointed assistant superintendent of motive power at Lincoln, and his former position has been abolished.

J. A. Conley, formerly master mechanic of the Atchison, Topeka & Sante Fe R. R., at Raton, N. M., has been transferred to the Valley division with office at Fresno, N. M. He succeeds **John Pullar,** who has been transferred to San Bernardino, Calif.

D. P. Brown, formerly with the Bryant Chucking Grinder Co., Detroit, Mich., is now associated with the Hendy Machine Co., Torrington, Conn. Mr. Brown is in charge of the company's office in the Chamber of Commerce Building, Rochester, N. Y.

S. R. Hunter, formerly with the Fairbanks-Morse Manufacturing Co., Beloit, Wis., as superintendent of the gas-engine department, has resigned to accept the position of superintendent of production of the American Roller Mill Co., Middletown, Ohio.

H. S. Patterson was recently appointed manager of the railroad department of the Walworth Manufacturing Co., with headquarters in Boston, Mass. **H. T. Goodwin** has been made assistant manager of the railroad department with headquarters in New York.

A. B. Enbody, formerly assistant master mechanic of the Central Railroad of New Jersey, with offices at Mauch Chunk, Penn., has been appointed master mechanic of the Lehigh & Susquehanna division in charge of locomotive and car departments and assignment of power, with office at Ashley, and **C. W. Culver,** formerly foreman at Mauch Chunk, has been appointed assistant master mechanic of the Lehigh & Susquehanna division with office at Mauch Chunk.

Ross Anderson has been appointed manager of the accessory plant of the American Locomotive Co., Richmond, Va. Mr. Anderson was superintendent of the Pittsburgh plant during the past year, and was at one time manager of the Toole Engineering and Machine Co., Baltimore, Md.

J. A. McFarran has been appointed master mechanic of the M. and M. division and branches of the Louisville & Nashville R. R., with office at the Montgomery shops, the position of assistant-master mechanic at Montgomery having been abolished. **T. F. Ryan** was made assistant master mechanic of the Cincinnati terminals and Kentucky division with office at the Central Covington shop. **F. W. Oakley** has been appointed master mechanic of the Eastern Kentucky division, with office at Ravenna, Ky., shops, and **B. E. Dupont** has been appointed master mechanic at the Howell, Ind., shops, Henderson and St. Louis divisions and St. Louis terminals.

Business Items

The Seattle Engineering School, Inc., Seattle, Wash., will erect a three-story school building and garage 120 x 250 ft. on Queen Anne Ave. Sherwood D. Fore, Lyon Building, is the architect and William T. A. Faulkner is the president.

The Sheffield Machine Tool Co., Dayton, Ohio, has taken over the manufacture of the Deming indicator formerly made by Charles M. Deming, the patentee, of Hartford, Conn. Mr. Deming will go to Dayton about July 1 to install the business. The manufacture of this indicator in the Sheffield shop will be under the personal supervision of Mr. Deming. All future correspondence should be addressed to the Dayton office.

The Crawford Machine Tool Co., Inc., New York, has taken over the business assets of the Joseph Crawford, Jr., Co., of Erie, Penn. The new company will be conducted by the same interests and without any substantial change in policy and it will maintain offices at 21 Park Row, New York, and Erie, Penn. Joseph Crawford, Jr., of Erie, Penn., is president, and Alexander Chessin of New York is secretary and treasurer. The sales office will remain in New York, where all correspondence should be addressed.

The Westinghouse Electric and Manufacturing Co., Pittsburgh, Penn., has purchased the property, business, and good-will of the Krantz Manufacturing Co., Inc., Brooklyn, N. Y., manufacturer of safety and semi-safety electrical and other devices, such as auto-lock switches, distribution panels, switchboards, floor boxes, bushings, etc. The supply department of the Westinghouse Electric and Manufacturing Co. will act as exclusive sales agent for the products of the Krantz Manufacturing Co., whose business will be continued under its present name. H. G. Hoke, of the Westinghouse Electric and Manufacturing Co., will represent the supply department at the Krantz factory.

Koch & Sandidge is the name of a new firm with offices at 19 South Wells St., Chicago, for handling the sales-engineering work for the line of "Jiffy" cutting tools made by the Universal Tool and Appliance Co., Milwaukee, and similar products. Paul W. Koch, although a partner in this new business, will remain active as president and general manager of the Electrical Sales Engineers, Inc., at Chicago. John H. Sandidge, the other member of this partnership, has been connected with the Cooper-Hewitt Electric Co. for over six years, being sales manager in the Chicago district for five years and recently Wisconsin manager with offices in Milwaukee. Mr. Sandidge will also become associated with the Electrical Sales Engineers, Inc., in selling the products of the Condit Electrical Manufacturing Company.

Catalogs Wanted

Steam, Gas and Electrical Equipment— The Seattle Engineering School, Inc., Seattle, Wash., is desirous of securing catalogs of equipment of this type.

Trade Catalogs

Barometric Condensing Plants—Ingersoll-Rand Co., 11 Broadway, New York. Form 876; single-page leaflet, 8½ x 11 in., on Ingersoll-Rand barometric condensing plants.

The Jacklift Master Truck. Lewis-Shepard Co., 44-48 Binford St., Boston, Mass. Catalog. Pp. 32; 9 x 11¾ in. Illustrated and showing various uses of the Jacklift master truck in a number of different industries. It also gives a description, specification and price list.

Champion Lathes—The Champion Tool Works Co., Cincinnati, Ohio. Loose-leaf catalog. Pp. 18; 8¾ x 11¼ in. Illustrating, describing and giving specifications of the 12, 14, 16 and 18 in. Champion lathes. The Champion taper attachment is also described and illustrated.

New Publications

Elements of Machine Design—By Henry L. Nachman. Two hundred and forty-five 5¾ x 9-in. pages; numerous tables, formulas, diagrams and illustrations. Published by John Wiley & Sons, Inc., New York. Price $2.

This book is intended for classroom work in elementary machine design, and is the result of the author's 15 years' experience in practical work and teaching the subject. The prospective student using this book is expected to have had courses in machine drawing and elementary mechanics. Based on a brief outline of the strength of materials given in the first chapter the author attempts to develop the equations for the design of the more common machine elements. This has been done very concisely, and frequently only an outline of the deduction has been given. Empirical formulas and rule-of-thumb methods commonly used in elementary texts on this subject have been avoided as far as possible. There are numerous things which in practice affects the design of machine parts that cannot with profit be discussed in the classroom, such, for instance, as the cost of construction or the capacity of shop machinery. For this reason the teacher must be content if the student acquires power to analyze the forces and the resultant stresses in machine parts and to apply the proper equations for their design. The illustrations have been well chosen to show typical constructions rather than a great variety, which only tends to confuse the inexperienced student. The various chapters deal with the strength of materials, screw fastenings, riveted joints, keys and cotters, shrink and force fits, shafts and axles, couplings and clutches, journals and bearings, belts and pulleys, friction wheels, toothed gears, rope transmission, chain gearing, pipes and cylinders, valves, flywheels, crankshafts, crankpins and eccentrics, connecting-rods, piston rods, eccentric rods, pistons, crossheads and stuffing boxes, hoisting-machinery details, springs and materials of machinery. The book is well printed on an excellent grade of heavy paper and is bound in substantial brown cloth.

Forthcoming Meetings

American Society of Mechanical Engineers. Monthly meeting, second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

The American Society for Testing Materials will hold its twenty-first annual meeting at Atlantic City, N. J., June 25-28, with headquarters at the Hotel Traymore. The permanent headquarters of the secretary-treasurer are under the name of the society, Philadelphia, Penn.

Boston Branch National Metal Trades' Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meetings first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 35 Broadway, New York City.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham..	$33.00	$33.00	$40.00
No. 2X, New York	34.25	.....	47.00
No. 2 Northern Foundry, Chicago	33.00	37.00	50.00
*Bessemer, Pittsburgh	36.30	37.25	55.95
*Basic, Pittsburgh	33.10	33.95	50.00
No. 2X, Philadelphia	34.25	33.75	46.75
*No. 2, Valley	34.10	33.95	50.30
No. 2 Southern Cincinnati	35.90	35.90	42.90
Basic, Eastern Pennsylvania	32.75	33.75	42.50

*Delivered Pittsburgh; f.o.b. Valley, 95 cents less.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.195	$4.195	$5.00	$4.20	$5.00	$4.20	$5.00
Soft steel bars	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Soft steel bar shapes	4.095	4.095	4.75	4.20	4.50	4.10	4.50
Soft steel bands	4.945	.....	....	....	....	....	....
Plates, ¼ to 1 in. thick	4.445	4.445	8.00	4.20	7.00	4.45	8.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.25
Warehouse, New York	4.70	4.60
Warehouse, Cleveland	4.10	4.45
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
*No. 28 black	5.00	6.445	6.445	9.50	6.385	8.25	6.45	8.50
*No. 26 black	4.90	6.345	6.345	9.40	6.285	8.15	6.35	8.40
*Nos. 22 and 24 black	4.85	6.295	6.295	9.35	6.235	8.10	6.30	8.35
Nos. 18 and 20 black	4.80	6.245	6.245	9.30	6.185	8.05	6.25	8.30
No. 16 blue annealed	4.45	5.645	5.645	9.20	5.585	7.95	5.65	8.70
No. 14 blue annealed	4.35	5.545	5.545	9.10	5.485	7.85	5.55	8.60
No 10 blue annealed	4.25	5.445	5.445	9.00	5.385	7.75	5.45	8.50
*No. 28 galvanized	6.25	7.695	7.695	12.00	7.695	10.00	7.70	10.50
*No. 26 galvanized	5.95	7.395	7.395	11.70	7.335	9.75	7.40	10.20
No. 24 galvanized	5.80	7.245	7.245	11.55	7.185	9.55	7.40	10.05

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 10%	List plus 25%
Cleveland	List plus 10%	List plus 10%
Chicago	List plus 10%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	35%	40%
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots, is:

	Current	One Year Ago
New York	$15.50–19	$20.00
Cleveland	20.00	12.30
Chicago	17.00	12.00

In coils an advance of 50c. usually is charged.

Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*

⅜, 11/32, 5/16, ¼, 7/32, 3/16	22.10 to 33.00
No. 8, 5/32 and No. 10	
⅛	
No. 12	
3/32, No. 14 and 1/16	
No. 18	
No. 20	

Very scarce.

Cast-Iron Welding Rods

3/16 by 12 in. long	16.00
¼ by 19 in. long	14.00
⅜ by 19 in long	12.00
½ by 21 in. long	12.00

*Special Welding Wire

⅛	33.00
5/32	30.06
3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.10	4.04	4.00
Toe calk	5.70	4.35	4.25
Openhearth spring steel (heavy)	7.50	8.00	7.50
Spring steel (light)	11.00	11.25	11.00
Coppered bessemer rods	9.00	8.00	7.00
Hoop steel	4.94½	4.75	4.95
Cold-rolled strip steel	8.50	8.25	8.50
Floor plates	6.19½	6.00	7.00

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
BUTT WELD					
⅛, ¼ and ⅜..	44%	17%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜..	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2¼ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
¾ to 3 in. steel butt welded	38%	22%	43%	28%	41.9%	26.9%
3½ to 6 in. steel lap welded	18%	List	39%	25%	37.9%	23.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 15 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	23.50*	23.50	31.00
Tin, in 5-ton lots	90.00	85.00	61.00
Lead	7.82½	7.25	12.00
Spelter	8.00	7.50	9.25

*Government price.

ST. LOUIS

Lead	7.75	7.25	9.25
Spelter	7.75	7.10	12.00

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper sheets, base	32.50-33.00	32.50	39.50	34.00	39.00	32.00	40.00
Copper wire (carload lots)	31.00	31.00	45.00	30.00	41.00	30.00	43.50
Brass sheets	31.75	31.75	45.00	30.00	41.00	30.00	43.50
Brass pipe base	36.50	36.50	47.50	41.00	48.00	40.00	47.50
Solder ½ and ½ (case lots)	62.00	70.00	39.75	62.00	39.50	70.00	39.50

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse; 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$25.25	$42.00
New York	26.25	45.50
Cleveland	30.00	38.00
Chicago	28.00	42.50

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 15.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	18.75	21.00	18.40	21.50
New York	16.50	23.00	17.00	23.25
Chicago	21.00	22.50	21.50	23.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	13.25	20.00
Chicago	13.50	28.00
Cleveland	16.00	27.50